CURRICULUM FOR

DIPLOMA IN

MECHANICAL ENGINEERING

SEMESTER I, II, III, IV, V & VI

PROGRAMME STRUCTURE

SET I

Semester - I

Course code	Name of Course	TEACHING SCHEME				EXAMINATION SCHEME				Total marks
		L	T	P	C	Theory Marks		Practical Marks		
						TH	TM	PR/OR	TW	
GN102	Engg. Maths - I	4	2	-	6	75	25			100
GN103	Applied Physics-I	4		2	6	75	25	-	50	150
GN106	Basic Engg.Skills	-	-	6	6	-	-	50	100	150
GN105	Comp. Fund & App.	-	-	4	4	-	-	50	50	100
GN203	Environmental Studies	3			3	75	25	-	-	100
Total		11	2	12	**25**	**225**	**75**	**100**	**200**	**600**

Semester - II

Course code	Name of Course	TEACHING SCHEME				EXAMINATION SCHEME				Total marks
		L	T	P	C	Theory Marks		Practical Marks		
						TH	TM	PR/OR	TW	
GN202	Applied Physics-II	4	-	2	6	75	25	-	50	150
GN201	Engg. Maths II	4	2	-	6	75	25	-	-	100
GN104	Applied Chemistry	3		2	5	75	25	-	50	150
GN101	Communication skills	-	-	2	2	-	-	50	50	100
GN205	Engg. Materials	4	-		4	75	25	-	-	100
GN204	Engg. Drawing	2	-	4	6	-		50	50	100
Total		**17**	**2**	**10**	**29**	**300**	**100**	**100**	**200**	**700**

SEMESTER I

GN 102 ENGINEERING MATHEMATICS- I

1. RATIONALE

There are variable and constant concepts in the engineering phenomena and problems, which need to be understood, analyze and predict their behaviour. For instance, motion and acceleration of an object under applied known force, effect of temperature and pressure under constant volume, etc. All these situations require modeling of constants and variables into a relationship known as formula (formulating) and solving problems of engineering by substituting the values of constants and variables. Thus mathematics is used to understand, analyse and find solutions. There are some standard principles and formulae, which should be understood by students and apply as per needs of situations in real life.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-102	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Engineering Mathematics	4	2	-	6	75	25	-	-	**100**

Minimum passing % : Theory 40%

Legends:

***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*

***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

Unit 0 Fundamentals of algebraic mathematical operations

- Use of scientific calculator
- Recall of algebraic operations & formulae
- Solving of simultaneous equations with two variables

Unit 1 Co-ordinate Geometry/ Analytic Geometry;

Purposes/Applications of Co-ordinate Geometry. Coordinate systems. *Straight Line*- Distance between two points. Internal & external division of a line. Area of triangle. Slope of line. Angle between two lines. Various forms of equation of line-parallel to axis, point-slope form, slope intercept form, two point form, intercepts form & normal form. General equation of line. Distance of a point from a line. - Equations of circle, Equations of tangent & normal to circle.

Unit 2 Trigonometry

Purposes/Applications of Trigonometry. Radian. Radian & degree. Area of sector & length of an arc. Trigonometric ratios of any angle & Trigonometric identities. Trigonometric ratio of allied angles, compound angles, & Multiple angles(only 2A). Sum & product formulae. Sine, Cosine rules. Solution of triangles

Unit 3 Limits & Functions

Functions- constants, variables. Kinds of functions (question not to be asked). Concepts of limits- algebraic, trigonometric, logarithmic & exponential functions (No question on method of substitution and Inverse Trigonometric function)

Unit 4 Differential Calculus

Purposes/Applications of Differential Calculus. Definition of Derivative. Derivatives of standard functions-applications. Derivative of sum, difference, product & quotient of a function. Derivative of composite, implicit & parametric functions with reference to - algebraic, logarithmic, trigonometric, inverse circular functions, exponential functions & logarithmic differentiations. Introduction to Second order derivatives.

Unit 5 Application of derivatives

Geometrical meaning of derivatives. Equation of tangent & normal to curves. Derivatives as rate, motion, related rates. Maxima & minima.

4. SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Marks
1	Co-ordinate Geometry	**14**	**20**
2	Trigonometry	**17**	**16**
3	Limits & Functions	**8**	**12**
4	Differential Calculus	**15**	**20**
5	Application of derivatives	**10**	**07**
		64	**75**

5. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1.	Deshpande S.P.,	Mathematics for Polytechnics	Griha Prakashan, Pune, 1996 or latest
2.	Grewal B.S;	Engineering Mathematics	Khanna Pub., New Delhi1995 or latest
3.	Prasad, I.B.;	Engineering Mathematics	Khanna Pub., New Delhi1997 or latest
4.	TTTI, Bhopal	Mathematics for Polytechnics Vol. – I & Vol. – II	TTTI, Bhopal Latest
5.	Wartiker P.N.,	Applied Mathematics	Griha Prakashan Pune, 1996 or latest

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GN 103 APPLIED PHYSICS-I

1. RATIONALE:

Being the basis of all engineering branches, the students must acquire knowledge of basic principles; laws and facts of Physics This knowledge will improve their ability to apply it in solving engineering problems and overall growth of their disciplines.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credit	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-103 Applied Physics I	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	**150**
	4	-	2	6	75	25	50	-	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:
***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*
***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

Unit 1 UNITS & DIMENSIONS

Fundamental and Derived Physical Quantities and their SI units. Dimensions and Dimensional formula, Principle of Homogeneity, use of Dimensional Analysis for checking the correctness of an equation. Definition of least count of Vernier Caliper, Micrometer Screw Gauge.

Unit 2 KINEMATICS

Vectors and Scalars-Definition, Difference between vectors and scalars, types of vectors with example.
Definition - Displacements and distance, Velocity and speed, uniform and average velocity, Uniform acceleration and retardation, problems based on kinematic equations for uniform acceleration. $V=u+at$, $S=ut + \frac{1}{2} at^2$, $v^2 = u^2 + 2as$. Velocity- time diagram, Motion under gravity.

Unit 3 PROPERTIES OF MATTER

Definition of Elasticity, Stress, Strain and Elastic limit. Hooke's Law. Definition of Young's modulus, Bulk modulus, Rigidity modulus. Determination of Young's modulus by Searle's method. Behaviour of wire under continuously increasing stress. Definition of Yield Point, Breaking Stress, and Factor Of Safety. Adhesive and Cohesive forces. Angle of contact. Concept and definition of Surface Tension, Surface Tension by Capillary rise method. Application of Surface Tension. Definition and explanation of Viscosity. Statement of Newton's law of viscosity, Terminal Velocity (no derivation) Stokes Law. Determination of Viscosity by Stokes method. Streamlined and Turbulent flow. Definition of Critical Velocity, Reynolds Number.

Unit 4 HEAT

Definition of specific heat and units of specific heat. Modes of transfer of heat transfer, Conduction, Convection and Radiation. Law of thermal conductivity. Definition of co-efficient of thermal conductivity. Determination of coefficient of thermal conductivity of a good conductor

Statement of Charles's law, Boyle's law and Gay Lussac's law. Derivation of general gas equation.

Unit 5 ELECTROSTATICS

Coulomb's Law of Electrostatics, Electric Field, Intensity of Electric Field, Electric Potential and its unit, Potential difference between two points (no derivation), Potential of a sphere, Potential of Earth, Definition and units of Capacitance, Principle of Capacitor, Capacitors in series, Capacitors in Parallel.

Unit 6 MAGNETISM

Magnetic Effect of Electric current (Oersted's Experiment) Magnetic Field, Intensity of Magnetic Field. Coulomb's Law of Magnetism, Magnetic lines of Force, Magnetic Induction, Expression for Magnetic Induction at the centre of a Circular coil carrying current (no derivation), Force acting on straight conductor placed in Magnetic Field (no derivation).

Unit 7 (A) LAWS OF FORCES & FRICTION (MECHANICAL AND ALLIED GROUPS)

Triangle law of forces, parallelogram law of forces (expression only), graphical & analytical representation of force, resolution of forces, resolving force into rectangular components.

Definition & concept of friction, types of friction, Force of friction, Laws of static friction, Coefficient of friction, angle of friction (expression only), angle of repose(only qualitative aspects)

OR

UNIT 7(B) : SEMICONDUCTORS (ELECTRONICS AND ALLIED GROUPS)

Energy Band structure of electronic material(conductor , semiconductor and insulator)

Definition of semiconductors, types of impurities added to the semiconductors, intrinsic and extrinsic semiconductors.

Types of semiconductors P- type and N- type, Structure of P- type and N- type,

Extrinsic semiconductor using pure Si and Ge semiconductors.

Types of carriers; N- type and P- type

Process of recombination of carriers.

Formation of P-N junction and depletion region.

4.SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS (THEORY)

Unit No.	Unit	Teaching Hours / Semester	Marks
1	Units and Dimensions	5	5
2	Kinematics	9	12
3	Properties of Matter	13	14
4	Heat & Gas Laws	9	10
5	Electrostatics	12	12
6	Magnetism	8	10
7A	Laws of Forces & Friction	8	12
	OR		
7B	Semiconductors	8	12
	Total	**64**	**75**

7A-Mechanical and allied branches **7BFor Electronics and allied branches**

5. SUGGESTED LIST OF EXPERIMENTS

Sr. No.	LIST OF EXPERIMENTS
1	Use of Vernier Caliper
2	Use of Micrometer Screw gauge
3	Determination of Surface tension by capillary rise method using Travelling Microscope.
4	Determination of coefficient of viscosity by stroke's method.
5	Determination of acceleration due to gravity ('g') by simple pendulum.
6	Determination of Young's modulus by Searle's method.
7	Determination of Coefficient of thermal conductivity by Searle's method.
8A	Find resultant force using parallelogram of forces
8B	Draw and interpret band structure of Insulator, Semiconductor and conductor, Band structure of P-type & N-type extrinsic semiconductor, Drawing PN junction.

6. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title	Publication and Year
1.	Halliday D and Resnickr	Physics Part-I & II	Latest
2.	Das S.K., Sisodiya M.L., Neher P.K., Kachhawa C.M.,	Physics Part-I & II for 10+2 Students	Latest
3.	B.G. Dhande	Applied physics for polytechnics	Latest
4.	Bhandarkar	Applied Physics for polytechnics	Latest
5.	Saxena HC & Singh Prabhakaer	Applied Physics Vol. I & II	Latest
6.	Rao, B.V.N.	Modern Physics	Latest
7.	R.K.Guar and S.L. Gupta.	Engineering Physics	Latest
8.	B.L. Thereja.	Engineering Technology	Latest
9.	Modern Publishers.	ABC of Physics	Latest
10.	V.K Mehta	Elements of electronic engineering	Latest
11	R S Khurmi	Applied Mechanics	Latest

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GN-105 - COMPUTER FUNDAMENTALS & APPLICATIONS

1. RATIONALE

The course on Computer Fundamentals & Applications will enable the students to understand the basic concepts related to computer fundamentals, Data Representation & Number Systems, Computer Languages, operating system, Computer Software and Internet Technology and will be able to apply the same in different areas of electronics engineering. Laboratory practice will help in developing the requisite skills.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-105	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	**100**
Computer Fundamentals & Applications	-	-	4	4	-	-	50	50	

Minimum passing % : Theory 40%

Legends:
***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*
***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

UNIT 1 Computer Fundamentals

1.Introduction to Computer

2. History, Evaluation, Classification and Generations of computers

3.Organisation of the Computer System

4. Hardware

Input device, Memory or Storage Devices, Processing Unit, Output device, Scanner

Printers.

4. Communication technology and evolution of communication mediums

6. Software

System software

Application Software

Shareware

Freeware

Open Source

7. Concept of Computer Viruses

Definition

Types

Preventive Measures

UNIT 2 Operating System

1. Introduction to operating system

Definition Functions , Types, Examples, Comparisons of Various Operating Systems

2. Windows Operating System-

GUI(Graphical user Interface), desktop, Start Menu, Task Bar, Status Bar, Scroll Bar, Title Bar, Toolbar, Menu Bar. File Organization: Creating, Saving, Deleting, Renaming, Cutting, Pasting, copying, moving, Searching Files and Folders. Applications: My Computer, Recycle Bin, Windows Explorer, Control Panel.

UNIT 3 Application Software

1. MS Word

- Introduction
  - Starting MS Word
  - Creating, saving and opening a document
  - Editing commands-Cut, Copy, Paste, Paste Special
  - Text Formatting, Bullets and Numbering, Borders and shading etc.
  - Tabs, Style, Views
  - Insert Table, Picture, OLE Objects, etc.
  - Checking Spelling and Grammar, Thesaurus
  - Page Layout & Printing
  - Mail Merge**.**

2. MS Excel

- Create, Save and open a worksheet
- Entering data – text, numbers and formulae in a worksheet, Hyperlink
- Navigating within a Worksheet and also between different Worksheets of a Workbook
- Inserting and deleting cells, rows and columns in a worksheet
- Select, copy, paste and delete cell data within the worksheet
- Using various formulae and inbuilt functions like Trigonometric, Statistical, Logical, Data Sorting
- Update worksheets using special tools like spell check and auto correct.
- Setup the page and margins of worksheets for printing

- Enhance worksheets using charts & graphs

3. MS Power Point

- Introduction and starting the program
- Starting a presentation
- Adding new slide
- Saving and Opening presentation
- Text formatting options
- Copy, Move and delete slides and text
- Applying designs
- Using Animations
- Slide Transitions, Hyperlink
- Insert clip art
- Viewing the presentation

UNIT 4 The Internet

Networks, Advantages of networking, Types of networks.

- History and Functions of the Internet
- Working with Internet
- Web Browsers, World Wide Web, Uniform Resources Locator and Domain, Names, Issues related to web security.
- Uses of Internet
- Search for information, Email, Chatting, Instant messenger services, News Group, Teleconferencing, Video-Conferencing, E-Commerce and M-Commerce.

Email

- Manage an E-mail Account
  E-mail Address, Configure E-mail Account, log to an E-mail, Receive E-mail, Sending mails, sending files an attachments and Address Book

- Downloading Files

5. SUGGESTED LIST OF EXPERIMENTS

S. No.	Unit No.	List of Experiments
1	**1**	Identify Input and output devices
2	**1**	Calculate capacity of different storage device
3	**2**	Identify OS and different application software s loaded on that OS
4	**3**	Load Windows operating system. Configure and load relevant device drivers

5	**4**	Practice on Windows 95/98/2000 ; o Starting Windows, Exploring the desktop, Arranging windows, My Computer, The start button, Creating Shortcuts, Practice on moving and sizing of windows o Study of file organization: creating, copying, moving, renaming and deleting o Practice on Windows Accessories- Notepad, Word Pad and Paint o Editing document & formatting text, Previewing and printing document/Image file o Practice on Windows Explorer **o** Recycle bin **o** Shutting down windows
6	**4**	Practice on MS-Word ; o Create and format document o Edit and Modify text- changing font size type and style o AutoText, AutoComplete, AutoCorrect, grammar and spellchecker, Find and replace of text o Open save and print a document o Insert, modify table o Insert graphics o Mail merge
7	**5**	Practice on Microsoft Excel o Create, save & format worksheet o Open and save worksheet file o Edit & modify data o Use formula and functions o Split windows and freeze pans o Data sort and security features o Create, edit, modify and print worksheet. o Create and edit charts
8	**5**	Practice on PowerPoint o Create, edit, insert, move, slides o Open and save presentation o Insert picture, audio slide layout, action button o Apply custom animation o Present slide show
9	**6**	Practice on: o Identification of type of Account. o Connecting to internet o Dial up access o Web browsing o Searching websites o Information searching o Email services **o** Creating email accounts & Receiving and sending mails

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	Norton Peter	Introduction to Computers (special Indian edition)	Tata McGraw Hills New Delhi, 6th Edition, 2005 ISBN: 0070593744
2	Kahate Atul	Information Technology	Tata McGraw Hills New Delhi, ISBN-13:9780070593718
3	Williams Stalling	Using Information technology: A Practical Introduction to Computers and Communication	Tata McGraw Hills New Delhi,
4	Curtin	Information Technology: The Breaking Wave (book only)	Tata McGraw Hills New Delhi, ISBN:0074635581
5	Ravichandran, D	Introduction to Computers and Communication	Tata McGraw Hills New Delhi, ISBN: 0070435650
7	Douglas E.	The Internet Book	Prentice Hall of India, New Delhi, 3rd Edition, ISBN: 812032286X
8	Basanbhara S.K.	Computer Today	Nita Mehta Publications, 2003 ISBN: 8186340742

GN 106 BASIC ENGINEERING SKILLS

1. **Rationale**:

A technician is expected to work on the shop floor. It therefore becomes essential for him to have a through exposure to safety aspects, fire fighting, first aid as he is the guide for the skilled and unskilled personnel working under him. From technical knowledge and skills point of view he is also expected to have knowledge on proper ways of using various hand tools, measuring devices etc. in addition to other engineering skills.

The course on Basic Engineering skills is aimed at providing him the knowledge and skills in all those areas through shop instructions, demonstrations and skill development exercises. This course is also aimed at providing the student the exposure to engineering equipment which will help him to assimilate the teaching which takes place at higher semesters.

2. **Teaching And Examination Scheme**

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
(GN106) Basic Engineering Skills	L	T	P	C	TH	TM	PR/OR	TW	150
	0	0	6	6	-	-	50	100	

Legends: L-Lectures; P-Practical; C-Credits; TH-End Semester Theory; TM-Test Marks;

PR/OR-End Semester Practica/Oral Examinations TW- Term Work

3. **Detailed Course Contents**

Unit 1: General Safety, Housekeeping, Fire Fighting & First Aid Introduction to General Safety aspects of engineering workshop, meaning and importance of housekeeping, possible fire hazards, fire triangle, types of fire extinguishers – selection and use, basic knowledge of first aid with specific inputs on cuts, burns, electric shocks, artificial respiration, handling emergencies.
Unit 2: Fitting Workshop Practice Introduction to the trade, Introduction to various hand Tools, Measuring and Marking Tools, cutting tools, Holding tools, Striking tools, Types of files and filing methods. Drill bits and drilling Processes, using portable and pillar drilling machine. Operations performed in fitting shop such as measuring, marking, chipping, filing, grinding, sawing, drilling tapping and deing. Use of spirit level and plumb bob.
Unit 3: Carpentry Workshop Practice Introduction to the trade, types of wood and its characteristics, forms of wood, defects in timber and its identification, wood working hand tools, wood working processes. Different

types of joints and their usage. Introduction to wood working machines- lathe , circular saw, band saw, wood planner, universal wood working machine.
Unit 4: Electrical Workshop Practice Brief introduction to power distribution, different hand tools used in electrical trade, different measuring instruments. Making of cable joints. Measurement of current, voltage, frequency and Power Consumption. Connecting and starting of Induction Motor. Changing of Direction of rotation of induction motor. Introduction to commonly used electrical Fittings (Domestic & Industrial). Reading of simple electrical drawings.
Unit 5: Basic Electronics Workshop Practice Introduction to basic electronic components, Introduction to use of Multimeter in measuring voltage, current, resistance, capacitance. Checking of connectivity. Introduction to soldering process. Soldering Irons- Types and wattage. Reading of basic electronic circuits.

Note: during first 20 minutes of the practical session, Instructor shall provide theoretical knowledge as prescribed in the curriculum. (Shop Talk)

Unit No.	Topic	Hours/ Semester
1.	General Safety, Housekeeping, Fire Fighting & First Aid	06
2.	Fitting Workshop Practice	36
3.	Carpentry Workshop Practice	18
4.	Electrical Workshop Practice	18
5.	Basic Electronics Workshop Practice	18
	Total	**96**

GN203 ENVIRONMENTAL STUDIES

1. RATIONALE

Due to various developmental activities carried out by man, our environment is continuously being abused and getting degraded. The air we breathe, water we drink, food we eat, land we live on, all are getting spoiled day by day. The purity of our environment is of prime importance for survival of human race on the earth. Man should not go for developmental activities at the cost of environment. This subject has been introduced in the Diploma Programme to bring about awareness towards the environmental purity amongst the students.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN203 Environmental Studies	L	T	P	C	TH	TM	TW	PR/OR	100
	3	-	-	3	75	25	-	-	

Minimum passing %: Theory 40% ***Duration of Theory Paper: 3 Hrs.***

3. DETAILED COURSE CONTENT

Unit 1 Multidisciplinary Nature Of Environmental Studies.

Definition, scope and importance. Need for public awareness.

Unit 2 Natural Resources

Renewable and nonrenewable resources. Natural resources and associated problems.

- Forest resources: Use and overexploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources: Use and over-utilization of surface and ground water, floods, droughts, conflicts over water, dams- benefits and problems.
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Case studies.
- Food resources: World food problems, changes caused by agriculture and

overgrazing, effects of modern agriculture, fertilizer & pesticide problems, water logging, salinity, case studies.

- Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
- Land resources: Land as a source, land degradation, man induced land slides, soil erosion and desertification.

Role of an individual in conservation natural resources. Equitable use of resources for sustainable life styles.

Unit 3 Ecosystems.

Concept of an ecosystem. Structure and function of an ecosystem. Producers, Consumers and Decomposers. Energy flow in the ecosystem. Ecological succession. Food chains. Food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems: (a) Forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) Aquatic ecosystems (Ponds, streams, lakes, rivers, oceans, and estuaries).

Unit 4. Biodiversity And Its Conservation.

Introduction – Definition: genetic, species and ecosystem diversity.

Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels. India as a mega-diversity nation. Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wild life, man-wild life conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Unit 5. Environmental Pollution.

Definition. Causes, effects and control measures of: Air pollution, water pollution, soil pollution, marine pollution, noise pollution, Thermal pollution, Nuclear hazards. Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of individual in prevention of pollution. Pollution case studies. Disaster management: flood, earthquakes, cyclone and landslides.

Unit 6. Social Issues And The Environment.

From unsustainable to sustainable development. Urban problems related to energy. Water conservation rainwater harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns; case studies. Environmental ethics: Issues and possible solutions. Climatic change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; case studies. Wasteland reclamation. Consumerism and waste products. Environmental protection act. Air (Prevention and control of pollution) Act. Water (Prevention and control of pollution) Act. Wildlife protection Act. Forest conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

Unit 7. Human Population And The Environment. Population growth, variation amongst nations. Population explosion – Family welfare programme. Environment and human health. Human rights. Value education. HIV / AIDS. Women and child welfare. Role of Information technology in environment and human health. Case studies.
Unit 8. Field Work. Visit local area to document environment assets – river / forest / grassland / hill / mountain. Visit to a local polluted site – urban / rural / industrial / agricultural. Study of common plants, insects, birds. Study of simple ecosystems – ponds, river, hill slopes, etc. (field work equal to 6 lecture hours).

4. SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours	Marks
1)	Multidisciplinary Nature Of Environmental Studies.	01	03
2)	Natural Resources.	10	12
3)	Ecosystems.	06	08
4)	Biodiversity And Its Conservation.	06	09
5)	Environmental Pollution.	08	12
6)	Social Issues And The Environment.	07	12
7)	Human Population And The Environment.	04	09
8)	Field Work.	06	10
		48	75

5. MANDATORY ACTIVITIES

In addition to the class room instruction, visits should be arranged in any 2 of the following areas:

1. Visit to NIO or Science Centre.
2. Visit to Selaulim/ Anjunem Dam.
3. Visit to study ecosystem (Pond, Stream, River, and Forest).
4. Visit to show Hill cuttings, mining areas.
5. Visit to show Rain water harvesting project / Vermicomposting plant / Watershed management project. (Krishi Vigyan Kendra – Old Goa)
6. Visit to water treatment/ waste water treatment plant.

6. SUGGESTED VIDEOS

In addition to the class room instruction, video films on environment may be shown.

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication
1	Erach Bharucha	Textbook of Environmental Studies for Undergraduate courses	University Press
2	P. Meenakshi	Elements of Environmental Science and Engineering	Prentice Hall of India (PHI)
3	S. Deswal & A. Deswal	A Basic Course in Environmental Studies.	Dhanpat Rai & Co.
4	Pandya and Camy	Environmental Engineering	Tata McGraw Hill
5	Asthana D.K. and Asthana Meera	Environmental Problems and Solutions.	S. Chand & Co
6	Centre for Environmental education	Video Film	Thaltej Tekra, Ahme
7	Dr. S.K. Dhameja	Environmental Studies	

SEMESTER II

GN 101 COMMUNICATION SKILLS

1. RATIONALE

This course deals with Student's proficiency in English by developing their skills in reading, writing and speaking. They will be able to appreciate the usage of grammar. Acquiring proficiency in English is absolutely essential for effective communication while serving on the job. It also deals with applications of the concepts and principles learnt. Using visuals in written communication and body language in oral communication highly enhances the effectiveness of the communication process. These and some other important aspects are discussed in this course. The practice-feedback-practice cycle is of utmost important for developing the communication competencies/skills.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-101	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Communication Skills		-	2	2	-	-	50	50	**100**

Minimum passing % : Practical 40%

Legends:

***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*

***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

Unit 1 - Fundamental of Communication skills

Definition, components (message, sender, receiver, transmission medium and protocol), types(verbal & no-verbal, technological & non-technological, etc), importance of communication skills, effective communication skills (phatic stage, personal stage and intimate stage), barriers in effective communications(verbal, non-verbal), barriers while speaking, other barriers (individual's viewpoints, emotional block, etc.) methods of and hint to increase communication skills, body language.

Unit 2 – Presentation Skills

Methods and styles of presentations (seminars, speeches, etc), the plan, objectives, audience, structure (sequential, hierarchical, question oriented pyramid, meaty sandwich), tips for good beginning and end, aids to presentation (visual, verbal), delivery style (eyes, voice, expression, appearances, stance, etc), techniques for a good speech (repeat, draw (signs, pictures), jokes, etc).

Unit 3 - Technical Reports, Letter Writing, CVs

Functions of Reports (information, initiate action, recommend new procedures, recording, coordinating project), techniques (basic format, steps, appendices), types of reports (emphasis on progress reports, industrial visit reports, inspection reports, accident reports, survey report, report on seminars, workshop, technical gathering, etc).

Types of letters, format function, qualities of a good letter, examples of job applications, leave applications, complaints, purchase orders, enquiries replies etc.

Brief mention of importance of etiquette in email communication, importance of careful proofing the documents sent.

Curriculum Vitae – definition, sample, tips for a good CV, covering letter

Unit 4 - Soft Skills

Importance of values, attitude and etiquettes in communication, ethics and manners, courtesy, honesty and reliability; personal integrity, flexibility – adaptability, team skills – cooperation; ability to follow regulations; willingness to be accountable; Ability to relate to co workers in a close environment, non verbal communication, leadership skills – self directed, ability to direct and guide others, self-supervising; ability to relate to co workers in a close environment; positive attitude; positive work ethic, written communication Skills- basic spelling and grammar; reading and comprehension, personal hygiene and energy, interpersonal skills – communication skills with public, fellow employees, supervisors, and customers, motivation – willingness to learn; caring about seeing the company succeed; understanding what the world is all about; commitment to continues training and learning; critical thinking skills, grooming – good personal appearance.

Unit 5 - Language Workshop

The Reading, Listening, Writing, Speaking Skills will be tested

1. **Reading Skills:**

   Articles from the newspapers, magazines, journals etc. will be given to the students to read aloud thus checking their pronunciation, clarity and their style of reading.

2. **Listening Skills:**

   Passages, Topics, Stories, Speeches of eminent people will be read or played. The students have to listen and their listening skills will be tested.

3. **Writing Skills:**

   a) Students to write on any given topic

   b) Students to compose their own stories

   c) Students will be given a particulars situation i.e. accident, college gathering etc.

and asked to write a report

4. Speaking Skills:

a) Students to speak on any given topic

b) Narrate a story written by them.

Group discussions in the classroom. This could include debates, discussion on current issues, role-playing.

4. List of Experiments :

- Oral presentation about technical products for five minutes.
- Seminar Presentation/Report writing and presentation on identified topics from science and technical subjects for short duration.
- Group discussion on science and technical topics.
- Organise mock interviews.
- Organise debates.
- Extempore speech for three minutes on a topic.
- Observe a process and reproduce orally in own words for three to five minutes.
- Arrange video recording of presentations for self-feedback.

5. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Year of Publication
1	Wren and Martin	Practical English Grammar	1992
2	John Sinclair (ed.),	Collins Cobuild English Grammar	William Collins & Sons Cp., London 1990
3	Krishna & Mohan,	Effective English Communication	Tata McGraw Hill, New Delhi 2000
4	Randolf, Quirk & Sidney Greenbaum	University Grammar of English	1993
5	Tiwari, N.P. et al ,	Communication Skills for Technical Students – Book	Somaiya Publications, 1995
6	Tiwari, N.P. et al,	A Communicative Grammar of English	Somaiya Publications, 1989

GN 104 APPLIED CHEMISTRY

1. RATIONALE

Applied Chemistry is multi-disciplinary science having wide applications in all the branches of engineering and technology. In simple terms, it is the science of chemical phenomena in various engineering situations. An understanding of the basic concepts of applied chemistry is essential not only for all chemists but also for engineers. Therefore it forms an indispensable base for them. The emphasis is given more on applications of principles of chemistry to engineering situations rather than fundamental principles only. It also develops in the students the habit of scientific enquiry, ability to investigate the cause and effect relationship, ability to interpret and analyze the results under given conditions.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-104 Applied Chemistry	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	**150**
	3	-	2	5	75	25	50	-	

Minimum passing % : Theory 40%

Legends:
***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*
***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

Unit 1 Atomic Structure and Chemical Bonding

Fundamental particles and their characteristics, Energy levels - definition, designation of energy levels, Bohr- Bury's laws for distribution of electrons in shells (1^{st} three laws only), concept and shape of orbitals (s and p only), Quantum numbers-designation, definition, values, Aufbau and Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, orbital electronic configuration of elements with atomic number 1 to 20, Lewis and Langmuir concept of stable configuration. Concept of electrovalent, covalent and co-ordinate bond, Formation, properties and examples of electrovalent compounds (NaCl, MgO, $CaCl_2$) covalent compounds (Cl_2, 0_2, N_2, $C0_2$)and coordinate compounds (0_3, $S0_2$).

Unit 2 Electrochemistry

Arrhenius theory of electrolytic dissociation., Degree of Ionisation- definition, factors affecting degree of ionisation , Nature of solute and solvent, concentration of solution, and temperature, Strong and weak electrolytes - definition and examples, Concept of the terms involved in electrolysis –conductor, insulator, electrolyte, non-electrolyte, electrolysis, electrodes, electrolytic cell, cathode, anode and current density, electrochemical series- concept and significance. Mechanism of electrolysis, Ionisation, primary reactions at the cathode, activity series of cations, primary reactions at the anode, activity series of anions, electrolysis of i. Fused NaCl using carbon electrodes, ii. aqueous NaCl using platinum electrodes iii. aqueous $CuS0_4$ using platinum electrodes iv. aqueous $CuS0_4$, using copper electrodes);

UNIT 3 Water and its treatment

Hard and soft water, types of hardness and its causes, disadvantages of hardness of water (i) for industrial use - dyeing, textile, sugar, paper, bakeries, (ii) in boilers for steam generation with special reference to sludge and scale formation (no chemical equations), zeolite and ion exchange process for water softening, desalination by electro dialysis and reverse osmosis, concept of pH

Unit 4 Corrosion and Its Control

Definition, Atmospheric corrosion (direct chemical corrosion) - definition, Oxidation corrosion, the nature of the oxide film, stable, unstable and volatile, mechanism of oxidation corrosion, corrosion due to other gases. Immersed corrosion (electrochemical corrosion) - definition, factors necessary for electrochemical corrosion , Galvanic cell corrosion, concentration cell corrosion- metal ion concentration and differential aeration. Mechanism of electrochemical corrosion- Hydrogen evolution mechanism, Oxygen absorption mechanism, Protection of metals from corrosion; galvanising, tinning, metal spraying , proper designing , using pure metals, using metal alloys, Cathodic protection- sacrificial anode and impressed current .Modifying the environment- De-aeration, De-activation, De-Humidification and alkaline neutralization.

Unit 5 Lubricants

Definition, functions of Lubricants, Types of Lubrication, Fluid Film, Boundary, Extreme Pressure, Classification of Lubricant - solid, semi- solid, liquid synthetic oils. Characteristics of Lubricants, Definition and Its significance -Viscosity. Viscosity Index, Flash and Fire Point, Oiliness, Pour Point, Volatility, Acidity, Emulsification and Saponification Value. Selection of Lubricants for Delicate Instruments, High Pressure and Low Speed Machines, Extreme Pressure and Low Speed Machines, Mechanisms of Lubrications.

4. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS (Theory)

Unit No.	Name of the unit	Hours	Marks
1	Atomic Structure and Chemical bonding	10	15
2	Electrochemistry	08	13
3	Water and its treatment	09	15
4	Corrosion and its control	16	25
5	Lubricants	05	07
	Total	**48**	75

5. SUGGESTED LIST OF EXPERIMENTS

Sr. No.	Unit No.	List of Experiments
1.		Double titration of acid and base using phenolphthalein
2.		Double titration of acid and base using methyl orange
3.		Redox titration of potassium permaganate, ferrous sulphate and oxalic acid.
4.		Determination of degree of hardness of water by EDTA method
5.		Determination chloride content of water by Mohr's method
6.		Determination of total alkalinity of water sample
7.		Titration of strong acid and strong base using pH meter
8.		Determination of conductivity of water
9.		Titration of strong acid and strong base using conductometer
10.		Corrosion susceptibility of aluminium to acid or base.

6. SUGGESTED LIST OF ACTIVITIES

S.No.	Title
1.	Quiz on Electronic configuration of atoms.
2.	Demonstration of process of electrolysis
3.	Demonstration of purification of water by domestic/economical method.
4.	Identification and application of lubricants in different equipment/glasswares used in different laboratories
5.	Visit to some metallurgical industries for demonstration of different processes of metallurgy.
6.	Preparation of chart of different alloys of steel and their uses
7.	Seminar on different aspects of fuel, properties and usages
8.	Use of pH paper for testing different samples of water, blood etc.
9.	Demonstration and use of different samples of paints, varnishes, drying oils, pigments,

S.No.	Title
	thinners, dryers, fillers, plasticizers and anti-skinning agents.

7. SUGGESTED LEARNING RESOURCES

Sl. No.	Author	Title	Publication and Year
1.	M.M. Uppal	A text book of Engineering Chemistry,	Khanna Publishers
2	V.P. Mehta	A textbook of Engineering Chemistry,	Jain Bros. Delhi
3	S.N. Narkhede	A Textbook of Engineering Chemistry	Nirali Prakashan
4	R.A. Banawat, S.K. Mahajan, S.K.Mehta	Textbook of Applied Chemistry	India Book House
	V.S. Godbole	Applied Chemistry	
5	R.S. Sharma	Textbook of Engineering Chemistry	Khanna Pubnlishers
	P.C. Jain and M. Jain	Engineering Chemistry	
6	J.C. Kuriacose and J. Rajaram	Chemistry in Engineering	Tata McGraw Hill Publishing Co.Ltd., New Delhi
7	Dr.S. Rabindra and Prof.B.K. Mishra	Engineering Chemistry:	Kumar and Kumar Publishers (P) Ltd., Bangalore -40
8	S.S.Kumar	A Text book of Applied Chemistry-I	Tata McGraw Hill, Delhi
9	Sharma	A Text book of Applied Chemistry -I	Technical Bureau of India, Jalandhar
10	S.S.Dhara	A Textbook of Engineering chemistry	S.Chand & Company, New Delhi
11	Dr. G.H. Hugar	Progressive Applied Chemistry – I & II	Eagle Prakashan, Jalandhar

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GN201 ENGINEERING MATHEMATICS- II

1. RATIONALE :

Mathematics is the backbone of all areas of engineering and technology and hence technician / engineers need to study relevant theories and principles of mathematics to enable them to understand and grasp the concept of advance courses of the curriculum. With above in mind, the necessary content for the engineering mathematics is derived to understand advance use of mathematics in solving engineering problems.

2. TEACHING AND EXAMINATION SCHEME :

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-201 Engineering Mathematics-II	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	**100**
	4	2	-	6	75	25	-	-	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:
***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*
***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENT :

Unit 1 Determinants Determinants of the second order and third order, solutions of equations in two or three variables using Cramer's Rule
Unit 2 Binomial Theorem - Binomial Theorem for a rational index, general term of binomial expansion, middle term (s).
Unit 3 Mensuration - Volume and surface area of - Prism, pyramid, frustrum of a sphere, frustrum of pyramid, frustrum of cone, Area and volume by Simpsons Rule
Unit 4 Matrices Definition and Notations, Elements of Matrix, Types of matrices, Special matrices - Square, Diagonal, Row, Column, Scalar Unit, Zero or null, upper and lower triangular matrices, Symmetric, Skew symmetric matrices . Addition, Subtraction and multiplication of matrices, Inverse of matrix using Adjoint method only Application of matrices in solving simultaneous equations in 2 or 3 variable.
Unit 5 Integral Calculus Definition, fundamental properties. Methods of Integration - Integration by substitution, Integration by parts, Integration by partial fractions.. Definition of Definite Integral Properties of definite integrals, Application of integration**,** area under a plane curve, volume of revolution.(simple sums only)

Unit 6 Differential Equations Definition, order and degree of a differential equation, solutions of differential equations of first order and first degree-variable separable type only. Second order differential equation of type $d^2y/dx^2 = f(x)$ only, Application of differential equation in engineering problems
Unit 7 Statistics (Mechanical and Allied Engg. Branches) . Measures of central tendency for grouped and ungrouped data - Mean, Median and Mode . Measures of dispersion for grouped and ungrouped data -range , mean deviation, standard deviation, variance and co-efficient of variation
OR
Unit 7 Complex Numbers. (Electronics engg and Allied branches) Definitions, Argand diagrams , polar form of a complex number, Addition, Subtraction, Multiplication & Division of a complex number. Exponential and circular function, De-moivres theorem, roots of a complex number- Cube roots of unity, n th roots of unity, , hyperbolic functions

4. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY):

Unit No.	Topic	Teaching Hours/ Semester	Marks
1.	Determinants	**5**	**7**
2.	Binomial Theorem	**7**	**10**
3.	Mensuration	**7**	**10**
4.	Matrices	**11**	**08**
5.	Integral Calculus	**17**	**20**
6.	Differential equations	**08**	**10**
7.	Statistics	**09**	**10 $**
	OR		
7	Complex Numbers	**09**	**10 #**
	Total :	**64**	**75**

$- for Mechanical and allied branches

 # - For Electronics and allied branches

5. SUGGESTED LEARNING RESOURCES :

S.No.	Author	Title of Books	Publication & Year
1.	Deshpande S.P,	Mathematics for Polytechnics	Griha Prakashan, Pune, 1996 or latest
2.	Grewa, I B.S;	Engineering Mathematics	Khanna Pub., New Delhi1995 or latest
3.	Prasad, I.B.;	Engineering Mathematics	Khanna Pub., New Delhi1997 or latest
4.	Wartiker P.N.,	Applied Mathematics	Griha Prakashan Pune, 1996 or latest

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GN 202 APPLIED PHYSICS-II

1. RATIONALE:

Physics is one of the basic building blocks for engineering sciences. Therefore, the students need to describe and explain the basic principles, laws & facts of physics. These skills will enhance their ability to apply it in solving engineering problems related to their respective branches of engineering

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-202 Applied Physics-II	**L**	**T**	**P**	**C**	TH	**TM**	TW	PR/OR	**150**
	4	-	2	6	75	25	50	-	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

Legends:
***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*
***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. DETAILED COURSE CONTENTS

Unit 1 FORCE, WORK, POWER, AND ENERGY

Definition of Force and its units. Types of Forces with example- Direct, Remote action e.g. Gravitational Force, Magnetic Force, Electric Force. Effect of Forces on body-External, Internal.

Work-definition and units, Graphical Representation of workdone, Energy definition and units.

Types of Mechanical Energies- K.E. & P.E. Law of Conservation of Energy, Total Energy, Power-definition and units, Power (Force X Velocity)

Unit 2 CURRENT ELECTRICITY

Ohms law, General equation of Ohms law, Factors affecting resistance, specific resistance and units. Effect of temperature on resistance, Law of resistance in series and parallel. Internal resistance and EMF of the cell. Potential drop along a uniform wire. Principle of potentiometer. Comparison of EMF of a given cell by single cell method. Camparision of EMF of a given cell by sum and difference method. Use of meter bridge to determine the unknown resistance.

Definition of Electric power and energy in d.c. circuit. Concept of Kilowatt hour, calculation of energy bills.

Unit 3 ELECTROMAGNETISM

Electromagnetic Induction, Faraday's Laws of Electromagnetic Induction, Lenz's Law, Self Induction & Mutual Induction.

Unit 4 LOGIC GATES

Introduction to Binary Number System, Concept of '0' and '1' in Binary System. Binary equivalent of Decimal numbers from 0 to 10

Logic Gates: 1. 'NOT' Gate , 2. 'OR' Gate 3. 'AND' Gate. NAND , NOR GATE Their Logic Representation & Truth Table

Unit 5 SOUND

Definition and examples of Free and Forced Vibrations, Resonance. Determination of velocity of sound using Resonance Tube.

Definition of Beats (No derivation), Beat frequency & application of Beats, Definition of Echo, Reverberation & Reverberation time, Sabine's Formula, Acoustical Planning of an Auditorium. Factors affecting Reverberation Time, Ultrasonic waves, Piezo Electric Effect, Applications of Ultrasonic waves.

Unit 6 CIRCULAR MOTION AND GRAVITATION

Defination of Uniform Circular Motion, Angular Displacement, Angular Velocity, Relation between Linear and Angular velocity, Defination and concept of Centripetal and Centrifugal Force.(No derivation), Expression for velocity of a vehicle moving on a curved Horizontal Road, Expression for Angle of Banking & Super Elevation of Road. Newton's Law of Gravitation, Force of Gravity. Acceleration due to Gravity, Expression for Acceleration due to gravity.

Unit 7(A) FUNDAMENTAL CONCEPTS OF SIMPLE MACHINES (MECHANICAL AND ALLIED GROUPS)

Definition of efforts, velocity ratio, mechanical advantage & efficiency of machine and their relationship. Laws of machines, examples of simple machine, definition of ideal machine, systems of pulleys (First & Second). Determination of velocity ratio ,Mechanical Advantage & Efficiency.

OR

Unit 7 (B) RECTIFIERS (ELECTRONICS AND ALLIED GROUPS)

V-I characteristics of P-N junction. Diode as a rectifier. Half wave rectifiers, working, input and output waveforms, percentage regulation,((V NL – V FL) / V FL)x 100

Full wave rectifier with centre tap transformer, working, input and output waveforms, percentage regulation

Bridge rectifier, working, input and output waveforms, percentage regulation

4. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS(THEORY)

Unit No.	Unit	Teaching Hours / Semester	Marks
1	FORCE, WORK,POWER & ENERGY	10	12
2	CURRENT ELECTRICITY	16	16
3	ELECTROMAGNETISM	6	8
4	LOGIC GATES & AWARNESS TO NANO SCIENCE	4	6
5	SOUND	8	9
6	CIRCULAR MOTION & GRAVITATION	10	12
7A	FUNDAMENTAL CONCEPTS OF SIMPLE MACHINES	10	12
	OR		
7B	RECTIFIERS	10	12
	Total	**64**	**75**

7A- for Mechanical and allied branches **7B- For Electronics and allied branches**

5. LIST OF EXPERIMENTS

1. Determination of Specific resistance of a material wire by Voltmeter and Ammeter.
2. Determination of Internal resistance of a given cell by using Potentiometer.
3. Calibration of Voltmeter by using Potentiometer.
4. Comparison of E.M.F. of two given cells by single cell method using potentiometer.
5. Determination of specific resistance by meter bridge.
6. Verify the law of resistances in series by meter bridge.
7. Verify the laws of resistances in parallel by meter bridge.
8. Determination of velocity of sound by Resonance tube.

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title	Publication and Year
1.	Halliday D and Resnickr	Physics Part-I & II	Latest
2.	Das S.K., Sisodiya M.L., Neher P.K., Kachhawa C.M.,	Physics Part-I & II for 10+2 Students	Latest
3.	B.G. Dhande	Applied physics for polytechnics	Latest
4.	Bhandarkar	Applied Physics for polytechnics	Latest
5.	Saxena HC & Singh Prabhakaer	Applied Physics Vol. I & II	Latest
6.	Rao, B.V.N.	Modern Physics	Latest
7.	R.K.Guar and S.L. Gupta.	Engineering Physics	
8.	B.L. Thereja.	Engineering Technology	
9.	Modern Publishers.	ABC of Physics	
10.	V.K Mehta	Elements of Electronic Engineering	

GN 204 ENGINEERING DRAWING

1. RATIONALE:

Drawing is a graphical language of engineering field. Engineering technician irrespective of his field of operation in an industry is expected to possess a thorough understanding of drawing, which includes clear spatial visualization of objects and the proficiency in reading and interpreting a wide variety of engineering drawings. It is the skill, which translates an engineering idea into lines and dimensions on a piece of paper. Besides this he is also expected to possess a certain degree of drafting skill- depending upon his job functions-in his day-to-day activities. This course of Engineering Drawing for Diploma courses is aimed at developing basic knowledge and skills of engineering drawing and use of computer in the field of Engineering Drawing.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
GN-204	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Engineering Drawing	2	-	4	6	-	-	50	50	**100**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

L*-Lecture;* ***T*** *- Tutorial;* ***P*** *- Practical;* ***C****- Credit;* ***TH****- End Semester Theory;* ***TM*** *– Test Marks:*

PR/OR *- End Semester Practical / Oral Examinations;* ***TW-*** *Term Work*

3. DETAILED COURSE CONTENT

Unit 1 Introduction

- Importance of Engineering drawing as a means of communication.
- Introduction to drawing equipment, instruments and their uses.
- Planning of drawing sheet as per I.S. 696 - 1972.
- Indian standard practices of laying out and folding of drawing
- Different types of lines used in engineering drawing.
- Importance of scale in Engineering Drawings.
- Lettering

Unit 2 Dimensioning techniques and standard conventions

- Methods of dimensioning, Dimensioning terms and notation (use of I.S. code 696 and 2709), General rules for dimensioning, Dimensioning of cylinder, holes, arcs of circle, narrow space, angles, counter sunk hole, screw thread, taper etc.
- Conventional representation of various materials.

Unit 3 Engineering Curves & Shapes

- Construction of an Equilateral and Isosceles triangle,Square,Rhombus,Regular pentagon & Regular hexagon given distance across the corners/ flats and given length of a side using general method of construction
- Types of Engineering curves
- Construction of Engineering curves like
  - Ellipse- by focus & directrix method and arcs of circles method
  - Parabola- by focus & directrix method and rectangle or oblong method
  - Hyperbola- by transverse axis & Focus and directrix method
  - Cycloid- by generating circle rolling on a straight line
  - Involutes of a triangle ,circle & pentagon
  - Draw normal & tangents to the above curves from given point on the curve
- Practice problems of drawing various engineering curves

Unit 4 Orthographic projection

- Definitions of various terms associated with orthographic projections.
- Planes of projections.
- Concept of Quadrants.
- First and third angle method of projection.
- Projection of points
- Projection of lines
  - (i) Parallel to both Principal planes
  - (ii) Parallel to one and Perpendicular to other Principal plane.
  - (iii) Inclined to one plane and parallel to other plane.
- Projection of Triangle, Square, Rhombus, regular Pentagon when inclined to one principal plane & perpendicular to other plane.
- Introduction to the following solids
  Cylinder, cone, cube.

  Right regular solids such as

  (i) Prism: Triangular & Square
  (ii) Pyramid: Square & Pentagonal.
  - Projections of above mentioned solids when axis is inclined to one principal plane & Parallel to other principal plane.

- Conversion of simple pictorial views into orthographic views.
- Practice problems on projection of points, lines and planes.
- *Problems where one end of the line is in one quadrant & other end in other quadrant and traces are to be excluded.*
- *Problems where apparent projection of plane are given, true shape & slope angle are to be drawn are excluded.*

Unit 5 Section of solids

- Concept of sectioning planes
- Auxiliary planes and true shape of section.
- Drawing projections and section of solids like square prism, square pyramid, pentagonal pyramid, cylinder and cone with sectioning plane inclined to one principal plane and Perpendicular to the other principal plane (Axis of solid perpendicular to one principal plane and parallel to the other)

Unit 6 Development of lateral surfaces

- Concept and importance of surface development in the engineering field.

  Methods of development of surfaces-Radial & Parallel line method.

  Development of surfaces for the following right regular solids-
- Cylinder
- Prism
- Cone
- Pyramids
- Development of solids standing on its base & cut by a plane inclined to either VP/HP and perpendicular to the other is also included.
- *Practice problems on above with top & bottom of the solid is excluded*

Unit 7 Isometric Views

- Limitations of orthographic projections.
- Procedure for preparing isometric projections.
- Difference between Isometric projection & Isometric view.
- Isometric view of geometrical solids and simple machine parts.
- Conversion of orthographic views into isometric views.
- Construction of Isometric view for any real object. Conversion of orthographic views of simple components into isometric views.

4. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS

Unit No.	Unit	Teaching Hours / Semester
1	Introduction	**1**
2	Dimensioning techniques & standard conventions	1
3	Engineering Curves & Shapes	4
3	Orthographic projections	**13**
4	Section of solids	3
5	Development of surfaces	4
6	Isometric projections	2
-	Revision	4
	Total	**32**

5. SUGGESTED LIST OF ACTIVITIES

Sheet No.	TITLE	Contents	Hours
1.	TYPES OF LINES, LETTERING, DIMENSIONING.	All types of lines, Single stroke vertical capital letters, Methods of Dimensioning-Aligned & unidirectional System, Conventional representation of materials.	4
2.	GEOMETRICAL CONSTRUCTIONS	Construction of Equilateral and Isosceles triangle, Square, Rhombus, Regular pentagon & hexagon	4
3.	ENGINEERING CURVES	Construction of ellipse, parabola, hyperbola by given methods. Involutes, cycloid. Draw normal and Tangent to curves.	8
4.	PROJECTION OF POINTS & LINES	Drawing projection of points in all 4 quadrants. Drawing of projections of lines in following positions (i) Parallel to both Principal planes (ii)Parallel to one and Perpendicular to other Principal plane. (iii) Inclined to one plane and parallel to other plane.	6
5	PROJECTION OF PLANES	Drawing the projection of Triangle square, Rhombus, regular Pentagon when inclined to one principal plane & perpendicular to other plane.	6
6	PROJECTIONS OF SOLIDS	Drawing projection of following solids Cylinder, cone, cube. Right regular solids such as Prism: Triangular & Square,Pyramid: Square & Pentagonal,when axis is inclined to one principal plane & parallel to other principal plane.	8
7	ORTHOGRAPHIC PROJECTIONS	Simple problems on conversion of pictorial into orthographic views.(atleast 2 problems each in 1st angle and 3rd angle)	4

Following shall be the list of sheets to be prepared as Engineering drawing lab work

8	SECTIONS OF SOLIDS	Drawing projections and section of solids like square prism, square pyramid, pentagonal pyramid, cylinder and cone with sectioning plane inclined to one principal plane and Perpendicular to the other principal plane (Axis of solid perpendicular to one principal plane and parallel to the other)	8
9.	DEVELOPMENT OF LATERAL SURFACES	Draw the Development of surfaces for the following right regular solids- Cylinder, Cone, Prism & pyramids (square, triangular, pentagonal).	8
10	ISOMETRIC VIEWS	Conversion of orthographic views of simple components into isometric views.	8

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title	Publisher
1.	BIS, India	IS. 696. (Latest revision).	BIS, India
2.	N.D. Bhatt	Engineering Drawing	Charoter Publisher,Anand
3.	R. K. Dhawan	Engineering Drawing & Machine Drawing	Kumar
4.	R.B. Gupta	Engineering Drawing	Satya Prakashan, Delhi
5.	P.S. Gill	Geometrical Drawing	Ketson & Sons
6.	P.S. Gill	Machine Drawing	Ketson & Sons
8.	TTTI, Bhopal	Work Book in Mechanical Drafting	TTTI, Bhopal
9.	T. Jeyapoovan	Engineering Drawing & Graphics Using AutoCAD 2000	Vikas Publishing House Pvt. Ltd, New Delhi.
10	N.D. Bhatt	Machine Drawing	Charoter Publisher,Anand

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GN 205 ENGINEERING MATERIALS

1. RATIONALE:-

Adequate knowledge of different types of engineering materials, their properties & applications are very essential for the engineers. This course content is designed to provide basic insight knowledge regarding engineering material and their applications which will be useful for the students to learn subjects of higher semesters. The range of materials available for engineering applications is quite vast, hence only the basic groups of ferrous non-ferrous, non-ferrous & other engineering materials with their general properties and uses have been stressed upon.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
G-205	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Engineering Materials	4	-	-	4	75	25	-	-	**100**

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T** - Tutorial; **P** - Practical; **C**- Credit; **TH**- End Semester Theory; **TM** – Test Marks:*

***PR/OR** - End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COURSE CONTENTS

Unit 1 Introduction to Engineering Materials

Classification of Materials

- Metal, Non-metal
- Ferrous Metal & Non-ferrous Metals.

Differences between Metals & non-metals.

Properties of Materials.

- Physical properties – Melting point, freezing point, boiling point, Density, Linear co-efficient of expansion, Thermal conductivity, Electrical resistivity.
- Mechanical properties – Strength, Elasticity, Plasticity ductility,

Malleability, Toughness, Brittleness, Hardness, fatigue, creep.

- Electrical properties – Resistivity, conductivity, Temperature coeff. of resistance, dielectric strength, Thermo electricity, super conductivity.
- Magnetic properties – permeability, coercive force, magnetic stresses.
- Chemical properties - Corrosion resistance, chemical composition, acidity, alkalinity.

Unit 2 Ferrous & Non-Ferrous Metals & its Alloys

- **Ferrous alloys.**
  - Low carbon steel, medium carbon steel, High carbon steel, their carbon percentage, properties & uses.
  - Cast iron – Grey cast iron, white cast iron, spheroidal grey cast iron, their properties & uses.
  - Alloy steels.
    - Constituents of alloy steels such as phosphorous sulphur, Silicon, Manganese and their effect on properties of materials.
    - Stainless steel, chromium – Nickel steel, Nickel-chromium-molybdenum steel, Nitriding steel, Manganese steel, its properties & uses.
  - Tool steel – composition, HSS, High carbon steel, properties & uses.
- **Non-ferrous Metals & alloys**
  - Aluminium – Properties & uses.
  - Aluminium alloys – constituents of alloy & their effect on properties of metal
  - Properties & uses of Duralumin, Y-alloy, Al-si alloy, Al-Zn-Mg alloys.
  - Copper – Properties & uses.
  - Copper alloys – Constituents of alloy & their effect on properties of metal.
  - Properties & uses of Copper – Zinc alloys such as Muntz metal, manganese bronze, copper-Tin alloys such as Bronze, copper aluminium alloys such as aluminium bronzes.
  - Properties & uses of lead & its alloys.

Unit 3 Non – Metallic materials

- Refractory
- Desirable properties.
- Difference between acid, basic & neutral refractories.
- Properties & uses of Fire clay refractory, silica refractory.
- Plastic
- Classification table only.
- Properties & uses of Thermosetting & Thermoplastic.
- Natural & Synthetic abrasive materials.
- Introduction, Properties & uses.
- Rubber
- Properties & uses of natural, neoprene, synthetic & butyl rubber.

- Vulcanization process.
  - Glass
- Properties & uses of soda glass, Borosilicate glass, fibre glass.
- Glass wool – composition, properties & uses.

  - Introduction to composite materials.Classification diagram only.

Unit 4 **Conductor, Semi Conductor, Insulating and Magnetic Materials.**

- Classification of Materials as conductor, Semiconductor and Insulating materials.
- Conductor Materials.
  - High conductivity materials
    - Copper, Aluminium, Carbon, Silver, Lead, Brass, Bronz, Tungsten & Gold.
    - Their properties as conducting materials and applications.
  - High resistivity materials
    - hichrome, constantan, manganin
    - Their applications
- Insulating materials
  - Introduction
  - Characteristics of Good Insulating materials
  - Solid Insulating materials
    - Wood, paper, rubber, mica, glass tibre, porcelain, varnish, PVC, Resins.
  - Their characteristics as insulating materials and applications.
  - Liquid insulating materials
  - Mineral oil, its properties as insulating material and applications.
  - Gaseous insulating materials like air, Nitrogen, Sulphur hexafloride & their applications.
- Semiconductor Materials.
  - Silicon & Germanium. Their specifications as semiconductor material and uses
- Magnetic Materials.

  Classification as:
  - Dia Magnetic
  - Para Magnetic
  - Ferromagnetic
  - Non magnetic

List of these materials and their applications.

Unit 5 Construction Materials

- Building Stones : Classification of rocks, Characteristics of good building stones, common building stones & their uses.
- Cement: Chemical composition of port land cement, outline of manufacturing process, types of cements, uses.
- Bricks: Bricks – Constituents, properties, classification, special bricks – refractory and flyash bricks; uses.
- Other materials:
  - Lime – Sources. Properties, uses.
  - Clay – Different building products from clay like tiles, pipes etc.
  - Timber – Common varieties of timber, uses wood products, veneer, plywood, etc.
  - Sand – Sources: rivers, crushed aggregates, characteristics uses.

4. SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Marks
1	Introduction to Engineering Materials	**04**	**09**
2	Ferrous & Non-Ferrous Metals & its Alloys	**16**	**18**
3	Non – Metallic materials	**12**	**12**
4	Conductor, Semi Conductor, Insulating and Magnetic Materials.	**16**	**18**
5	Construction Materials	**16**	**18**
		64	**75**

Semester - III

Course code	Name of Course	TEACHING SCHEME				EXAMINATION SCHEME				Total marks
		L	T	P	C	Theory Marks		Practical Marks		
						TH	TM	TW	PR	
CS301	Engg.Mechanics	3	1	2	6	75	25	50	-	150
ME301	Machine Drawing	2	-	4	6	75	25	50	-	150
ME302	Manufacturing Process I	3	-	4	7	75	25	50	-	150
ME303	Thermal Engineering	3	1		4	75	25	-	-	100
CS305	Computer Aided Drafting	-	-	4	4	-	-	50	50	100
CS302	Elements of Electrical & Electronics Engg.	3	-	2	5	75	25	25		125
Total		**14**	**2**	**16**	**32**	**375**	**125**	**225**	**50**	**775**

(CS301) ENGINEERING MECHANICS

1. RATIONALE.

The focus of the course is to study rigid bodies, subjected to motion or equilibrium with the particular emphasis of engineering applications. This course plays a key role in engineering and is a pre- requisite for all design applications. Basic understanding of the concepts and principles involved in mechanics is essential. The concepts in Applied Mechanics form the base of all engineering disciplines. Applications of principles to engineering situations is emphasized in this course. Considering the level of student, concepts are difficult; hence classroom demonstration should be used to explain concepts and principles.

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CS301	L	T	P	C	TH	TM	PR /OR	TW	
Manufacturing Processes-I	3	1	2	6	75	25	-	50	150

Minimum passing % : Theory 40% and Practical 40% Duration of Theory Paper: 3Hrs

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE.

The course content should be taught and implemented with the aim to appreciate and apply the Principles and Laws of Engineering Mechanics in basic Engineering Design concepts.

4. DETAILED COURSE CONTENT

CH1. FORCE **09 Mrks** **05hr**

Definition & units of Force, Types of Forces, its Characteristics, Effect of Forces,

System of Forces, Resolution & Composition of Forces (Resolving along X & Y Axis only).

Relationship between Resultant & Equilibrant Force.

Application of Resolution to find Resultant of coplanar concurrent Force System, and Finding missing force when resultant is given.

CH2. MOMENTS **09Mrks** **04hrs**

Definition and units, Sign conventions (Take clockwise +ve, Anticlockwise -ve)

Definition & units of couple (clockwise +ve, Anticlockwise -ve)

Characteristics of couple, Varignon's Theorem,

Application of above to find Resultant in magnitude, direction and line of action in Coplanar Non- concurrent and parallel Force system

CH.3 EQUILIBRIUM **18Mrks** **12hrs**

Concepts of Equilibrium,Conditions of Equilibrium for Two forces, Three forces, concurrent & non concurrent force system, Lami's Theorem and its application..

Concepts and drawing of Free Body Diagram involving not more than three bodies.

Definition of Beam, types of beams, types of Supports and types of loading.

Application of Equilibrium to beams (Beams with two supports at the ends, Beams with overhangs) with Concentrated loading, UDL, Partially UDL Loading only.

Applications of Equilibrium to determine the forces in the member of the perfect simple support and cantilever truss using method of Joints. Graphical method/ Maxwell diagram for determination of forces in the member of truss.

CH.4 FRICTION **09Mrks** **06hrs**

Definition, Coulombs Law of static friction, coefficient of friction, Angle of friction, Cone of friction, Angle of Repose

Application of Friction with a block on horizontal and inclined Plane , Ladder friction.

CH.5 KINETICS **12Mrks**
09hrs

D'Alemberts Principle and its Application

Simple problems related to Motion of Lift, Two connected bodies with a single string, suspended on horizontal and inclined planes.

CH.6 MOMENTUM, IMPACT, AND IMPULSE **06Mrks**
04Hrs

Definition and units of Momentum and Impulse

Definition of impulsive force

Law of Conservation of Momentum.

Simple problems related to Momentum and Impulse, impulsive force, Law of Conservation of Momentum

CH.7 WORK, POWER & ENERGY **12Mrks** **08Hrs**

Definition and units of Work, Power and Energy.

Forms of Energy – Kinetic and Potential Energy.

Principle of Conservation of Energy

Simple numerical problems to calculate Work, Power, Energy & conservation of Energy.

Total = 75 Mrks **48 Hrs**

Engineering Mechanics (Practicals)

Experiments:- (Minimum 06 experiments)

1. To Verify Polygonal Law of forces.

2. To Prove Lami's Theorem.

3. To find Co-efficient of Friction.(Any Two Surfaces)

4. To Determine Reactions in Beam Apparatus.

5. Four experiments on Lifting Machine to find M.A, V.R , Efficiency, and to obtain Law of Machine

Graphical Analysis: - 3 sheets (Half Imperial)

a) Determination of Resultant of Coplanar Concurrent Forces.

b) Determination of Resultant of Coplanar, Non-concurrent Forces and Parallel.

c) Analysis of Trusses (Simply supported and Cantilever) using Maxwell diagram.

Reference Books :-

1. Fundamental of Applied Mechanics – Dadhe, Jamdar, Walavaikar

2. Applied Mechanics – R.S. Khurmi

3. Engineering Mechanics – A.R. Basu

4. Applied Mechanics Vol-I – R.C. Patel & B.M. Patel

ME 301 MACHINE DRAWING

1. RATIONALE:

By this time the student has gained basic knowledge of engineering drawing. Hence in this course stress, looking to the professional needs of the technicians, more emphasis has been given on the use of I.S. code of practice and reading and interpretation of manufacturing drawings. The topics on multi-view representation, dimensioning and tolerance and sectional views of machine parts are included to build foundation for production drawing. The topic of pipe drafting will help the students to understand the importance and functions of piping system in Industry. Computer Graphics is a modern concept in Mechanical Drafting and knowledge of the same is required now a days. Detailed assembly drawing, Geometric & dimensional tolerancing are considered essential for the technician's level.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 301	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	
Machine Drawing	2	-	4	6	75	25	-	50	**150**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: **4 Hrs**.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE:

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency ***Draw & interpret assembly and detailed drawings of given machine parts/components as per standards.***

4. DETAILED COURSE CONTENT

Unit 1 Conventional Representation Conventional representation of different materials, conventional representation for ball bearings, roller bearings, springs, bolts and nuts, screws, studs, spoked wheels. Different types of sections.
Unit 2 Free hand sketches of following Machine parts Hexagonal headed bolt, washer, nut, Assembled and individual, Keys: sunk key, Feather key, woodruff key, Gib and cotter Joint Muff coupling, flexible coupling, V-belt pulley, flat belt pulley with arms.
Unit 3 Assembly drawing Knuckle joint, Protected type flange coupling, Foot step bearing, Feed check valve (NRV), Piston and connecting rod of I.C. engine
Unit 4 Detailed Drawings Socket and spigot joint, Universal coupling, Plummer block, Stop Valve

Unit 5 Pipe fittings and pipe joints
Different pipe fittings like Coupling, cap, Tee , elbows ,cross ,lateral ,reducer ,valves, union ,plug. Single line and double line Representation of the pipe fittings. Pipe joints: Socket joint, socket and spigot joint, union joint, expansion joint.
Unit 6 Welds and welded joints
Different Types of welded joints : Lap joint, butt joint ,Tee joint ,corner joint, fillet weld. Conventional/Sectional representation of fillet, butt, single and double U, V,J and Bevel weld, seam weld, spot weld. Representation of weld details on drawing: site weld, weld all round, weld on arrow side ,on other side, intermittent weld, weld length, weld length ,weld size ,concave finish, flush finish, weld size.
Unit 7 Elements of production drawing
Geometrical Tolerances: Types, terminology, representation of geometrical tolerances on drawings. Dimensional Tolerances: Terminology, selection of dimensional tolerances, representation of dimensional tolerances on drawings. Surface Roughness: Terminology, representation of surface roughness on drawings.

5. SUGGESTED DISTRIBUTION OF MARKS & HOURS

Unit No.	Unit	Teaching Hours/ Semester	Marks Distribution for End Semester Exam
			Total
1	Conventional Representation	3	9
2	Free hand sketches of following Machine parts	5	9
3	Assembly drawing	6	15
4	Detailed Drawings	6	15
5	Pipe fittings and pipe joints	4	8
6	Welds and welded joints	4	9
7	Elements of production drawing	4	10
	Total	**32**	**75**

- Only critical dimensions are to be remembered by students and other dimensions can be used approximately as per proportion.

6. SUGGESTED LIST OF ACTIVITIES

Following shall be the list of sheets to be prepared as machine drawing lab work

S.No.	Title
1	One sheet on conventional representation and Free hand sketches (Unit 1 and Unit 2)
2	One sheet on Assembly drawing (Unit 3)
3	One sheet on Detailed drawings (Unit 3)
4	One sheet on Pipe fittings , pipe joints and welded joints (Unit 5 and Unit 6)
5	One sheet on production drawing(Unit 7)

7. SUGGESTED LEARNING RESOURCES

S.No.	Title	Author and Publisher
1.	Elements of Machine Drawing	N.D.Bhatt. Anand Charotkar
2.	Machine Drawing	R.K.Dhawan, S. Chand
3	Machine Drawing	P. S Gill
4	Machine Drawing	Mali, Chaudhari, Vrinda Publications
5	Machine Drawing	K. R Gopalkrishna, Subhas Publication
6	Machine Drawing	Venugopal

ME302 – MANUFACTURING PROCESSES-I

1. RATIONALE

As a technician the knowledge and practical skills in different manufacturing processes are essential and hence enough weightage is given in this course towards skills development. Further the technician should be able to handle machine, equipment, tools and accessories in the recommended manner and also follow safety precautions. The contents of this course are oriented towards the above.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 302	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	
Manufacturing Processes-I	3	-	4	7	75	25	-	50	**150**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency ***Prepare the job as per given specification by selecting and applying appropriate manufacturing processes following safe working procedures.***

4. DETAILED COURSE CONTENT

Unit 1 Foundry

Pattern Making

Introduction, Materials used for pattern making, Types of patterns, Pattern allowances,

Introduction to cores, core boxes, core materials, Core prints, and core making.

Moulding

Introduction, Moulding tools and equipment, Ingredients of moulding sand, Types of moulding sands, Sand additives, Properties of moulding sand ,Types of moulds, Steps involved in making a mould, Moulding processes: Bench molding, floor molding and machine molding

Gating and Riser System

Elements of gating system: Functions of the following: pouring basin, sprue, runner, gates, risers.

Melting Practice

Construction and working of Cupola furnace.

Casting Methods

Introduction to permanent mould casting, Working principle and advantages of Centrifuging, Hot chamber and cold chamber pressure die casting.

Casting Defects

Different types of casting defects, their causes and remedies.

Unit 2 Welding

Introduction

Principle of welding, Classification of welding processes, Advantages and limitations of Welding.

Manual Metal Arc Welding

Principle of operation of arc welding, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity

Gas welding and cutting

Principle of operation of gas welding, Types of gas welding flames and their applications,

Oxy acetylene gas welding equipment: oxy acetylene gas welding torch, Filler rods and Fluxes. Introduction to gas cutting

Other welding processes
Working principle and applications of the following welding processes

Resistance welding: spot welding, seam welding, submerged arc welding(SAW), Metal inert gas (MIG) welding, Tungsten Inert Gas welding (TIG)

Weld Defects - Causes and Remedies

Various weld defects like under cutting, overlap, improper penetration, improper fusion, slag inclusion, porosity, blow holes, cracks, spatter loss- Causes and Remedies.

Unit 3 Metal Forming Processes

Press working

Basic working principle of mechanical and hydraulic press.

Sheet metal working: Trimming, punching, notching, blanking, embossing, stamping, and deep drawing.

Forging

Open die forging, closed die forging, press forging.

Unit 4 Metal Cutting

Introduction to metal cutting : Types of cutting tools, tool geometry, significance of rake angles, Tool signature, Cutting tool materials , Orthogonal and oblique cutting, Types of chips and Cutting fluids, Cutting parameters : Cutting speed, feed and depth of cut and their effect.

Unit 5 Lathe

Introduction, Description and function of various parts of a lathe, specification of a lathe, Lathe accessories:- Centers, dogs, chucks, collets, face plate, angle plate, mandrel, steady rest, taper turning attachment, tool post grinder.

Unit 6 Drilling

Introduction, classification of drilling machines and their description, nomenclature of a drill, Types of drills, Taps and reamers.

Various operations performed on drilling machine - drilling, spot facing, reaming, and boring, counter boring, countersinking, tapping.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours	Total Marks
1	Foundry	10	15
2	Welding	10	15
3	Metal Forming Processes	06	10
4	Metal cutting	08	10
5	Lathe	08	15
6	Drilling	06	10
		48	75

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency – ***Prepare the job as per given specification by selecting and applying appropriate manufacturing processes following safe working procedures. Workshop Instructors should explain various safety measures to be followed by the students during the practical sessions.***

S. No.	Unit No.	Experiment	Hours
1	1	To prepare a single piece pattern: one job	06
2	1	To prepare a spilt pattern : one job	06
3	1	To prepare a mould cavity using Single piece pattern : one job	06
4	1	To prepare a mould cavity using split pattern : one job	06
5	2	To prepare welding job in flat and horizontal position by arc welding process. (Selection of welding current, type and diameter of Electrode to be expalined)	12
6	3	To prepare a hexagonal prism from a M.S Round bar and thereafter into a flat chisel.	06
7	3	To prepare a round hook from round M.S. bar	06
8	5	To prepare a job on a lathe machine as per given dimensions involving following operations: facing, plain turning, step turning, taper turning, knurling, drilling, chamfering, grooving, parting etc.	16
		Total	64

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	S.K.Hajra Chaudhary & A.K. Hajra Chaudhary	Elements of Workshop Technology Vol. I & II	Media Promoters & Publishers Pvt Ltd. Mumbai
2	P. N Rao	Manufacturing Technology (Foundry, Forming and welding)	Tata McGraw Hill Publishers,New Delhi, Fifth edition 1992
3	O.P Khanna and M. Lal	A Text book of Production Technology Vol. I & II	Dhanpat Rai Publications New Delhi Revised edition 1999
4	R K Jain	Production Technology	Khanna Publishers, New

			Delhi

ME 303 THERMAL ENGINEERING

1. RATIONALE

Mechanical engineering diploma holders have to work with various power producing; power absorbing and heat transfer devices. In order to understand the principles, construction & working of these devices, it is essential to understand the concept of energy, work, heat & conversion between them. Hence it is important to study the course of Thermodynamics. It includes the study of various sources of energy, basic laws & concept of thermodynamics, gas laws, properties of steam & generation. Heat transfer forms the basis for different power engineering application.

Boilers find application in different process industries. Steam turbines and condensers are the major component of any steam power plant. Mechanical engineer should understand working and application of these devices.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 303	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	
Thermal Engineering	3	1		4	75	25	-	-	**100**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Apply concepts and laws of thermodynamics to manage various processes and equipment/instruments used in the area of Thermal Engineering.***

4. DETAILED COURSE CONTENT

Unit 1 Basics of Thermodynamics (No Numericals)

Types of systems, properties of systems, Extensive and Intensive properties, and their units (S.I). Work and Energy- Thermodynamic definition of work, heat, difference between heat and work, definitions of Potential Energy, Kinetic Energy, Internal Energy and concepts of enthalpy and entropy

Unit 2 Laws of Thermodynamics

Laws of Thermodynamics – Zeroth's Law, First Law of Thermodynamics, principle of energy conservation(simple numericals), irreversibility, Second Law of Thermodynamics, Kelvin – Plank & Clausius statements.Applications to heat engine, refrigerator and heat pump(simple numerical)

Unit 3 Ideal Gas

Concept of Ideal gas, Charles law, Boyle's law, Gay-Lussac's law, Avogadro's law, equation of state for Perfect gas,

Characteristic gas equation (no derivation), universal gas constant.

Ideal gas processes: - Isobaric, Isochoric, Isothermal, Adiabatic, Polytropic with representation of the processes on P-V and T-S diagram (only simple numeric problems)

Unit 4 Properties of steam and Vapor Processes

Enthalpy & Entropy of water and steam, Generation of steam at constant pressure with representation on various charts such as T-H, T-S, H-S,. Properties of steam and use of steam table, Quality of steam, Types of steam Calorimeters (No Numericals), Enthalpy-entropy chart (Mollier diagram), Vapour cycles, Carnot cycle, Rankine cycle, Calculation of work done and efficiency of Rankine cycle using Mollier Chart.

Unit 5 Steam Boilers

Steam Boilers: - Classification of boilers. Principle & working of Cornish, Cochran, Babcock - Wilcox and Lancashire boilers

Construction and working of high pressure Boilers - La Mont, Loeffler and Benson Boiler.. Boiler draughts- natural and mechanical.Boiler mountings & accessories. Introduction to Indian Boiler Regulations (IBR) (for information only)

Unit 6 Steam Turbines (No Numericals)

Steam nozzle – Types of nozzles and applications, concept of Mach number, critical Pressure.

Steam turbine - Classification of turbines, Construction and working of Impulse and Reaction turbine.

Compounding of turbines, nozzle control governing, Concepts of Reheating & Regenerative feed heating.

Unit 7 **Steam Condenser (No Numericals)**

Steam condenser - Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers.

Sources of air leakage, concept of condenser efficiency, vacuum efficiency.

Cooling Towers- Forced draught, natural draught and induced draught type.

5. SUGGESED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Theory Marks Distribution for End Semester Exam *(Duration – 3 Hours)*
6.	Basics of Thermodynamics	04	06
7.	Laws of Thermodynamics	04	09
8.	Ideal Gas	10	15
9.	Properties of steam and Vapour Processes	08	12
10.	Steam Boilers	10	15
11.	Steam Turbine	06	09
12.	Steam Condenser	06	09
	Total	**48**	**75**

Legends: *R = Remembrance; U = Understanding; A = Application and above levels*

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	Patel and Karamchandani	Elements of heat engines Vol.I and II	
2	Pandya & Shah	Thermal Engineering	Charotar publishing house,Anand
3	R.S. Khurmi	Thermal Engineering	
4	K.R. Gopalkrishnan	Elements of Mechanical Engg.	

(CS 302) ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

1. RATIONALE:

A Mechanical Engineering Diploma holder in his job in industry has to interact with many electricalmachines and electronics based controls in operation of various machine tools and machine control systems. Therefore a basic knowledge about electrical and electronics engineering relevant to his job requirement of operation and maintenance in industry is mandatory to perform his job efficiently.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credit	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	C	TH	TM	TW	PR/OR	
ELEMENTS ELECTRICALAND ELECTRONICS ENGINEERING.	3	-	2	5	75	25	25	-	125

Minimum passing % : Theory 40% **Duration of Theory Paper:** 3 Hrs.

Legends:

L-Lecture; T - Tutorial; P - Practical; C- Credit; TH- End Semester Theory; TM – Test Marks:

PR/OR - End Semester Practical / Oral Examinations; TW- Term Work

3. Unit- I–AC Fundamentals (2hrs) (3marks)

Sinusoidal AC voltage waveform.

Definition of terms related to AC wave-- average value, RMS value.

Definition of power factor and its significance.

Unit- II – Distribution of Electrical Energy (9hrs) (15marks)

Voltage levels in the various stages in the flow of electrical power from 110KV substation to 11KV/440V distribution transformer(using single line diagram only).

Method of laying underground cables for distribution of power.
Voltage levels for commercial and domestic use.
Conduit wiring system- surface and concealed, its advantages and disadvantages.
Definition of Earthing, its necessity .
Types of Earth electrodes—Pipe and Plate electrode.
Methods of reducing earth resistance.

Unit- III – Cables , Switching and Protective Devices (8hrs) (15marks)

Construction of three phase PVC insulated power cables.
Specifications of PVC cables.
Colour codes of single phase and three phase PVC cables.
Functions and symbols of Switch-Fuse Unit, Fuse-switch Unit, Contactors, MCB, MCCB and ELCB.
Fuses- Construction and Applications of Rewirable fuses and HRC fuses.
Construction and operation of a simple electromagnetic relay and limit switches.

Unit- IV – Transformers (4hrs) (06marks)

Principle of operation and basic construction of a single phase transformer (core and winding only).

EMF equation(no derivation and no numericals).

Losses in a transformer, efficiency and voltage regulation(no derivation and nonumericals).

Significance of KVA Rating of transformer.

Unit- V – DC Motors (6hrs) (09 marks)

Working principle of DC motors, main parts of DC motor and their functions,.

Classification of DC motors (shunt, series and compound and their applications).

Necessity of a starter for DC motors (No study of starters).

Methods of reversal of direction of rotation of DC shunt and series motor.

Unit- VI – AC Machines (6hrs) (09marks)

Principle of operation of three phase induction motor.

Main parts of three phasesquirrel cage & Slip Ring Induction motors.

Applications of induction motors.

Necessity of starter, Names of starters used, reversal of direction of rotation.

Working principle of an alternator.

Unit- VII – Basic Electronic Devices (9hrs) (12marks)

Semiconductor theory-Construction of Intrinsic and extrinsic semiconductor, P and N type semi conductors, working principle of Diode, diode V-I characteristics, Full wave centre-tap and bridge rectifiers- circuit diagram,operation and waveforms, capacitor filter to reduce ripple voltage.
Transistor -NPN and PNP, construction , symbol and operation. Transistor CE Amplifier-circuit diagram and operation using waveforms only. Applications of transistors (naming only)

Unit- VIII – Digital Logic Gates (5hrs) (06marks)

Binary number system, Symbols and Truth Tables of AND, OR,NOT,NAND,NOR,X-OR,X-NOR Gates

4. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS (THEORY)

Unit No.	Unit	Teaching Hours / Semester	Marks
1	AC Fundamentals	2	03
2	Distribution of Electrical Energy	9	15
3	Cables,Switching and Protective Devices	8	15
4	Transformers	4	06
5	DC Motors	6	09
6	AC Machines	6	09
7	Basic Electronic Devices	8	12
8	Digital Logic Gates	5	06

5. SUGGESTED LIST OF EXPERIMENTS

(Any 8-10)

Sr. No.	LIST OF EXPERIMENTS
1	Identification of various components of a Diesel-Engine Generator set and study its operation.
2	Connection of a single phase Transformer and measurement of Input and Output voltages, currents and power for different loads.
3	Simulation of fuse failure on any one primary phase of a 3-phase transformer and study its effect on the secondary voltages.
3	Connection, Starting, speed controland reversal of direction of rotation of DC shunt motor
4	Connection and Starting of three phase induction motor using manual and automatic star delta starter
5	Connection, starting, running and speed control of Slip Ring induction motor
6	Calculations for selection of PVC cables for different currents.
7	Identification of Fuses ,MCBs and ELCBs and study of operation of MCB and ELCB for different simulated faults.
8	Circuit assembly, measurement of input and output voltages and fault simulation and trouble shooting of Bridge and Centre-tap Rectifiers
9	Circuit assembly for ON/OFF control of single phase loads such as lamps, home appliances,etc. using transistorized circuit and a Relay.
10	Verification of truth tables of Logic Gates

6. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title	Publication and Year
1	B.L. Thereja.	Text book of Electrical Technology	Latest
2	V.K. Mehta	Principles of Electronics Engineering	Latest

(CS 305) COMPUTER AIDED DRAFTING

1. RATIONALE:

The market driven economy demands frequent changes in product design to suit the customer needs.With the introduction of computers the task of incorporating frequent changes as per requirement is becoming simpler. This course has been introduced at Diploma level to develop the skills in student so that they can generate various digital drawing s as required using various CAD software.

1. Teaching and Examination Scheme

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CS305 COMPUTER AIDED DRAFTING	L	T	P	C	TH	TM	TW	PR/OR	100
	0	-	4	4	-	-	50	50(P)	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

2. COURSE CONTENTS: Teaching hours

1. Introduction and CAD Preliminaries. 2 hours
   - Computer aided drafting concept.
   - Hardware and various CAD software available.
   - Components of a CAD software window such as Titlebar, Standard toolbar, Menu bar, Object properties toolbar, draw tool bar, Modify toolbar, Cursor cross hair, Command window, status bar, Drawing area,UCS icon.
   - File features: New file, Saving the file, Opening an existing drawing file, Creating Templates, Import and Export of file, Quit.
   - Setting up new drawing : Units, Limits, Grid, Snap.
   - Undoing and Redoing action.

2. Drawing using CAD software: 10 hours

- Drawing basic objects : Point, Line, Circle, Arc, Ellipse, Parabolas, polygon, Rectangle, Multiline, Doughnut, Drawing with precision, Drawing construction lines and rays, Calculating distance and angle, Use of measure, Divide, Inquiry commands, redraws and Regenerating screen display.
- Methods of specifying points, Absolute coordinates, Relative Cartesian, and Polar coordinates.
- Using Object snap: Endpoint, midpoint, Intersection, Centre Point, Quadrant point, Nearest Perpendicular, Apparent Intersection, etc.

3. Edit/modify features and viewing drawings. 10 hours
   - Object Selection : selection set with its options like Pick box, Window, Crossing, Previous, Last drawing, etc.
   - Editing Commands like : Zoom all, Zoom Previous, Zoom Extents, Zoom window, Zoom real time, Zoom Dynamic, Zoom Pan.
   - Modify commands: Erase, Copy, Mirror, Offset, Array, Move, Scale, Stretch, Lengthen, Trim, Extend, rotate, break, join, chamfer, fillet.

4. Organising Drawing: 6 hours
   - Concepts of layers: creating layers, naming layers. making layers ON/OFF, freeze-thaw layers, lock/unlock layers, setting the properties of layers like colour, line type, line weight.
   - Concept of blocks : Creating, inserting, redefining and exploding blocks.
   - Concept of Hatch: Selecting hatch pattern, Hatch styles, Hatch Orientation, associative hatch, Boundary hatch, Hatching Object.
   - Polylines: Drawing polylines, editing polylines, drawing spline curves, editing splines.

5. Dimensioning and Tolerancing 8 hours
   - Dimensioning : Types of dimensioning, Linear, Horizontal, Vertical, Aligned, rotated, Baseline, continuous, diameter, radius, angular dimension, Leader.
   - Dimension scale variable,adding geometric tolerances

- Editing dimensions
- Single line text,Multiline text.
- Text styles: selecting font, size, arrows, alignment, etc.

6. 3D-features 2 hours
   - Right hand rule/local global co-ordinate system.
   - Specifying 3D coordinates
   - Using UCS
   - Defining user coordinate system using UCS command with its options.
   - Viewing in 3D

7. Isometric Drawing: 10 hours
   - Settings for isometric drawing, isometric Snap mode, switching between isometric planes, isocircles, simple isometric drawings.

8. Solid Modeling 12 hours
   - Concept of solid modeling
   - Creating predefined solid primitives such as box, cone, cylinder, sphere, torus, wedge.
   - Constructing a region, creating an extruded solid, creating a revolved solid.
   - Creating composite solids using union, intersection and interface commands.

9. Model space, Paper space, viewports and layouts 2 hours
   - Concept of model space and paper space.
   - Creating viewports in model space and creating floating viewport in paper space.
   - Shifting from model space to paper space and vice versa.

10. Printing/ Plotting drawing. 2 hours

- Standard sizes of sheet.
- Selecting various plotting parameters such as paper size, paper units, drawing orientation, plot scale, plot offset, plot area, print preview.

3. PRACTICALS

1. Drafting of common template for all the following assignments with Institute logo and standard title block.
2. Five problems on different geometrical shapes.
3. Dimensioning of above figures.
4. Three problems with polar and rectangular arrays.
5. Three problems on 2D entity generation, which involve the use of layers and blocks.
6. Two problems on orthographic views for various Engineering drawing objects covering dimensioning, text, etc.
7. Two problem on isometric drawing of Engineering drawing object.
8. Create at least two solid models, which cover all the features available in solid modeling.
9. Drafting project:
   a) Civil Engg. & Architectural Engineering: Plan, elevation and section of a single story residential building.
   b) Electrical & Electronics Engg.: Electrical layout of components like bulbs, fan, A.C., T.V. point, telephone point, etc. for a single story house.
   c) Mechanical Engg.: Industrial components such as machines, automobiles , jigs and fixtures with dimensioning, tolerancing ,text, title block, etc.
   d) Shipbuilding Engg.: Body plan of a ship.
   e) Mining Engg.: Plan and section of an opencast mine benches, Plan and section of an underground mine.
   f) F.T.E.E. : Front View and Bottom View of a Simple truss like Saw Tooth truss, King-Post truss, Snow Tooth truss. (Any one of the three)

4. LEARNING RESOURCES

1. AutoCAD for Engineering drawing made easy – P. Nageshwar Rao- Tata McGraw Hill.
2. Mastering AutoCAD – George Omura- BPB Publication.
3. AutoCAD 2004 – Sham Tickoo- Galgotia Publications, New Delhi.
4. AutoCAD 2000 – Devid Frey- BPB Publication.
5. An Introduction to AutoCAD 2000 – A. Yarwood- Longman publication.
6. Using AutoCAD 2000 – Ron House – Prentice Hall.
7. Latest AutoCAD Manual – Autodesk Inc. – Autocad Inc.
8. CATIA V6 Essentials by Jones & Bartlett learning.
9. Inside Catia by Paul Carman, Paul Tigwell.
10. CATIA Tutorials by Nader G. Zamani.
11. ProE/Creoelements or any equivalent reference/text books.

Semester - IV

Course code	Name of Course	TEACHING SCHEME				EXAMINATION SCHEME				Total marks
		L	T	P	C	Theory Marks		Practical Marks		
						TH	TM	TW	PR/OR	
ME401	Strength of Materials	3	1	2	6	75	25	50	-	150
ME402	Manuf. Process-II	3	-	4	7	75	25	50	-	150
ME403	Mechatronics	3	-	2	5	75	25	25	25	150
ME404	Hydraulic Machinery	3	1	2	6	75	25	50	25	175
ME405	Energy conversion	3	-	2	5	75	25	50	25	175
ME406	Engineering Metrology & Quality Control	3	-	2	5	75	25	-	-	100
Total		**18**	**2**	**14**	**34**	**450**	**150**	**225**	**75**	**900**

(ME401) STRENGTH OF MATERIALS

1. RATIONALE:

Machine parts are subjected to various types of loads resulting in development of stresses and strains. If, these stresses and strains are allowed to develop beyond the safe limit, the concerned part may fail. As a technician, it becomes very essential to understand the effects of loads on any part All these factors are focussing the attention of the technicians and engineers for need based designs by studying the effects of loads, stresses and strains in the parts and find necessary solutions. This subject deals with the effect of various forces under static situation & the resulting stresses in different components.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 401 Strength of Material	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	**150**
	3	1	2	6	75	25	-	50	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE:

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Apply the laws of Statics to estimate different types of stresses & strains under different loading situations.***

4. DETAILED COURSE CONTENT

Unit 1	**Simple stress & strain** ▪ Definition of stress & strain. ▪ Tensile & compressive stress & Strain, elastic limit, Hooke's law, Young's Modulus, Stress- Strain curve for ductile & brittle material, Significant points on stress-strain curve. ▪ Thermal stresses in homogeneous sections ▪ Shear load, shear stress & strain, modulus of Rigidity. ▪ Lateral strain & Poisson's ratio. . Volumetric strain, Bulk modulus. Relation between modules of elasticity, bulk Modulus & modulus of rigidity.
Unit 2	**Principal stress & strain** • Different states of stresses, • Normal & Tangential stress on oblique planes, resultant stress. • Principal stresses & principal planes (no derivation) • Analytical method to calculate principal stresses.
Unit 3	**Shear Force & Bending Moment** • Types of beams & supports. • Concepts of shear force & bending moment, sign conventions. Shear force & bending moment diagram for simple cantilever & simply supported beams subjected to point & uniformly distributed load only.
Unit 4	**Moment of Inertia** • Centroid and Center of Gravity • Definition of M.I., radius of gyration, • Perpendicular & Parallel axis theorem. • M.I. of Rectangular, Circular, Semi-circular, Triangular, Hollow rectangular, symmetrical l-section, Channel section, Tee & Angle section.
Unit 5	**Theory of Simple Bending & Columns with eccentric loading** • Concept of pure bending; • Theory of simple bending, neutral axis • Bending stress distribution diagram, • Moment of resistance & application of flexural formula for solid rectangular & circular section, I-section, hollow rectangular & circular section. • Concept of direct & eccentric loads. • Stress distribution in symmetrical columns with eccentric loading about one axis.
Unit 6	**Torsion** • Concept of pure torsion, moment of resistance, • Torsion equation, assumptions in theory of pure torsion, • Strength of circular solid and hollow shaft in pure torsion. • Shear stress distribution • Polar modulus, Power transmitted by shaft.

Note : Question paper will not carry questions on derivation.

5. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS

Unit No.	Unit	Teaching Hours / Semester	Theory Marks Distribution for End Semester Exam			
			R level	U level	A level	Total
1	Simple stress & strain	10	4	4	7	15
2	Principle stress & strain	6	3	3	6	8
3	Shear Force & Bending Moment	8	2	2	10	14
4	Moment of Inertia	8	2	2	6	12
5	Theory of Simple Bending	8	2	4	8	14
6	Torsion	8	2	2	6	12
	Total	**48**				**75**

Legends: *R = Remembrance; U = Understanding; A = Application and above levels*

6. SUGGESTED LIST OF EXPERIMENTS

Sr. No.	Unit No.	Title of Practical
1.	1	Demonstration of working of Universal testing machine (UTM)
2.	1	Tensile test on mild steel, brass and aluminum using UTM.
3.	1	Compression test on wood using UTM
4.	1	Single shear & double shear test on mild steel bars using UTM.
5.	1	Hardness tests on metals. (Brinell, Rockwell test, Vickers)
6.	3	Izod impact test on M.S., Aluminum, Brass
7.	3	Charpy impact test on M.S., Aluminum, Brass
8.	6	Flexural test on mild steel/ wood specimen
9.	7	Torsion test on mild steel specimen

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title	,Publisher
1.	R.S. Khurmi	Strength of materials	S. Chand Publisher, New Delhi
2	S. Ramamurutham	Strength of materials	Dhanpat Rai & sons
3	I.B. Prasad	Strength of materials	I.B. Prasad
4	Bhavikatti	Strength of materials	
5	B.C. Punamia	Strength of materials	
6	Sadhu Singh	Strength of materials	
7	Timoshenko & Gere	Mechanics of Materials	CBS Publisher & Distributors, New Delhi
8	B.P. Sharma.	Laboratory Experiments in Strength of materials	
9	Surya Narayan	Testing of Metallic materials by	
8.		Strength of Materials	Schaum Series
9.	F.L.Singer	Strength of Materials	London Harper & row

(ME402) MANUFACTURING PROCESSES-II

1. RATIONALE

This course provides knowledge and hands on experiences on various operations performed on basic and modern machine tools. In this course emphasis is on making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes, so that they are in a position to undertake the task of preparing jobs using various machines/equipment in the workshop. This experience will help the students to undertake various tasks performed in production industries.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 402	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	
Manufacturing Processes-II	3	-	4	7	75	25	-	50	**150**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency ***Prepare the job as per given specification by selecting and applying appropriate manufacturing processes following safe working procedures.***

4. DETAILED COURSE CONTENT

Unit 1 Capstan and Turret Lathe

Introduction to Capstan lathe and Turret lathe, Principal parts of capstan and turret lathe, Turret indexing mechanism, Bar feeding mechanism, Work holding devices - Jaw and collet chucks, Tool holding devices - Slide tool holder, Knee tool holder, knurling tool holder, recessing tool holder, form tool holder, tap and die holder, box tool holder, bar stops, Introduction to turret tooling layout, Comparison of capstan, turret and conventional lathe.

Unit 2 Milling Machines

Introduction, working principle, types of milling machines like - plain milling m/c. vertical milling m/c. & Universal milling m/c, planer type & fixed bed milling m/c. Milling machine attachments & work holding devices, milling-cutters, milling operations. Universal dividing head-construction & working, Indexing -direct indexing & simple indexing only.

Unit 3 Grinding and Broaching Introduction, grinding machine types, center-less grinding, work holding devices and attachments, types of abrasives, bonds and bonding process, Grit, Grade and structure of wheels, wheel shapes and sizes, dressing & truing of grinding wheels, marking system of wheels, Nomenclature and selection of grinding wheels, mounting of grinding wheels, balancing of wheels. Super finishing operations- Lapping, Honing, polishing. Broaching machines-Introduction & Types. Types of broaches, Broach structure, broaching methods, advantages and limitations.
Unit 4 Planer, Shaper and Slotter Introduction to planer, shaper and slotter, types of planers, principal parts of double housing planer, planer operations, Work holding devices on Planer. Types of shaper, Principal parts of a standard shaper, Shaper drive mechanism, Shaper feed mechanism, Work holding devices on shaper, Shaper operations, Types of slotting mechanism, Slotter parts, Slotter drive mechanism, Slotter operations, work holding devices on Slotter. Cutting tools for planer, shaper and slotter.
Unit 5 Non conventional Machining Processes Introduction and working principle of Ultrasonic Machining (USM), Electro Chemical machining (ECM), Electro Discharge Machining (EDM), Electron Beam Machining (EBM) Laser Beam machining (LBM)

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours	Theory Marks Distribution for End Semester Exam
			Total
1	Capstan and Turret Lathe	10	**15**
2	Milling Machines	10	**20**
3	Grinding and Broaching	12	**15**
4	Planer, Shaper and Slotter	10	**15**
5	Non conventional Machining Processes	06	**10**
	Total	**48**	**75**

6. SUGGESTED LIST OF EXPERIMENTS

S. No.	Unit No.	Experiment
1	*1.*	Observe the operations performed on Turret/ Capstan Lathe in a near by workshop/industry and prepare a report for the same.
2	2.	Produce a rectangular block as per given drawing by face milling and prepare a slot on one face.
3	2.	Produce a gear by indexing device on a milling machine
4	3	Grind lathe tool, drill bit and milling cutter
5	3	Preparing job on following machines:- a) Surface grinder b) Cylindrical grinder
6	4	Prepare a V-block on shaper machine.
7	5	Survey a near by market and prepare a report on cutting fluids and lubricant available in the market for various machine tools
8	6	Compile information from internet related to non conventional machine tools
9		Demonstrate a video film showing non conventional machining processes

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	S.K.Hajara & A.K. Hajra Chaudhary	Elements of Workshop Technology Vol-1& II	Media Promoters and publishers Ltd.
2	W.A.J. Chapman	Workshop Technology, Vol. I & II	Standard publishers Distributors
3	Raghuwanshi	Workshop Technology, Vol.	Latest
4	Kaushik & Gupta	Workshop Technology, Vol. I & II	Latest
5	M. Adithan and A B. Gupta	Manufacturing technology	New Age International (P) Ltd, New Delhi
6	HMT	Production technology	Tata McGraw Publishers; New Delhi

7	Juneja and Sekhon; Wiley	Fundamentals of metal cutting and machine tools	Eastern Ltd., New Delhi

Other learning resources

- Lab Manual on 'Workshop Technology', NITTTR Bhopal, 2006
- Operating Manuals of various equipment/instruments supplied by manufacturers
- Video films on machine tools

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(ME403) MECHATRONICS.

1. RATIONALE:

Rapid development in technology and competitive economy has led to development of new trends in manufacturing industry such as CNC machines, Automation, FMS etc. which consists of combination of mechanical, Electrical and Electronics systems. Diploma engineer in professional life has to operate and maintain systems being developed in the area of mechtronics. In view of this, it is important for him to understand fundamental facts, concepts, principles and application of mechatronics systems which enables him to work as technician to adopt an interdisciplinary approach of engineering while working on shop floor.

2. TEACHING AND EXAMINATION SCHEME:

Course code & Course Title	Periods/ Week (In Hours)			Total Credit	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 403 MECHATRONICS	L	T	P	C	TH	TM	TW	PR/OR	150
	3	-	2	5	75	25	25	25	

Minimum passing % : *Theory 40%* ***Duration of Theory Paper:*** *3 Hrs.*
Legends:

L-Lecture; T - Tutorial; P - Practical; C- Credit; TH- End Semester Theory; TM – Test Marks:

PR/OR - End Semester Practical / Oral Examinations; TW- Term Work

Unit- I–Introduction to Mechatronics

Introduction to Mechatronics, advantages and disadvantages of mechatronics,Traditional V/S Mechatronics Approach,Basic elements of mechatronic system(Block Diagram), Elements of Measurement systems, Control system: Open loop & Closed loop Control system with block diagram and example, Application of Mechatronics.

Unit- II – Sensors and Transducers

Introduction to sensors and Transducers, Difference between sensor and transducer, Performance Terminologyrelated with sensor,(a)Static characteristics -range and span, error, accuracy, sensitivity, repeatability/reproducibility, stability, resolution.(b)Dynamic characteristics-response time, time constant, rise time, settling time.

Working principal and application of following sensors/Transducers : (a)Displacement,position,proximity-Potentiometer, strain gauge, differential transformer (LVDT),eddy current proximity sensor,optical encoder, pneumatic sensor. (b) Velocity and motion-tachogenerator, pyroelectric sensor. (c) force-strain gauge load cell (d) Pressure- Diaphragm

pressure gauge, Piezoelectric sensor, tactile sensor. (e) Liquid flow- turbine meter, orifice plate. (f) liquid level- float, differential pressure. (g) temperature- Bimetallic strip, thermistor,RTD, thermocouple. (h) light- Photodiode.

Factors for selection criteria of sensors, Introduction to smart sensors.

Unit- III – Signal Conditioning, Data Acquisition, data presentation systems

Block diagram ofGeneral Measurement system components, Necessity of signal conditioning, Process of signal conditioning, Mechanical amplification and electrical signal conditioning, Function of Signal Conditioning Equipment, Introduction to DAQ Systems (simple Block diagram and elements of DAQ systems),need for ADC and DAC, Data Signal transmission- introduction to Mechanical, Hydraulic, Pneumatic, Magnetic and electric transmission. General aspects of data presentation/display.

Unit-IV – Actuations Systems

Introduction and Classification of Actuators.

Pnuematic Actuation System: Basic Elements of Pneumatic System

Hydraulic Actuation Systems: Basic Elements of hydraulic system.

Working principal and Graphical Representationof following :

Valves: Direction control valves(3/2 DC Valve, 5/2 DC Valve) actuation methods of DC valves,Non Return valves, Pressure Control valves, Flow control Valves.

Cylinders: Single Acting and Double acting cylinder.

Rotary Actuators: Gear motors and Vane Motors.

Drawing of simple pneumatic circuit using above symbols.

Electrical Actuation systems: Switching devices: Relays, Solenoid type devices: Solenoid valves, Drive systems: Stepper Motor and servo motor. (Brief Working with neat sketches)

Comparison of Pneumatic, Hydraulic, Electric actuators

Unit-V – Microprocessor and Microcontroller

Microprocessor: General aspects: definition and brief description with basic block diagram, characteristics of Microprocessor, features of microprocessor, uses ofmicroprocessor:

Microcontroller: Introduction,characteristics, classification and applications, Basic Block diagram.

Comparison betweenmicroprocessor and microcontroller.

Unit-VI – Programmable Logic Controller (PLC)

Introduction to PLC: Need for PLC, Definition, comparison between PC and PLC, advantages and disadvantages of PLC, PLC sizes, criteria for selection of PLC.PLC system layout (Basic block diagram) architecture of PLC.

Input/output processing.PLC function and operation.

Ladder programming:Concept of Ladder Diagram,sequence of ladder programming, logic functions, use of latching, internal relays, timers, counters.

Elementary level Ladder diagram like motor start and stop,etc.

Unit- VII- Mechatronics Systems

Case studies of Mechatronics systems : Engine Management system, Automatic Washing machine, Automatic camera. (Brief description with sketches)

Introduction to Microelectromechanical Systems (MEMS).

4. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS (THEORY)

Unit No.	Unit	Teaching Hours / Semester	Marks
I	**Introduction of Mechatronics**	3Hrs	06
II	**Sensors and Transducers**	8 Hrs	12
III	**Signal Conditioning, Data Acquisition, data presentation systems**	6Hrs	09
IV	**Actuations Systems**	12Hrs	18
V	**Microprocessor and Microcontroller**	06Hrs	09
VI	**Programmable Logic Controller (PLC)**	10Hrs	15
VII	**Mechatronics Systems**	03Hrs	06
	Total	**48Hrs**	**75 Mks**

5.SUGGESTED LIST OF EXPERIMENTS

1)Experiment on sensor trainer to understand working and application of different Sensors used in Automated System.

Temperature sensor, Pressure sensor, Flow sensor, level sensor, proximity sensor. Force sensor Etc.

2) **Identification, working of different actuating elements using cut section models**

Relay, solenoid valve, stepper motor, servo motors, valves, cylinders etc

3)**Experiment on PLC trainer by developing ladder diagram for following:**

i) Water Level control

ii) Elevator Control

iii) Conveyor Belt control

iv) Traffic Light control

v) Measurement of speed of a motor,etc

4) **Experiment to build any two simple Pneumatic circuit systems in Automation.**

5) **Experiment to build any two simple Electro pneumatic systems in Automation**

6) Demonstration and working of Automatic Process control plant like bottling plant.

or

6)) Demonstration and Working of Automated system like: FMS, AS/RS, Pick and Place robot etc

7). SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title	Publication
1	W. Bolton	Mechatronics	Pearson Education Ltd
2	R. K. Rajput	Mechatronics	S. Chand Publications
3	Pnuematic Controls	Joji P.	Wiley-India Publications
4	James L. Johnson	Introduction to Fluid Power Control	Delmar- Thomson Learning
5	John. W. Webb and Ronald Reis	Programmable Logic Controller	Prentice Hall of India
6	Histand B.H and Alciatore D.G	Introduction to Mechatronics and Measurement systems	Tata- McGraw Hill Publishing
7	Kolk R.A and Shetty D.	Mechatronics Systems Design	Vikas Publishing New Delhi

(ME404) HYDRAULIC MACHINERY

1. RATIONALE

Hydraulic machinery plays an important role in the conversion of hydraulic energy to mechanical energy and vice-versa. Hydraulic turbines are used for meeting our day-to-day power demands. Also different types of pumps are essential equipment in all the industries. Hydraulic systems have a wide range of applications in machine tools, material handling, marine, mining, metal processing, equipment and other fields. Similarly pneumatic control is extensively used as an effective method of automation technique.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 404 Hydraulic Machinery	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	**175**
	3	1	2	6	75	25	25	50	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Select, operate and maintain fluid machinery based on fluid characteristics.***

4. DETAILED COURSE CONTENT

Unit 1 Introduction

Definition and classification of fluids, Branches of hydraulic -Hydrostatics & Hydrodynamics, Fluid properties - Density, Specific gravity, specific weight, viscosity, surface tension, capillarity, compressibility.

Unit 2 Pressure Measurements

SI Units of Pressure, Pressure head, Atmospheric pressure, Positive and Negative Gauge pressure, Absolute pressure , Pascal's Law.

Pressure measuring devices-manometers-principle & working of piezometer tube, simple 'U' tube, differential 'U' tube and inverted 'U' tube manometers, Bourdon pressure gauge-its working principle & constructions, Calibration of pressure gauges.

Unit 3 Hydrostatics

Pressure on plane surfaces immersed in liquid – horizontally, vertically & inclined to free surface, calculation of total pressure and determination of centre of pressure for circular, triangular & rectangular surfaces immersed in one type liquid.

Unit 4 Hydrodynamics

Types of flow - steady; unsteady, - uniform, non-uniform, laminar and turbulent flow, compressible, incompressible flow, Continuity equation. Energies of liquid - pressure head, Datum head, velocity head, Total energy of liquid, Bernoullis theorem — Pitot tube, Venturi-meter. Definition of an orifice, types, Vena contracta, Hydraulic coefficients Cc, Cv and Cd, discharge through an orifice (circular & open discharge). -- No Derivation.

Unit 5 Flow through Pipes

Laws of fluid friction, Reynold's number and it significance, Various losses in pipe flow- major and minor losses- loss of head due to entrance, sudden enlargement, sudden contraction, Hydraulic gradient line and total energy line, Flow through pipes in series and parallel.

Unit 6 Water – Turbines

Classification of water-turbines, Impulse turbines - Pelton wheel, Construction and working of pelton wheel, Definition of heads,

Reaction Turbines- Francis Turbine construction and working, Advantages and Disadvantages of Francis Turbine over a pelton wheel. Propeller and Kaplan turbines – Construction and working, Specific speed of turbines (definition). Performance characteristics of Hydraulic turbines, Main or constant head characteristics curves, Operating or constant speed characteristic curves. Methods of Governing of hydraulic turbines , Cavitation : causes and effects , Water hammer - causes, effect and remedial measures .

(Note- No numerical in this Unit)

Unit 7 Centrifugal Pumps

Introduction, classification, construction & working of a centrifugal pumps, Types of casings, Types of impellers, manometric head of pump, losses and efficiencies of a centrifugal pump, minimum starting speed. Multistage centrifugal pumps, pumps in series, pumps in parallel, specific speed, characteristics of centrifugal pumps, priming of a centrifugal pump, specifications & selection of pumps, NPSH, pump operating procedure, maintenance- faults & remedies of centrifugal pumps.

(Simple problems to calculate Power,Head,Discharge & Efficiency, without Use of Velocity triangle)

Unit 8 Reciprocating pumps Introduction, classification of reciprocating pumps, main components and working of a reciprocating pump, discharge, Single acting reciprocating pump, Double acting reciprocating pump, Air vessels, functions of air vessels, Application as Vacuum pump. (Simple problems to calculate Power,Head,Discharge & Efficiency, without Use of Velocity triangle)
Unit 9 Miscellaneous Pumps, Intensifier and Accumulators Construction, working and application of rotary vane pump, screw pump, Gear pumps. Construction, working and application of hydraulic intensifier and Accumulators. (Note- No numerical in this unit)

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Theory Marks Distribution for End Semester Exam			
			R level	U level	A level	Total
1.	Introduction	02	2	2	-	4
2.	Pressure Measurements	06				8
3.	Hydrostatics	06	8	10	6	8
4.	Hydrodynamics	06	6	6	4	8
5.	Flow through Pipes	06	2	4	6	10
6.	Water – Turbines	07	4	8	6	12
7.	Centrifugal Pumps	07				12
8.	Reciprocating pumps	04				07
9.	Miscellaneous Pumps, Intensifier and Accumulators	04				06
	Total	48	30	38	32	75

Legends: *R = Remembrance; U = Understanding; A = Application and above levels*

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency - ***Select, operate and maintain fluid machinery based on fluid characteristics.***

S. No.	Unit No.	Experiment
1	2	Measurement of pressure of water in a pipe by manometer
2	4	Verification of Bernoulli's theorem
3	4	Flow measurement using Venturimeter and orifice plate
4	5	To determine the relationship between loss of head and velocity for pipe flow
5	6	Performance trial on Pelton wheel
6	6	Performance trial on Francis turbine
7	7	To plot performance characteristics of centrifugal pump
8	7	Assembly dismantling and troubleshooting of centrifugal pump
9	8	Assembly dismantling and troubleshooting of reciprocating pump

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	Khurmi R.S.	A Text book of Hydraulics, Fluid Mechanics and Hydraulic Machines.	
2	Bansal	Fluid Mechanics	
3	Rajput	Hydraulic Machines	
4	Modi P.N./ Seth S.M.	Hydraulic and Fluid Mechanics	
5	Jagdish Lal	Hydraulic and Fluid Machines	

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(ME405) ENERGY CONVERSION

1. RATIONALE

Energy is the ability to do work. Energy of fossil fuels, solar radiation, or nuclear fuels can be converted into other energy forms such as mechanical power through engines- propulsive power or electrical power through alternators or heating to make it useful for our work. Such a transformation of energy from one form to other, is known as Energy Transformation. Often, machines are used to transform energy. The study of the processes and machines is a subject content of Energy conversion. This knowledge is important in design, operation and maintenance of various kinds of mechanical engineering and technological products and processes.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 405 Energy Conversion	L	T	P	C	TH	TM	PR/OR	TW	175
	3	-	2	5	75	25	25	50	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency ' ***Apply principles of energy conversion in production, operation and maintenance of energy conversion equipment in industry or society'.***

4. DETAILED COURSE CONTENT

Unit 1 Blowers & Air Compressors (No numerical**)**

Difference between a blower & compressor. Applications, kinds and construction of blowers. Applications of compressed air in industries. Air compressors-Classification & specification of Compressors. Reciprocating compressor system- construction, working, applications, & maintenance problems (engine/motor, tank, safety valve, pressure control mechanism Single acting and double acting compressors, Single stage and multi-stage compressors Inter-cooling and after cooling, Conditions for maximum efficiency, Volumetric efficiency, Effect of clearance volume, Free air delivered (no derivation of formulae). Working principles, Construction, applications, and maintenance problems

of Rotary Air Compressors- Centrifugal, Axial flow, Vane type, screw compressor.

Unit 2 Internal Combustion (IC) Engines

Importance & applications of IC engines. Classification & specification of an IC engines. Construction of an IC engine. Comparison of SI and CI engines. Air standard efficiencies of Otto cycle, Diesel cycle, and Dual combustion/semi diesel cycle. Construction and working of Petrol engine (two stroke and four stroke). Diesel engine (two stroke and four stroke). Valve timing diagrams for SI & CI engine. I.C. engines systems: Lubrication, Cooling, Ignition system, Starting systems, Petrol Fuel systems (carburetion & MPFI) and Diesel fuel systems. Super-charging and Turbo-charging- purpose, comparison & construction. Calculations of MEP, IP, BP, mechanical and thermal efficiencies, Fuel consumption/specific fuel consumption, Engine performance testing, Heat balance sheet. Common faults and remedies.

Unit 3 Energy Generation Through Power Plants

Types, layout, components and salient features of following power plants:

- Thermal power plant
- Hydro-electric power plant
- Nuclear power plant
- Gas turbine power plant

Unit 4 Solar Energy Based Equipment

Energy form Sun on earth. Applications of solar energy. Construction of Solar energy based equipment- water heater, cooker, solar lamp, room heaters, solar still, vehicles.

Unit 5 Wind & Wave Energy

Wind energy potential, Wind data, Site selection, Vertical and Horizontal type of wind Mills and their construction & working.

Wave energy potential in sea areas, Introduction to methods of converting wave energy into power.

Unit 6 Bio Gas Energy

Biogas energy- potential- Principle of working & construction of simple plant.

5. SUGGESTED LIST OF EXPERIMENTS

S. No.	Unit No.	Experiment
1	1	Determination of indicated power, brake power and mechanical efficiency of air compressor
2	1	Assembly, dis-assembly and trouble shooting of reciprocating type air compressor
3	1	Assembly, dis-assembly and troubleshooting of blower
4	1	Demonstration of screw compressor through field visit
5	2	Assembly and dis-assembly of petrol engines

6	2	Assembly and dis-assembly of diesel engines
7	2	Troubleshooting of I.C. Engines
8	3	Exposure to power plant through field visit
9	4	Guest lecture by experts and demonstration of solar energy based equipment
10	5	Visit to a near by wind mill site to see the construction and operation of wind mill
11	6	Making a model of Bio-Gas plant

Note: In case of non availability of any of the above , CDs on the same can be used as learning resource.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Minimum Teaching Hours per Semester	Theory Marks Distribution for End Semester Exam
			Total
1	Blowers & air Compressors	**12**	**18**
2	Internal combustion (IC) engines	**16**	**24**
3	Energy generation through power plants	**07**	**10**
4	Solar Energy based Equipment	**05**	**07**
5	Wind & Wave Energy	**06**	**10**
6	Bio gas energy	**02**	**06**
	Total	**48**	**75**

Legends: *R = Remembrance; U = Understanding; A = Application and above levels*

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	Patel & Karamchandani	Elements of Heat Engines Vol. I and II	Dhanpat Rai and Sons
2	Ganeshan	I C Engines	
3	srinivasan	Automative engines	
4	M L Mathur & R.P. Sharma	I C Engines	
5	R.S. Khurni	Thermal Engineering	
6	G.D. Rai	Non Conventional source of energy	

Other learning resources-

1. Thermal Engineering, S. Donkundwar
2. power plant engg: S. Donkundwar
3. power plant ENGINEERING: f.t. Morse
4. Thermal Engineering, P.L. Ballaney

(ME406) ENGINEERING METROLOGY AND QUALITY CONTROL

1. RATIONALE

A diploma engineer often comes across varied types of measurements in the actual practice. Measurement plays an important part in the operating environment. Diploma engineer should be proficient in making the measurements of various kinds in different situations. This course is intended to teach the student's facts, concepts, principles and procedures of measurement of different elements of machine at production stage as well as inspection of machine tools so that they can work as an inspector or supervisor in manufacturing system on shop floor effectively and efficiently.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 406	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	
Engineering Metrology and Quality Control	3	-	2	5	75	25	-	-	**100**

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCIES TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Select and use appropriate instrument for accurate measurement, Inspection & Quality control.***

4. DETAILED COURSE CONTENT

Unit 1 Introduction

Definition of Metrology, Need of inspection in industries, Common terminology used such as - Accuracy, Precision, Sensitivity, Magnification, Errors, Sources of errors.

Unit 2 Limits, Fits & Gauges

Definition of Tolerance and Allowance, Types of fits, Hole & shaft basis system of fits. Types of gauges. Taylor's Principle of Gauge design, need for allowances on gauges. Problems on Tolerance calculations. (No numerical in gauge design)

Unit 3 Linear and Angular Measurements

Standards of Measurement, Line and End standards, End and length bars, instruments used for linear measurements such as Vernier caliper, micrometer, slip gauge. Concept of Angular measurement. Construction & working of angular measurement instruments such as- Bevel protractor, Sine bar, Angle gauges, Clinometer, Autocollimator, Angle Dekkor. Concept and need for calibration.

Unit 4 Comparators

Definition of comparator, Classification, Different types of comparators such as- Dial Indicators as Mechanical comparator, Pneumatic comparator, Relative advantages and disadvantages of various types of comparators. Characteristics of good comparator, Working mechanism of dial indicator, requirements of dial indicator, Applications of comparators for checking.

Unit 5 Metrology of Screw threads and gears

Terminology of screw, Error in threads, Measurement of various parameters of screw thread such as major diameter, minor diameter, effective diameter, pitch etc., Effect of pitch errors, Thread measurement instruments - bench micrometer, screw thread micrometer, floating carriage micrometer, tool makers microscope, Optical profile projector for profile testing. Use of pitch gauges. Terminology of Gear tooth, Sources of errors in gear measurement, Measurements of chordal thickness, addendum using gear tooth vernier.

Unit 6 Testing Techniques

Parallelism and measurement of surface finish, Testing of Straightness by sprit level & autocollimator, Flatness testing by optical flats, Squareness testing by dial indicators, Parallelism testing by dial indicator and various cases of parallelism & square ness testing. Circularity testing (Roundness testing) using dial indicator, Methods of measuring surface finish, stylus probe instruments, Tomlinson surface meter, Parameters for surface finish measurements.

Unit 7 Basic Concept of Quality Control

Definition of quality, Quality control, cost and value of quality, concept of quality circle. Introduction to quality circle, TQM, ISO system

Unit 8 Statistical Quality Control

Importance of statistical methods in quality control, attributes & variables, sampling procedures, control charts (X bar & R chart, p chart, c chart)- , OC-curves. Sampling plans- single sampling, double sampling, Concept & Application of six sigma. (Simple numerical on control charts)

5. SUGGESED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Theory Marks Distribution for End Semester Exam (Duration – 3 Hours)
			Total
1	Introduction	03	03
2	Limits, Fits & Gauges	06	09
3	Linear and Angular Measurements	07	12
4	Comparators	06	09
5	Metrology of Screw threads and gears	07	12
6	Testing Techniques	06	12
7	Basic Concept of Quality Control	03	03
8	Statistical Quality Control	10	15
	Total	**48**	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency – ***Select and use appropriate instrument for accurate measurement, Inspection & Quality control.***

S. No.	Unit No.	Experiment
1	**2**	Use of limit gauges such as –Plug, snap, ring, Go-No-Go, thread, taper, thickness
2	**3**	Taper angle measurement using Slip gauges Dial Indicator and sine bar
3	**3**	Use of linear measuring instruments like vernier caliper, vernier depthgauge
4	**3**	Measurement of angles using Clinometer/Bevel Protractor/Auto-collimator/Angle Dekkor/Angle Guages
5	**3**	Use of Dial indicator for measurement of the Dimensions of job

6	**4**	Use of Pneumatic comparators for measurement of Diameter in mass production.
7	**5**	Finding Major/minor/effective diameter of screw thread, using micrometer/tool makers microscope/screw thread micrometer. Use of pitch gauges for screw thread measurement (BS/Metric/ISO)
8	**5**	Finding PCD/effective diameter, Addendum dia, dedendum dia. Chordal thickness of Gear using various instruments available.
9	**5**	Use of optical projector for studying various geometries related to objects like-Gear tooth, Screw threads and other similar items
10	**6**	Use of Stylus Probe instrument /Tomlinson surface meter/Optical flats for measuring surface roughness
11	**7**	Study of procedures adopted in any ISO certified organization
12	**8**	Plotting X Bar and R Charts for given set of data and interpretation of results

7. SUGGESTED LEARNING RESOURCES

S.No.	**Author**	Title of Books	**Publication & Year**
1	R. K. Jain	Engineering Metrology	Khanna publishers Delhi
2	K. J. Hume	Engineering Metrology	The industrial press, New York
3	I.C. Gupta	Engineering Metrology	
4	Beckwith and Buck	Mechanical Measurement	Addison Wesley publishing London.
5	ASTME	Hand book of Industrial Metrology	Practic Hall of India
6		Metrology and Quality Control	Vrinda Publication - Jalgaon

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Semester - V										
Course code	**Name of Course**	**TEACHING SCHEME**				**EXAMINATION SCHEME**				**Total marks**
		L	**T**	**P**	**C**	**Theory Marks**		**Practical Marks**		
						TH	**TM**	**PR/OR**	**TW**	
ME501	Theory of Machines	4*	-	2*	6	75	25	-	25	125
ME502	Refrigeration & Air conditioning	3*	-	2*	5	75	25	25	25	150
CS601	Industrial Organisation & Management	3*	-	-	3	75	25	-	-	100
IT501	Industrial Training	-	-	16	16					GRADE
CS501	Entrepreneurship Development	-	-	2*	2	-	-	-	50	50
Total		**10**	**-**	**22**	**32**	**300**		**125**		**425**

***Workload shall be doubled**

Semester - VI

Course code	**Name of Course**	**TEACHING SCHEME**				**EXAMINATION SCHEME**				**Total marks**
		L	**T**	**P**	**C**	**Theory Marks**		**Practical Marks**		
						TH	**TM**	**TW**	**PR/ OR**	
ME601	M/c Design Practice	4	-	2	6	75	25	25	25	150
ME602	Mechanical Engg. Project	-	-	6	6	-	-	50	50	100
ME603	Industrial Engineering	3	-	2	5	75	25	25	-	125
E2	Elective-II	3	-	2	5	75	25	25	25	150
E2	Institutional Elective/Elective-II	3	-	2	5	75	25	25	25	150
CS602	Business Comm.	-	-	2	2	-	-	50	50	100
Total		**13**	**-**	**16**	**29**	**400**		**375**		**775**

Elective -II

ME611Jigs & Fixtures Design
ME612 Fundamentals of Mat. Handling
ME613 Computer Aided Design & Manufacturing (CAD/CAM)
ME614 Automobile Engg.
ME615 Renewable Energy Sources
ME616 Welding Engg.
ME617Modern Marketing Magmt.
ME618 Safety Engg.
ME619 Maintenance Engg.
ME621 Material Handling Design Concept
ME622 Press Tool Design
ME623 Power Plant Engg.
ME624 Marine Engg.
ME627 Fluid Power Control
ME628 CNC Machines
IE6** Institutional Elective

SEMESTER V

(ME501) THEORY OF MACHINES

1. RATIONALE

This course will enable the student to understand the basic concepts related to mechanism of machines. The number of links transmitting forces and motion comprise mechanisms. These mechanisms are built with the help of linkages, cams and followers, gears, belt drives, etc. The course shall deal with geometry ofthe mechanism as well as with the forces that are acting and transmitting. As a technician, one should have the necessary knowledge and skills about these mechanisms for fabrication and operation. This course deals with different kinds of mechanisms and their applications in practical situation. Laboratory practice will help in developing the requisite skills.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME501 Theory of Machines	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	125
	4	-	2	6	75	25	-	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Apply concepts of kinematics and dynamics to design & fabricate simple mechanisms.***

4. DETAILED COURSE CONTENT

Unit 1 Kinematics of machines

Definition-kinetics, kinematics of machines, scope, purpose and application of machines, Kinematic link or element, kinematic pairs and their classification, degrees of freedom, inversion of single slider crank chain, inversion of double slider crank chain, practical application of quick return mechanisms.

Unit 2 Cams and Followers

Types of cams and followers, Drawing of profile of radial / disc cams with following types of reciprocating followers- i) Knife edge ii) Roller Follower (with offset also) with following types of motions- i) Uniform velocity ii) Simple harmonic motion (SHM) iii) Uniform acceleration and retardation.

Unit 3Flywheel

Piston effort, Crank effort diagram of i) Single cylinder steam engine, ii)four stroke I.C. engine iii) Mechanical Punching press. Flywheel as a energy storage device. Terminology related to flywheel- coefficient of fluctuation of speed, coefficient of fluctuation of energy.

Unit 4 Governors

Function of Governor, difference between Flywheel & Governor. working principle of Centrifugal and Inertia governor. Classification of Centrifugal Governor, Construction and working of Watt and Porter Governor Definitions: 1. Sensitiveness, 2. Stability 3. Isochronism 4. Hunting 5. Governor effort and Power. (No mathematical treatment &numericals)

Unit 5 Bearing and clutch friction

Friction of a screw and nut, Friction in flat collared and pivot bearings; uniform pressure and uniform wear assumptions, power loss due to friction. Types of thrust bearings and power loss due to friction in thrust bearing. Single plate and Multiplate Disc clutch, factors affecting power transmission in clutches. (No numericals in Clutches)

Unit 6 Power Transmission Devices

Belt & Chain Drives

Belt materials, Law of belting, types of belt drive- open & crossed. Calculation of belt length(No Derivation of Formula) , velocity ratio, Ratio of tensions on tight and slack sides for flat and V belts, belt slip and creep, Effect of centrifugal tension on power transmission. Condition for maximum power to be transmitted, initial tension, Determination of cross-sectional dimensions of belt. Introduction to chain drive, types of chains, comparison of belt & chain drive.

Gear and Gear Trains

Introduction, Law of gearing, Types of gears and their selections for different applications, Gear terminology and construction of involute gear tooth-profile, Gear trains- simple and compound, train value.

Unit 7 Brakes & Dynamometers

Definition, classification and comparison of brakes and dynamometers.
Construction and working of brakes: i) Block brakes - single shoe, double shoe, ii) Band brakes, iii) Band and block brake iv) Internal expanding shoe brake, v) Hydraulic and vacuum brakes. Calculation of braking torque, braking force / effort for block brakes and band brakes only.

Construction and working of dynamometers:-Absorption and transmission type, Prony-brake dynamometers, Rope brake dynamometers, Transmission type dynamometers, and Procedure to calculate power transmitted by Rope brake dynamometer.

(No Numerical on Dynamometers)

Unit 8 Balancing and Vibration

Need for balancing, balancing of revolving masses in a single plane. Vibration-Introduction, definition, causes & effects. Types of vibration. Use of vibration pads, shock absorbers, dampers and springs to reduce vibrations. (No numerical on vibration).

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	Kinematics of machines	08	6
2.	Cams and Followers	10	12
3.	Fly Wheel	06	6
4.	Governors	04	6
5.	Bearing and Clutch Friction	10	12
6.	Power Transmission Devices	12	15
7.	Brakes & Dynamometers	10	12
8	Balancing and Vibration	04	6
	Total	64	75

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency - ***Apply concepts of kinematics and dynamics to design & fabricate simple mechanisms. (Any Six of the below)***

S. No.	Unit No.	Experiment
1	1	Mini project on inversions of kinematics chains such as four-bar mechanism, single and double slider crank mechanism.
2	2	Drawing sheet based on construction of cam profile, (any 3 problems) by graphical method.
3	4	Demonstration of working of any one type of centrifugal governor
4	6	Understand a single plate disc clutch through assembly and disassembly of a disc clutch unit .
5	6	Measurement of brake power by using mechanical dynamometer
6	6	Prepare a drawing on construction of involute gear tooth profile
7	6	Exposure to power transmission systems through Industrial Field visit
8	6	Measurement of Slip and Creep in belt drive.
9	8	Drawing sheet based on graphical solution of on balancing of masses in single plane.

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	R.S Khurmi and J.K Gupta	Theory of Machines	Eurasia Home
2	S. Rattan	Theory of Machines	TATA MCGRAW HILL
3	Thomas Bevan	Theory of Machines	C.B.S. Publishers
4	P.L.Ballaney/	Theory of Machines	Khanna Publishers
5	Shah and Jagadishlal	Theory of Machines	Metropolitan book Co. Pvt.Ltd.
6	J.E. Shigley	Theory of Machines	Mcgraw Hill
7	P.C. Sharma ,Purohit	Theory of Machines	PHI

(ME502) REFRIGERATION & AIR CONDITIONING

1. RATIONALE

Refrigeration and air conditioning is a specialized area and is of prime importance in today's context.. Refrigeration & air-conditioning is one of the most important and specialised branch of mechanical Engg. This course provides basic knowledge and skills to the students in the area of refrigeration, principle of refrigeration systems, refrigerants, air conditioner, their types, principle and working.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME502 Refrigeration &Air conditioning	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***' Use principles of refrigeration, ventilation & air conditioning for production, erection, operation and maintenance of refrigeration & air conditioning equipment'.***

4. DETAILED COURSE CONTENT

Unit 1Fundamentals of Refrigeration

1) Definition of Refrigeration, unit of Refrigeration & Coefficient of Performance
2) Standard rating of a refrigeration machine (1TR).
3) Types of Refrigeration systems (Brief Classification).

Unit 2Refrigerants

1. Classification of refrigerants. 2. Designation of refrigerants.

2. Desirable properties of refrigerants.

3. Properties, uses and Applications of commonly used refrigerants like R-22, R 134 –A and Ammonia.

4. Effect of Refrigerants on Environment:- Ozone depletion & Global warming.

Unit 3Simple Vapour Compression Refrigeration (VCR) System

1) Schematic layout & working of VCRs.
2) Functions of components of vapour compression system.
3) Representation of vapour compression cycle on (T-S) and (P-h) diagram.
4) Determination of theoretical & actual COP of VCRs.
5) Factors affecting the performance of vapour compression system
6) Applications of vapour Compression System.
7) Cascade system of refrigeration: introduction & application.

Unit 4Vapour Absorption Refrigeration System

1. Schematics layout & working of vapour absorption system.
2. Functions of components of vapour absorption system.
3. Electrolux refrigerator construction and working.
4. Applications of vapour absorption system.

Unit 5Refrigeration Components

1. Construction, working & Applications of Hermetically-sealed compressor, open type compressor, screw compressor, scroll, and centrifugal compressors.
2. Condensers: Types- air & water-cooled, Shell & tube, Evaporative.
3. Cooling towers, and spray ponds.
4. Expansion Devices: Thermostatic expansion valve, Capillary tube, Low – side & high side floats valve.
5. Evaporators- Types- Flooded & dry expansion, bare tube, plate & tube, finned tube.
6. Defrosting.

Unit 6Psychrometrics

A. Definition of Pscychometry, Psychometrics, Purpose of air conditioning.
B. Psychometrics of air: Definitions of i) Dry air, ii) Moist air, iii) Saturated air, iv) DBT, v)WBT, vi) DPT, vii)Specific humidity, viii) relative humidity, ix)wet bulb depression x)Dew point depression xi)Enthalpy of Moist air
C. Construction & working of sling psychrometer.
D. Reading properties of moist air from Psychrometric charts.

Unit 7Psychrometric Process

A. Description and representation of following psychrometric processes on psychrometric charts:
Sensible heating, Sensible cooling, humidification, dehumidification, Cooling and dehumidification, Cooling and humidification, Heating and dehumidification, heating & humidification, Mixing of air streams.

B. Simple numerically to be solved by using Psychrometric charts for above processes.
C. Definition of sensible heat factors such as RSHF & GSHF.

Unit 8Air Distribution 1 Air handling unit- Construction and Working. 2.Room Air Distribution: Requirements of good room air distribution, Draft, Types of supply air outlets. 3. Duct system: Layout & description, Perimeter, loop, extended plenum systems.
Unit 9Air Conditioning Systems: **Construction, working & application** i) Window Air Conditioner ii) Split type A/C system iii) Centralised A/C System. 2) Air conditioning control: temperature control, Air movement, and humidity control.

5. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS

Unit No.	Unit	Teaching Hours / Semester	Total Marks
1	Fundamentals of Refrigeration	3	6
2	Refrigerants	4	6
3	Simple Vapour Compression Refrigeration (VCR) System	8	12
4	Vapour Absorption Refrigeration System	6	9
5	Refrigeration Components	6	9
6	Psychrometrics	6	9
7	Psychrometric Process	5	9
8	Air Distribution	4	6
9	Air Conditioning Systems	6	9
	Total	**48**	**75**

6. SUGGESTED LIST OF EXPERIMENTS

Minimum six of the following experiments to be conducted.

Sr. No.	Title of Practical
1	Identification, use & functions of various components of a vapor compression refrigeration system.
2	Identification and use of various tools and equipments in maintaining Refrigeration systems involving operations like cutting, bending, swaging, flaring, pinching & brazing.
3	Determination of C.O.P. of a Refrigeration System Test rig
4	Dismantling/Assembly of Hermetically Sealed compressor to understand the construction.
5	Dismantling/Assembly of an Open Type compressor to understand the construction.
6	Fault finding and trouble shooting under Routine Maintenance of any one of the following Refrigeration Equipment (use of trouble shooting chart system recommended): a) Domestic Refrigerator. b) Storage type water cooler. c) Cold Storage. d) Ice Plant
7	Carry out refrigerant charging of a Refrigeration System.
8	Demonstrations of various Psychrometric processes on a Test-Rig
9	Identification of various parts of following Air-condition System. i) Window ii) Split iii) Package/Central (Field Visit)
10	Installation and Routine maintenance of Window/SPLIT Air-conditioner.
11	Estimate Cooling Load of a Classroom/Office /Laboratory following industrial practices (with the help of guest faculty/Industrial expert).
12	Data collection of various Refrigeration and Air/conditioning equipment from the market so as to provide their specification.

7. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1	R.K. Rajput	Refrigeration and Air conditioning (S.I) units)	, S.K. Kataria& Sons, Delhi-11006
2	Domkundwar&Arora	Refrigeration & air conditioning	Dhanpatrai and sons
3	C.P. Arora	Refrigeration & air conditioning	Tata McGraw Hill Pub.
4	P.N. Ananthnarayan	Basic refrigeration & air conditioning	Tata McGraw Hill Pub.
5	P.L.ballaney	Refrigeration & air conditioning	Khanna Publishers

Other learning resources-

- Refrigeration tables & charts & air conditioning data- Kothandaraman, C P
- **Handbook of Air Conditioning and Refrigeration, 2e (PB)**

Field Visits:

1. Visit to cold storage,
2. Visit to 5 star hotels,
3. Visit to Goa dairy.
4. Visit to Telephone Exchange.

(CS601) INDUSTRIAL ORGANISATION AND MANAGEMENT

1. RATIONALE

When a diploma pass out will start working in the wok place in any office or shop floor, he /she has to perform work or get work done from subordinates on day to day basis as well as for ongoing week or month. This performance has to be very efficient and effective in order to achieve the set goals. The work performance demands proper manaegement of all kinds of resources (money, material, men, machines, methods, time) for achievement of goals. This management has a science part as techniques of planning, organising, directing &controlling. It has an art part, how well these techniques are applied to get the desired results. The student should have a good knowledge of art & science of management, so that he is able to motivate himself & others to work.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CS601 Industrial Organisation and Management	L	T	P	C	TH	TM	PR/OR	TW	100
	3	-	-	3	75	25	-	-	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency **– *' Use principles of industrial management in production, operation & maintenance of mechanical components & systems'.***

4. DETAILED COURSE CONTENT

Unit 1 Business Organisation

Types of business organizations: Individual Proprietorship Organisation, partnership organization, Joint Stock Companies : Private Ltd and Public Ltd , Co-operative societies, Public sector Organisation

Structure of business organization: Line Organisation, Functional Organisation , Line and staff Organisation, Project organization

Unit 2 Business Management

Functions of management: Concept of management and administration, management as an art and science, evolution and growth of scientific management- contribution of F.W Taylor, management functions such as forecasting, planning, organizing, directing, communicating, controlling, co-ordinating, motivating, guiding, counseling and decision- making.

Functions in Industry: Procuring, store- keeping, inventory control, material handling, manufacturing or production, supervision, quality assurance, packing and forwarding, marketing- sales promotion, research and development, supervisory skills. Introduction to ISO.

Unit 3 Financial Analysis

Finance: Introduction, sources of finance, important financial statement such as profit and loss, balance sheet and cash flow.

Cost Concepts: Introduction, necessity of costing, elements of cost- direct and in direct, variable and fixed, prime cost, overhead cost, total cost, marginal costing, break- even chart analysis, angle of Incidence.

Materials management: Economic Order quantity, reordering system, base stock and lead time, inventory valuation , ABC Analysis

Definition of Budget and Budgetory control

Depreciation: Methods of calculating depreciation charges : Straight Line Method , Sinking Fund Method, Diminishing Balance Method.

Obsolescence- definitions and reasons.

Unit 3 Personnel Management

Functions of Personnel Department: Human resource Planning, selection and recruitment, training and placement, promotion and transfer, motivation and morale of workers, welfare of employees.

Industrial Relations: Relations with Individual worker, relations with unions, relations with government, settlement of disputes of employees, collective bargaining, conciliation, arbitration, grievance handling mechanism, domestic inquiry.

Wages and Incentives: Types of wage plans – Time rate and piece rate, characters of good

wage plan, incentive – objectives and advantages, character of good incentive plan, individual and group, incentive plan, difference between incentive and wage.

Unit 4 ***Industrial Acts and Taxes***

Introduction to Following Industrial Acts:

Industrial Disputes Act 1947/1956;

The Indian Factories Act 1948

The Workmens Compensation Act 1923;

Introduction to sales tax, Custom and excise duty , VAT.

Unit 5 ***Project Management : Network Analysis***

(Introduction to basic concepts with simple problems)

PERT- Programme Evaluation and Review Technique: Definition, network diagrams, advantages.

CPM- Critical Path Method: Definition, finding critical Path, advantages, Comparison of PERT and CPM.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Minimum Teaching Hours per Semester	Total Marks
1	Business Organisation	**6**	**9**
2	Business Management	**10**	**15**
3	Financial Analysis	**13**	**21**
4	Personnel Management	**10**	**15**
5	**Industrial Acts and Taxes**	**4**	**6**
6	**Project Management** **Network Analysis**	**5**	**9**
	Total	**48**	**75**

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication & Year
1.	T R Banga , S.C. Sharma	Industrial organization & Engineering Economics	Khanna Publishers Latest
2.	O.P. Khanna	Industrial engineering & management	Khanna Publishers
3.	Awate, Chunawala, Bhandarkar, Shrinivasan	Industruial Organisation & Management	Latest
4.	M.C. Shukla	Bussines Organisation & management	Latest
5.	M. Mahajan	Industrial Engineering & Production Management	DhanpatRai& co.
6.	O.P. Khanna	Industrial engineering & management	Khanna Publishers
7.	Satya saran Chatterji	Modern Business- Organisation & Management	Latest

(IT501) INDUSTRIAL TRAINING

1. RATIONALE:

Industrial Training is a newly introduced component, in the curriculum under Revised Semester Pattern system for all 03 year Diploma Programmes. It is a Training programme designed to expose & prepare the students for the Industrial work situation. This exposure and hands on experience, will further enhance the prospects of student fraternity to be better placed on completion of their course.

2. TEACHING AND EXAMINATION SCHEME

Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory		Practical		Total
IT501 INDUSTRIAL TRAINING	L	T	P	C	TH	TM	PR/OR	TW	Grade
	-	-	16	16	-	-	30	70	

Minimum passing %: 40%

Legends:
PR/OR *-End Semester Practical / Oral Examinations;* ***TW-*** *Term Work*

3. DETAILED COURSE CONTENTS

Students are required to study and have hands-on experience wherever possible in the following areas (depending on availability):

1. Company Profile
2. Organizational Structure
3. Company Product Range
4. Manufacturing Facilities Available /Services provided
5. Plant / Facility Layout
6. Operations / Production Processes
7. Production Planning and Control
8. Detail study of Latest Equipment/ Technologies Used
9. Stores Functions
10. Material Handling Systems/ Equipments
11. Quality Management Systems / Functions
12. Maintenance and Repair Practices
13. Safety Practices / Safety Equipments
14. Utilities
15. Logistics
16. Sales and Marketing
17. Ethics, Statutory Rules and Regulations followed
18. Product Design and Development
19. Any other area specific to the Industry providing Training

4. TERM WORK & PRACTICALS

Evaluation Scheme					
TW				PR/OR	TOTAL Marks
Attendance Marks*	Industrial Mentor's assessment Marks	Institute Mentor's assessment Marks	Training Report	Report Assessment &Seminar/Viva	
10	20	20	20	30	100

* 01 mark shall be deducted for every Absence (with or without permission).

Daily Dairy

The daily dairy should-be maintained in a book. It should reflect the day to day activities performed by the student (including task, men and materials involved). It should be counter signed by the Industry Mentor. It will become the basis for writing reports on the complete training.

Training Report

The training report should be submitted by the training students should include the following salient points- Certificate from institute, Certificate of training from company, detailed write up as per daily dairy, detailed drawings, working drawings, photographs, safety precautions, techniques for work minimization on site, organizational chart, Importance of project to the society, special methods/techniques/equipment should be separately high lightened, including environmental aspects. The report should be informative and technical, typed with double spacing on good quality bond paper and bound.

Assessment of Training Report be based on Knowledge, Presentation, Quality of contents and Sketches.

Note :

a. Student/s undergoing Industrial Training shall follow Rules and Regulations of the Industry.
b. Industrial Training will generally be organised and conducted in accordance with Industrial Training Manual duly prescribed by the Board.

5. SUGGESTED SPECIFICATION TABLE WITH MARKS & HOURS (THEORY)

Unit No	Name of the Unit	Teaching Hours	Marks
1	PR/OR	08 Weeks	30
2	TW		70
	Total	**08 Weeks**	**100**

Note:

1. For Industrial training Grades will be awarded based on marks scored as follows:

80% and above Marks – Grade 'A'
60% to 79% Marks – Grade 'B'
40% to 59% Marks – Grade 'C'
Marks below 40% - Grade 'D'

2. TW and PR/OR shall be separate Heads of passing. Student has to secure minimum Grade'C' for passing.

(CS501) ENTREPRENEURSHIP DEVELOPMENT

1. RATIONALE

The course on Entrepreneurship Development focuses on creating awareness regarding entrepreneurial traits, entrepreneurial support system, opportunity identification, project report preparation and understanding of legal and managerial aspects related to setting up of enterprise. This can be helpful in motivating technical students to start their own small-scale business/enterprise.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
CS501 Entrepreneurship Development	**L**	**T**	**P**	**C**	**-**	**-**	**PR/OR**	**TW**	50
	-	-	2	2	-	-	-	50	

Minimum passing % Practical 40%

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Prepare a detailed project report for an identified product/service.***

4. DETAILED COURSE CONTENT

Unit 1:Introduction (7 Hours, 12 Marks)

Meaning of entrepreneurship, need in the present scenario, definition of an entrepreneurship, qualities of an entrepreneur, functions of an entrepreneur, risks and rewards of entrepreneurship.

Definition of Micro, Small And Medium Enterprises (MSME).Classification of Micro, Small And Medium Enterprises (MSME). Types of Enterprises - manufacturing, service and franchisee.

Unit 2:Forms of Business Organisation (2 Hours, 9 Marks)

Main features of Sole Proprietorship, Partnership, Private Limited Company, Public Limited Company, Co-operative Society.

Unit 3:Entrepreneurial Support System (6 Hours, 9 Marks)

Central Government Agencies: Functions of Small Industries Development Bank of India(SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC), Micro, Small And Medium Enterprises -Development Institute (MSME- DI), Technology Business Incubator (TBI), Khadi& Village Industries Commission (KVIC).

State Government Agencies: Functions of District Industries Centre(DIC), Goa Industries Development Corporation (GIDC), Economic Development Corporation (EDC), Financial Institutions-Banks, Goa Handicrafts and Rural Small Scale Industries Development Corporation (GHRSSIDC), Rural Development Agency (RDA), Khadi and Village Industries Board (KVIB).

Unit 4: Business Opportunity Identification(7 Hours, 6 Marks)

Evaluation of business opportunity:- selection of industry, initial prospects study, product marketing concept, decision to proceed, feasibility study, project evaluation.

Unit 5: Market Research (6 Hours, 12 Marks)

Definition of demand, factors affecting demand, law of demand,demand curves

Definition of supply, factors affecting supply,law of supply, supply curves.

Preparation of questionnaire. Data collection for setting up a small enterprise.

Unit 6: Legal Aspects (4 Hours, 9 Marks)

Procedure of registration of Micro, Small And Medium Enterprise (MSME), meaning and registration of Value Added Tax(VAT), Service Tax, PAN. Slabs of Income tax.

Unit 7: Project Report (16 Hours, 18 Marks)

Need for project report, importance of Project report,

scope of project report:Economic aspects, technical aspects,financial aspects, managerial aspects, production aspects.

List the contents of a project report.

Proforma of a project report which includes:-Introduction,scheme, profitability and projections, infrastructure, break- even point, names and addresses of suppliers, remarks.

Project Profile.

Project appraisal criteria:- technical feasibility, financial feasibility, economic viability, commercial viability, managerial competency, political and labour considerations.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	MARKS
1	Introduction	7	12
2	Forms of Business Organisation	2	9
3	Entrepreneurial Support System	6	9
4	Business Opportunity Identification	7	6
5	Market Research	6	12
6	Legal Aspects	4	9
7	Project Report	16	18
TOTAL		**48**	**75**

6. MANDATORY ASSIGNMENTS

1. Preparation of a Case Study on leading entrepreneurs of Goa. (To be taken while conducting Unit 1)
2. Preparation of a Case Study on leading entrepreneurs of India. (To be taken while conducting Unit 1) Unit 1)
3. Filling of template of “Business Model Canvas”
4. Prepartion of Project Profile.
5. Preparation of Project Report.

7. SUGGESTED ACTIVITIES:

1. Visits to related departments (DIC,Banks,Tecnology Business Incubators, MSME-DI, NSIC, KVIC, KVIB).
2. Study visits to industries.
3. Organise entrepreneurship related event / activities.
4. Organise lectures/seminars with successful entrepreneurs.
5. Organise brainstorming sessions on ideation.
6. Establish an Entrepreneurship Development Cell.

8. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Year of Publication
1.	*Sharadjawadekar, shobhadodlani,*	*Business entrepreneurship*	*Suvicharprakashanmandalpune,*
2.	*S.S. Khanna*	*Entrepreneurship development*	*S. Chand & Co. Ltd, New Delhi,*
3.	*Vasant Desai*	*Management of small Scale Industry in India*	*Himalaya Publishing House*
4.	*DilipSarwate*	*Entrepreneurial development Concepts and practices*	*Everest Publication House, Pune*
5.	*CB Gupta and P Srinivasan*	*Entrepreneurship Development*	*S. Chand and Sons,* *New Delhi*
6.	*PM Bhandari*	*Handbook of Small Scale Industry*	

SEMESTER VI

(ME601) MACHINE DESIGN PRACTICE

1. RATIONALE

Mechanical engineer/ technicians should posses the knowledge of production design & maintenance. In order to perform the jobs in this area he should have the through understanding of the working principles of the machine parts. The machine elements are subjected to forces and stresses; therefore machine parts should be designed to function for a long period of time without wear and tear. Through this course the students are introduced to simple design of the machine elements like the fasteners, coupling, levers, spring, bearing, etc. While designing data book, design handbook, etc. is to be referred so that the design is economical.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME601 Machine Design Practice	L	T	P	C	TH	TM	PR /OR	TW	150
	4	-	2	6	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 04 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Design simple machine elements like fasteners, shafts, couplings etc., for given conditions.***

4. DETAILED COURSE CONTENT

Unit 1 Introduction

General procedure in machine design, General consideration in machine design, use of machine design data handbook, standardization.

Fundamentals

Types of external loads, concept of stress, strain, stress strain diagram for ductile and brittle materials, proof stress. Types of stresses induced: Tensile, compression, shear, bearing pressure intensity, crushing, bending, and torsion. Creep and fatigue strength, Endurance limit. Factor of safety, general consideration in selecting factor of safety. Theories of failures.

Unit 2 Design of simple machine parts.

Design of machine parts subjected to direct and bending stresses such as C-clamp, offset link. Design of simple machine parts like cotter joint, knuckle joint, bell crank lever, arms of pulleys, bearing cap.

Unit 3 Design of Shafts, keys and couplings.

Design of shafts: Types shafts, shaft materials, standard sizes, design of solid and hollow shaft based on strength and rigidity criteria. Design of line shafts with one pulley or two pulleys in between two bearings.

Design of keys: Design of sunk key, effect of keyways on strength of the shaft.

Design of couplings:

Design of muff coupling, Design of rigid flange coupling.

Unit 4 Design of fasteners:

Design of screwed joints: stresses in screwed fasteners, bolts of uniform strength, design of bolted joint subjected to eccentric loading (max 4 Nos of bolts).

Design of welded joints:

Design of parallel and transverse fillets welds, axially loaded symmetrical section.

Design of welded joint subjected to eccentric loading.

Unit 5 Design of Power screws

Thread profiles used for power screws, torque required to overcome thread friction ,self locking and overhauling condition, efficiency of power screws.

Design of screw jack (Nut and screw and handle Only)

Unit 6 Design of springs

Classification, application and function of springs, materials used for spring, spring terminology, wahl's stress correction factor, stresses and deflection in spring. Design of Helical compression spring with circular cross-section . Energy stored in a spring, leaf spring design and construction.

Unit 7 Antifriction bearings

Types of bearings, sliding and rolling contact bearing and their comparison, terminology: life; load relationship, basic static load and basic dynamic load.

Selection of bearing from the manufacturers catalogue. .

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	**Introduction**	8	9
2.	**Design of simple machine parts.**	12	12
3.	**Design of Shafts, keys and couplings.**	15	21
4. 5.	**Design of fasteners** **Design of Shafts, keys and couplings.**	12	12
6.	**Design of Power screws**	6	6
7.	**Design of Springs**	8	12
8.	**Antifriction Bearings**	3	3
	Total	**64**	**75**

6. SUGGESTED LIST OF PRACTICALS

The Term work shall consists of the record of the following design assignments in the form of Journal & design sheets .

S. No.	Unit No.	Title
1	2	Socket and Spigot Cotter Joint **or** Knuckle Joint.
2	3	Shaft with one or two Pulleys, intermediate
3	3	Rigid Flange Coupling.
4	6	Mechanical Screw Jack.
5	-	Solid Modeling of any simple machine component using any one CAD software like AUTOCAD , Pro-E, CATIA, UNIGRAPHICS, SOLID

		EDGE, SOLID WORKS, etc.

7. **SUGGESTED LEARNING RESOURCES**

S.No.	Author	Title of Books	Publication & Year
1	R.S.Khurmi. and J.K.Gupta	Machine Design	S Chand
2	P.L. Ballaney	Machine Design	Dhanpathrai& sons Delhi
3	Pandya and Shah	Machine Design	Charotar publishing house, Anand
4.	V.B Bhandari	Design of machine elements	Tata Mc-Graw Hill
5.	G.R.Nagpal	Machine Design	Khanna Publishers

Other learning resources

- Different types of machine parts/components.
- Wooden cut section models of machine parts/components.
- Production drawings from industries.

(ME602)MECHANICAL ENGINEERING PROJECT

1. RATIONALE

After knowledge of various mechanical engineering subjects, it is time to learn the application of this knowledge to real life situations by study, analysis and modification of prevalent processes and machines, equipment or instrument, design simple mechanical systems, identify, define & solve problems, make new products, etc. This may be done individually or in groups. This is known as Project work. Thus, it is a purposeful time bound student activity to accomplish higher level cognitive, psychomotor and affective domain learning.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME602 Mechanical Engineering Project	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	100
	-	-	6	6	-	-	50	50	

Minimum passing % : Practical 40%

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Able to carry out critical study, find areas of improvements, suggest/carry out modification, design or make a component, assembly, machine, equipment, system or process to meet desired needs within realistic constraints such as economic, environmental, social, manufacturability and sustainability.

4. AREAS OF PROJECT

1. Product modification- any part, machine or equipment may be studied for its operating controls, energy usage, work performance in order to improve its performance, reduce cost, save energy, increase output, improve any other quality parameters, etc.

2. Process Modification- any process in industry, commercial orgnisation or service sector may be studied for its sequence of activities, man power deployment, operating expenses, energy usage, work performance in order to improve its performance, reduce cost, save energy, increase output, improve any other quality parameters, etc.

3. Lay out Modification- The arrangement of facilities in industry, commercial orgnisation or service sector may be studied for its usefulness in terms of movements of materials, men, operation & maintenance, etc in order to improve its performance, reduce cost, reduce transportation costs, increase production, improve any other quality parameters, etc.

4. Plant modification- Study of a plant and its accessories in order to improve efficiency, reduce down time, increase production, improve any other quality parameters, etc. The plant may of any industry- Ice Plant, Cold storage, Milk Dairy, Mineral water, food processing, ore processing, water filtration, air conditioning, ventilation, etc.

5. Make new part, mechanism or product- use creative ideas to make new object by using available materials, tools, equipment, etc in order to reduce price, work performance, energy efficiency, etc.

6. Make a new / modified part design or drawing with 3D modelling in computer soft ware using any design software.

Guidelines-

1. As far as possible, each student should do the project work independently. However, group work could be considered based on the quantum of work or interdisciplinary work involving electrical, civil, electronics, computer areas, etc.
2. The Teacher should guide students in selection of project.
3. The Teacher assigned with project work of students should monitor the progress at a regular interval of time, so that work is completed in time.

5. TW : TERM WORK ASSESSMENT

stage	Topic	Total marks
1	Selection area of project	**5**
2	Literature survey, study of component, equipment, machine, plant, layout, etc.	**5**
3	Defining problems, setting goals.	**10**
4	Generating alternatives	**5**
5	Developing a useful solution	**10**
6	Testing a useful solution for feedback	**5**
7	Report writing	**10**

stage	Topic	Total marks
	Total	**50**

6. PR/OR : END SEMESTER PRACTICAL

stage	Topic	Numbers
1	Importance & relevance of topic for industry & society	**5**
2	Extent of Literature survey, study of component, equipment, machine, plant, layout, etc	**5**
3	Whether problem have been defined properly	**10**
4	Satisfactory Development of solution	**10**
5	Testing of solution	**5**
6	Report writing	**15**
	Total	**50**

(ME603) INDUSTRIAL ENGINEERING

1. RATIONALE

Any technician comes across various problems in a manufacturing industry. Production planning and control are one of the basic activities that determine the effectiveness of production enterprise. Technician engaged in various industrial areas should therefore have basic knowledge of various industrial engineering techniques for achieving the best results. The optimum use of resources requires the knowledge of Industrial Engineering. The course is designed to develop in the student the necessary competencies to apply principles of work study in selecting the most economical method for executing work resulting in reduction of wastages and manufacturing cost.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME603 Industrial Engineering	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	125
	3	-	2	5	75	25	-	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency **– ' *Use principles of industrial Engineering in production, operation & maintenance of mechanical components & systems'*.**

4. DETAILED COURSE CONTENT

Unit 1 ***Process Engineering***

Concept of process engineering:Functions of process Engg.

General manufacturing process,

Product Engg Process planning and selection, Operation planning

Process Planning : Concept of process planning, factors affecting planning such as size and form of material

Processing method, Assembly process, Assembly charts.

Machine Capacity and Selection: Concept ofcapacity, individual machine capacity, plant capacity, balancing plant capacity

Relationship between process and m/c selection, basic factors in selection of machines, selection among alternatives.

Unit 2 Production Planning and control

Need for PPC, effect and Advantages

Functions of PPC such as planning, scheduling, routing, dispatching , expediting ,inspection and evaluation.

Unit 3 Production Systems

Types of production, Classification of production system : job, batch , mass and continuous.

Unit 4 Plant Layout

Objectives of plant layout, principles of plant layout, advantages of plant layout, factors influencing plant layout.

Types of plant layout: Product, Process, combination (Mixed) , Fixed position layout.

Unit 5 Productivity

Definition, productivity measures: Partial and Total productivity, Productivity measurement, advantages and limitation of productivity measures, important, factors influencing productivity.

Unit 6 *Work Study*

Concept of work study means to increase productivity.

Purpose of work study, Work study techniques.

Work study procedure, Roles played by diff. cadres in work study.

Unit 7 Method study

Definition of method study, Objectives of method study. Steps involved in method study.

Method study symbols, Method recording techniques : charts – Operation Process charts , Flow process chart ,Two handed process chart, Multiple activity cart, Diagrams- Flow diagram

micro motion study – Steps in micro motion study, Therbligs.

Principles of motion economy.

Unit 8 Work Measurement

Definition, Objectives of Work measurement, Techniques of work measurement, steps in time study, Time study equipments, selection of worker for Work measurement

Performance rating and computation of standard time, basic time and allowances,

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Minimum Teaching Hours per Semester	Total Marks
1	***Process Engineering***	**8**	**12**
2	***Production Planning and control***	**4**	**9**
3	***Production Systems***	**3**	**6**
4	***Plant Layout***	**6**	**9**
5	***Productivity***	**4**	**6**
6	***Work Study***	**5**	**9**
7	***Method Study***	9	12
8	***Work Measurement***	9	12
	Total	48	75

Suggested list of Practicals

1. A problem on line balancing and plant capacity.

2. Field Visit to Industry for studying plant layout.

3. Measurement of standard time for any activity in institute.

4 Construction of two handed Process chart taking a particular case study.

5. Construction of any Other time study recording technique chart taking a particular case study.

6. Process Improvement using Work study (Case Study)

7. Power point Presentation on "Ergonomics".

6. SUGGESTED LEARNING RESOURCES

S.No.	Author	Title of Books	Publication
1	MartandTelsang	Industrial engineering & Production management	S. Chand Publishers
2	O.P. Khanna	Industrial engineering & management	Khanna Publishers
3	M. Mahajan	Industrial Engineering & Production Management	DhanpatRai& co.
4	Suresh .Dalela	work study and Ergonomics	Saurabh Publisher
5	E. J Riches	Introduction to Work study	ILO

(CS602) BUSINESS COMMUNICATION

1. RATIONAL :

The course on Business Communication will help in development of speaking, listening, writing, and reading skills in students, with special reference to business environment like writing business letters, notes, reports, documents, holding meetings and discussions, working in groups, etc. . Special provision has been made for language workshops where the communication skills of the students can be enhanced.

2. Teaching and Examination Scheme:

Course Code & Course title	Periods per week in hours			Total credits	Examination scheme				
					Theory Marks		Practical Marks		TOTAL Marks
	L	T	P	C	TH	TM	PR/OR	TW	
CS602 Business Communication	-	-	2	2	-	-	50	50	100

3. Competences to be developed through this course:

The course content should be taught and implemented with the aim to develop different type of skills leading to the achievement of the competency "Communicate effectively in given Business situations''.

4. Detailed Course Content :

	Unit 1.1: Communication Skills in the work place Communication within the organizational, Types of communication, functions of Internal & external communications Definition, components, importance of effective communication skills, types- verbal-non verbal, methods and hints to improve communication skills, body language, Précis and comprehension
	Unit 1.2: Modern Office technology for communications: Using technology and internet to **obtain** information about suppliers, their credibility, latest specification of items, contacting people, quick feedback, social networking, skype, whatsapp, spell check, **dissemination** of information, send email to staff, paperless office, etc
	Unit 2.1: Seminars Objectives, topic selection, audience, structure, tips for good beginning and end, aids to presentation.
	Unit 2.2: Project work: A link between the theory and the practical Tips: Narrow down to the topic, specific not vague, data collection, structure, critical thinking and analysis.

Unit 3.1 : Report writing: Understanding Objective and Subjective report writing (i)Feasibility report: Definition, types, economic feasibility, technical feasibility, definition. (ii) Trouble Report: Purpose, instances when trouble reports are written, procedure followed in writing trouble report (iii) Formal Reports: Essay, Pamphlet, Booklet or Book report, Parts of a book Report, understanding how to write formal reports
Unit 3.2 : Illustrations in a report: Uses, types, Use of illustrations: Tables, graphs, charts, Venn diagram, organizational charts, flow charts, maps, photographs, drawings and diagrams.
Unit 4.1: Topic -Letter writing: Credit letter, Collection and sales letters
Unit 4.2: Memorandum: Definition, difference from letter, examples of memorandum
Unit 5.1: Meetings: Preparation, Notice for the meetings, Agenda
Unit 5.2.: Note taking during meetings, minutes of meeting
Unit 6.1: Tender: Procedure, Preparation, Types of tenders, Single tender, local tender, e tender, Structure, Tender Notice, Terms and conditions, Payment details, specification, Documents to be submitted, placing orders, Evaluations, drafting advertisements for tenders
Unit 7: Job Interviews: Preparing for a Job Interview, guidelines on facing job interviews, ways of scouting for jobs, Writing Job Application, resume,

Marking scheme :

Term Work **Maximum marks**

Overall classroom performance……..…….10

Workbook (assignments)…… ……25

Classroom activity (language workshop)…… ……....15

Term End Assessment

Components **Maximum marks**

Questions on syllabus……..20

Activity……..30

4. **Suggested specification table with hours and marks (Practical) :**

Unit No	Topic	Teaching hours per semester
1.	Communication Skills in the work place	04
2.	Organizing seminars, project work	04
3.	Report writing	05
4.	Letter Writing	05
5.	Meeting	05
6.	Tenders	04
7.	Job interviews	05
	Total hours	32

5. Suggested learning resources :

1. Business Correspondence and report writing, by R C Sharma & Krishna Mohan, Tata Mcgraw hill, New Delhi 2002,
2. Principles and practices of Business Communication ,Doctor R. Doctor A., Seth Publishers,14th edition,2006
3. The functional aspects of communication skills, P. Prasad, Sharma K. Rajendra, S. K. Kataria and Sons,2006
4. Raul R. Timm, How to make winning presentations, Sneha printers, Mumbai,
5. Stand and Deliver, how to become a masterful communicator and public speaker,
6. Dale Carnegie Training, CPI Cox & Wyman, UK.

(IE6**) INSTIUTIONAL ELECTIVE

1. **RATIONALE** :

It has been observed that the curriculum prescribed, is many times out of context of Industry, on account of the pace with which technology development is taking place at Industry end. Due to this, gap exists between the Industry requirement of manpower and manpower produced by the Polytechnics. Board takes some time to incorporate the development of technology in the curriculum and many a times technology becomes outdated when it is incorporated in the curriculum. Further the expertise to train students as per Industry current requirement is available at the institute, but the same cannot be taught to students, as it is not a part of curriculum.

To address this situation, Board has decided to permit Institutions affiliated to Board, to identify such technologies or other aspects and teach the same to the students as an elective subject called "Institutional Elective". Through this Institutional Elective subject, Institutions will be able to cater to the requirements of Industry by identifying their immediate requirement and prepare the students for the requirement by developing the curriculum in consultation with the Industry.

As many a time's same subject may not be offered more than one or two years, a non conventional way of teaching – learning may be required to be adopted. Participation of Industry experts, guest lecturers, visit to Industry, exploring the knowledge available on net, etc may be essential to achieve the objectives.

2. TEACHING AND EXAMINATION SCHEME :

Course code & course title	Periods/Week (in hours)			Total Credits	Examination Scheme				
					Theory		Practical		Total Marks
IE6**	L	T	P	C	TH	TM	PR/OR	TW	
INSTIUTIONAL ELECTIVE	3	-	2	5	75	25	25	25	150

3. DETAILED COURSE CONTENTS :

a) Curriculum shall be drafted by the concerned department by interacting with Industry counterpart in regards to the Newer Technology required to be transferred for purpose of Teaching /Learning process.
b) Department shall work out the modalities of execution of the curriculum at Industry/Institute Level.
c) Curriculum shall be forwarded to Board for approval before its implementation.

(ME611) JIG & FIXTURES DESIGN

1. **RATIONALE:** Modern business environment is growing more and more dynamic and competitive in nature. Today's market demands a good quality product delivered right in time. It is a very difficult task to maintain a good and stable quality of products without disturbing their time schedules. Properly planned use of jigs and fixtures on the shop floor reduces this problem to a great extent. Jigs and fixtures help to increase production rates and still maintain the dimensions well within specified tolerance. Hence it is essential for a production-shop supervision to be well equipped with the knowledge of jigs and fixtures. This subject aims at training the student in elementary design aspects and uses of jigs and fixtures.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME611 JIG & FIXTURES DESIGN	L	T	P	C	TH	TM	PR /OR	TW	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3Hrs*

3. DETAILED COURSE CONTENTS

Unit 1 INTRODUCTION (5 hrs – 10mks)

Significance & PURPOSE OF Jigs & Fixtures. Definition. Advantages. Economic consideration. Elements of Jigs Fixtures: Locating elements, clamping elements. Tool guiding and setting elements. General design principles.

Unit 2 LOCATION & LOCATING DEVICES (7 hrs – 15mks)

Location: Six degrees of freedom; Duty of location system; Choice of location system; Redundant location; Six point location principle; Locating Methods: From a plane surface, From a profile, From a cylindrical surface. Typical locators and their applications: Support/rest pads or pins; Fixed; Adjustable; Locators from a profile: Pins; Location nests; Locators from a cylindrical surface: Location post; Location pot; Conical locators; Cylindrical locator in combination and use of diamond pin; Vee locators: Fixed; Sliding.

Unit 3CLAMPING (8 hrs – 20mks)

Principles of clamping; Position; Strength; Productivity Operator Fatigue; Work-piece variation. Types of clamps; Screw clamps and use of floating pad; Strap or plate clamps; Retractable strap clamps; Swinging strap clamps; Edge clamps; Spider clamps; Pivoted clamps; Pivoted strap clamps; Pivoted edge clamps; Pivoted two way clamps; Hinged clamps; Swinging clamps; Quick action clamps: Use of 'C' washer & captive 'C' washer; cam clamps; Eccentric shaft clamp; Toggle clamp; Use of quarturn nut; Multiple clamping:

Equaliser; Stacking; Power clamps.
Unit 4 INDEXING DEVICES (5 hrs – 10mks) Linear Indexing; Rotary Indexing; Indexing plate; Rotary Indexing Tables.
Unit 5 DRILL JIG BUSHES (5 hrs – 10mks) Material and heat treatment. Types of bushes: Press fit bushes and slip bushes; Headed bushes and Headless bushes; Renewable bushes; Liner bushes; Threaded bushes; Special bushes; Fit & tolerances.
Unit 6 DESIGN OF JIGS & FIXTURES (18 hrs – 35mks) Drill jig designs- Types of jigs: Plate jigs & channel jigs; Angle plate jigs; Post jig and pot jig; Turn over jig; Leaf or Latch jig; Box jig; Provisions for swarf removal; Design procedure; Design of milling fixture; Use of tenons; Use of cutter setting block; Design procedure. Design of turning fixture: Arrangement for mounting the fixture on the spindle; Design procedure; Balancing.

4. PRACTICAL:

Sr. No.	Topic	Components
1.	Designs of simple drill-jig, for a given component, (Assembly & Details)	2
2.	Design of simple milling fixture, for a given component, (Assembly & Details)	2
3.	Design of simple turning fixture, for a given component, (Assembly & Details)	1

5. SUGGESTED SPECIFICATION TABLE WIYH MARKS & HOURS(THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	**Introduction**	**05hrs**	**07mks**
2.	**Location & Locating Devices**	**07hrs**	**11mks**
3.	**Clamping**	**08hrs**	**15mks**
4.	**Indexing Devices**	**05hrs**	**08mks**
5.	**Drill Jig bushes**	**05hrs**	**08mks**
6.	**Design of Jigs & Fixtures**	**18hrs**	**24mks**
	Total	**48hrs**	**75mks**

6. REFERANCE BOOKS

Sr. No.	Title of Book	Author
1.	Fundamentals of Tool Design	ASTMI
2.	Tools Design	Donaldson and Goold
3.	Jigs & Fixtures	P.H. Joshi

(ME612) FUNDAMENTALS OF MATERIAL HANDLING

1. RATIONALE:

Materials are required in every step of human life and materials form the backbone of any industry. Materials are required to be handled in production, packaging, storage, transportation etc. This subject deals with the fundamental knowledge of material handling which a technician is required to acquire for the detailed study of material handling technology in subsequent courses.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME612 Fundamental of Material Handling	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of competencies like – To understand Material Handling function, Unit Load Concept, Plant Layout & Material Handling, and Material Handling Cost Concepts

4. COURSE CONTENTS

Unit 1. Introduction To Material Handling

Definition and scope of material handling, Place of material handling in Industry, Material handling activities and functions, Unproductive nature of Material handling, Importance and benefits of material handling, limitations of Material handling, Development of material handling, Factors related to material handling, Relationship of material handling to other organisation, activities like purchasing, inventory control, production control, industrial engineering etc.

Unit 2. Principles Of Material Handling

Listing of all the material handling principles, Using the principles of material Handling for some selected Industrial application.

Unit 3. Unit Load Concept

Advantages and disadvantages of unit load, Types of unit loads, basic ways to move a unit load, Planning unit load system, Pallets and containers, Palletless handling & unit load efficiency.

Unit 4. Basis For Material Handling Analysis

Scope of the activity, Material flow cycle, Material handling equation, Factors for consideration in analysing problems - concept to be developed using industrialsituations.

Unit 5. Plant Layout & Material Handling

Definition, types of plant layout, Advantages and disadvantages of plant layout, Influence of material handling on plant layout, building for the plant, Consideration in planning and designing plant building, Single storeyed and Multistoreyed building, Advantages of single storeyed and multistoreyed building, Interrelation of plant layout and material handling, Typical plant layouts for selected industrial situation.

Unit 6. Material Handling At The Workplace

Definition. Advantages of proper workplace handling, Relationship between material storage and the workplace, principles of workplace layout, Workplace handling, Workplace handling equipment, industrial robots.

Unit 7. Material Handling Cost Concepts

Reasons for determining accurate material handling cost, Scope of material handling cost, Factors affecting material handling cost, evolution of direct costs and indirect cost, Activity cost determination, Determining total

handling cost.

5. SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1.	Introduction To Material Handling	**08**	**12**
2.	Principles Of Material Handling	**08**	**12**
3.	Unit Load Concept	**05**	**09**
4.	Basis For Material Handling Analysis	**06**	**09**
5.	Plant Layout & Material Handling	**08**	**15**
6.	*Material Handling At the Workplace*	**05**	**09**
7.	*Material Handling Cost Concepts*	**08**	**09**
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of various competencies.

Sr. No.	Unit No.	Assignment
1	1	Multimedia presentation on collection of information pertaining to material handling in any industry.
2	2.	Listing of different material handling principles for any given industry.
3	3.	To collect information on different sizes of pallets, containers; handling of pallets and containers; manufacturers of pallets and containers.
4	4	Describing material flow cycle for any selected/given industry.
5	5	Preparing a plant layout for a selected/given industry and listing the observations regarding the layout.

6	6	Preparing a work place layout for a given workplace.

7. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title of book	Publication
1	James M. Apple.	Material handling system design	Ronald Press Co., 1972.
2	M.P. Alexandrov.	Material handling equipment	Moscow :MIR
3	Theodor H. Allegri	Material handling principle: & practices	FL: Krieger
4	James M. Apple.	Plant layout and material handling	Malabar Fl.Krieger

(ME613) COMPUTER AIDED DESIGN AND MANUFACTURING

1. RATIONALE

The market driven economy demands frequent changes in product design to suit the customer needs. With the introduction of computers the task of incorporating frequent changes as desired is becoming simpler. Similarly the concept of manufacturing has undergone significant revolutionary change. Main change lies in the replacement of conventional Machines and Equipments with Computerized Numerically Controlled Machines and process of equipments. This has resulted in the enormous saving in the areas of manufacturing, it is essential that Diploma holders should be exposed to basic concepts of Computer Aided Design and Manufacturing using various CAD software & CNC machines programming.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 613 COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C	TH	TM	PR/ OR	TW	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with an attempt to Develop a solid model & operate Computer Numerical Machines to produce simple machine components.

4. DETAILED COURSE CONTENT

Unit 1: Introduction to Computer Aided Design

Computer role in industrial manufacturing, Meaning and definition of

Computer aided design (CAD) and Computer Aided Manufacturing (CAM).

Need of CAD and CAM integration, Product cycle.

CAD/CAM hardware:- CAD workstation hardware configuration, CAD workstation functions,

Types of CAD input (Cursor control) , Graphic Terminals, CAD hard copy devices.

Meaning of host satellite CAD system, Types of data Storage methods.
Unit2:GeometricModelling Need of geometric modelling, Types of geometric models. Data base structures for graphic modelling, Types of geometric modelers, Graphic standards: introduction to GKS(Graphic Kernel System), PHIGS (Programmer's Hierarchical Interface for Graphics, IGES (Initial Graphics Exchange Specifications), Modelling facilities desired in the system. Transformation of Graphic elements (Two and Three dimensional only), Geometric construction method-sweep, solid modelling. Primitive and Boolean operations, Free form surfaces, Classification of surfaces.(No numerical treatment)
Unit 3: Introduction to computer numerical Control Introduction- NC, CNC, DNC, Advantages of CNC, Coordinate system in CNC machines, Motion control systems, Point to Point, Straight line Continuous (Contouring), Application of CNC machines, Standard communication interfaces.
Unit4:PartProgramming Fundamentals of manual part programming: NC-Words, Programming Formats, Part programming using G and M codes, Use of subroutine and Do Loop, Computer Aided part programming (APT)
Unit 5: Industrial Robotics Introduction, physical configuration, basic robot motions, technical features such as- work volume, precision and speed of movement, weight carrying capacity, drive system, end effectors, robot sensors. Application- Material transfer, machine loading, welding, spray coating, Processing operation, assembly, inspection.

Unit 6: Automation

Basic elements of automated system, advanced automation functions,

Levels of automation. CAD/CAM and Automation.

Flexible manufacturing system (FMS):- Introduction, FMC,

FMS configuration and layout, Advantages of FMS, FMS applications

Computer Integrated Manufacturing (CIMS): Introduction,

General application guideline for the CIMS, Types of manufacturing system in CIM,

Overview of CIMS machine tools and equipments,

Function of primary and secondary MHS in CIMS,

Overview of: Function of computer CIMS, CIMS data files,

system reports, personnel requirement in CIMS

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	Introduction to Computer Aided Design	04	6
2.	Geometric Modelling	10	15
3.	Introduction to computer numerical Control	08	12
4.	Part Programming	08	12
5.	Industrial Robotics	10	15
6.	Automation	08	15
	Total	**48**	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to – **Develop a solid model & operate Computer Numerical Machines to produce simple machine components. The Following Softwares may be used; CATIA, CREO(PROE), Solidworks, Solidedge, Unigraphics, Think 3 or Any other standard 3D Modelling Software.**

Term work shall consist of the record of the following modeling assignments using any CAD Software as above in the form of a Journal:

S. No.	Unit No.	Experiment
1	**1**	General Awareness of the Software to be used & to Create, Save & retrieve files & folders& understand their related file Extensions. Software related Commands.
2	**2**	Creation of 2D Model using entities. At least 5 problems.
3	**2**	Dimensioning & editing of the above 2D models & saving them.
4	**2**	Understanding 3D modeling environment & generating 3 D models. At least 5 Problems.
5	**4**	Writing a simple part program for CNC lathe & CNC Machining Centre & Machining one job each.(CNC Trainer)
6	**4**	Writing a Simple part program using Subroutine & DO loop & Machining one job each (CNC Trainer)
7	**5,6**	Industrial Visit To Get acquainted with Latest automation techniques in manufacturing.

7. SUGGESTED LEARNING RESOURCES

S. No.	Author	Title of Books	Publication & Year
1	Michael Fitzpatrick	Machining and CNC	Tata McGraw Hills New Delhi
2	P. Radhakrishnan	CNC Machines	New Central Book Agency (P) Ltd. ISBN : 8173811849 ISBN:-13: 9788173811845
3	B. S. Pabla, B. S. Pabla M. Adithan, M. Adithan	CNC Machines	New Age Publishers, ISBN: 8122406696 9788122406696
4	Ibrahim Zeid	CAD/CAM Theory & Practice	McGraw Hill, Original from the University of Michigan Digitized 17 Dec 2007 ISBN 0070728577 9780070728578
5	Aided Manufacturing Kundra / TMH	Numerical Control & Computer Aided Manufacturing	Tata McGraw Hills New Delhi
6	Edward J. Preston, George W. Crawford, Mark E.	CAD/CAM Systems	Published by M. Dekker, 1984 Original from the university of California Digitized 15 Feb 2008 9780824772574
7	Richard N. Stover	An Analysis of CAD/CAM	Prentice-Hall, 1984 Digitized 17 Dec 2007 ISBN 0130328715 9780130328717

Other learning resources:-

- User manuals & online help files & Tutorials of different CAD software.

- Operating Manuals of various CNC Machines and Machining Centers supplied by manufacturers

(ME614) AUTOMOBILE ENGINEERING

1. RATIONALE: -

Automobile Industry is the backbone of Industrial Development in any country. With the ongoing process of liberalization and an increasing demand for automobiles, a need to have trained technical manpower has become imperative. With this view, this subject is kept at the VIth Level and brings to the Diploma student an awareness of the construction and working of various types of automobiles. The knowledge will help him to understand the preventive maintenance required to be done. It also helps him to understand the fault diagnosis so as to carry out the right repair maintenance of the automobile.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 614 AUTOMOBILE ENGINEERING	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/ OR**	**TW**	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COURSE CONTENTS

1.	**INTRODUCTION TO AUTOMOBILE ENGG.**
	History &Components of an automobile Classification of automobiles based on use, capacity, body style, etc. Terms used & Vehicle dimensions: Wheel track and wheel base etc. Layout of general Automobile system. 4 wheel drive Automobile 2 wheel drive Automobile.
2.	**CHASSIS CONSTRUCTION** 3.1 Types of chassis frames 3.2 Conventional/Framed chassis 3.2.1 Functions of chassis frame 3.2.2 Various loads on the frame

	3.2.3 Frame construction 3.2.4 Frame sections and materials 3.2.5 Sub-frames 3.2.6 Defects in frames 3.3 Frameless chassis/monocoque design
3.	**AUTO ENGINES** 3.1 Fuel Injection timing of diesel engine 3.2 Petrol injection systems 3.2.1 Pulsed and continuous petrol injection 3.2.2 Multi point injection (MPI) v/s Throttle Body injection (TBI) 3.2.3 Advantages of MPI over carburetion engine 3.2.4 Electronic fuel injection (EFI) engine management system, functions of various sensors and actuators 3.2.5 Spark ignition timing of petrol engines
4.	**POWER TRANSMISSIONS** 4.1 Clutch: Types, operation, trouble shooting 4.2 Fluid Coupling 4.3 Types of gear boxes, transfer case (4WD) 4.4 Torque convertor 4.5 Planetary gear set, overdrive 4.6 Automatic transmission 4.7 Gearbox/transmission trouble shooting
5.	**ELECTRICAL SYSTEM** Battery, Starting And Generating system, ignition system, lighting and electrical instruments, engine management systems for multipoint fuel injection , trouble shooting

6.	**AUTO AIR CONDITIONING** flow of a/c Circuit, types of compressors, types of Refrigerants including Eco friendly, charging, trouble shooting
7.	**BRAKE SYSTEM** 7.1 Hydraulic brake system 7.2 Pneumatic brake system 7.3 Air assisted hydraulic brakes 7.4 Vacuum assisted hydraulic brakes 7.5 Drum and disc brakes 7.6 Introduction of ABS brakes
8.	**STEERING SYSTEM** 8.1 Steering linkage for rigid axle suspension 8.2 Steering linkage for independent suspension 8.3 Steering gearbox types 8.4 Steering geometry 8.5 Wheel alignment and wheel balancing 8.6 Power steering 8.6.1 Electronic power steering 8.6.2 Hydraulic power steering • Integral type Linkage type
9.	**SUSPENSION SYSTEM** 9.1 Leaf spring suspension 9.2 Coil spring suspension 9.3 Torsion bar 9.4 Independent suspension 9.4.1 Double Wishbone type 9.4.2 McPherson strut type 9.5 Shock absorber
10.	**AUTO GARAGE TOOLS AND EQUIPMENT** Box and open edged spanner set, torque wrench, hydraulic jacks, stroboscope, various gauges and meters, hydraulic hoist, special tools
	Total 75 marks

4. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1	INTRODUCTION TO AUTOMOBILE	3	6
2	CHASSIS CONSTRUCTION	3	6
3	AUTO ENGINES	6	9
4	POWER TRANSMISSIONS	8	12
5	ELECTRICAL SYSTEM	5	9
6	AUTO AIR CONDITIONING	4	6
7	BRAKE SYSTEM	5	6
8	STEERING SYSTEM	7	9
9	SUSPENSION SYSTEM	4	6
10	AUTO GARAGE TOOLS AND EQUIPMENT	3	6
	Total	48	75

5. SUGGESTED LIST OF PRACTICAL ASSIGNMENTS

Term work shall consist of the record of the following assignments:

S. No.	Unit No.	Assignments
1	**3**	Dismantling and assembly of petrol engine
2	**3**	Dismantling and assembly of diesel engine
3	**4**	Replacement of friction plate in single plate dry clutch
4	**4**	Dismantling and assembly of synchronmesh gear box
5	**4**	Removal of final drive and differential assembly ,checking and adjustment for proper tooth contact and backlash between the pinion and crown wheel
6	**6**	Tracing of the air conditioning circuits of an automobile and identifying the different components and learning the charging procedure
7	**7**	Replacement of brake shoes/ linings and friction pads (disc brakes),replacement of master cylinder and wheel cylinder kits
8	**8**	Replacement of tie rods or tie rod end of steering linkage
9	**9**	Replacement of bushes in leaf spring suspension system

6. SUGGESTED LEARNING RESOURCES

S. No.	Name of Author	Title of the Books	Name of the Publisher
1	Joseph Heitner	Automotive mechanism	
2	Crouse and Anglin	Automotive Maintenance and Repairs	Mir Publishers
3	Newton and Steeds	Motor Vehicle Technology	
4	Judge	Electrical System	
5	Dr.Kirpal Singh	Automobile EnggVol I & II	Standard publisher delhi

(ME615) RENEWABLE ENERGY SOURCES

1. **RATIONALE**: The power demand in the country is increasing at a very fast rate & power production is not able to keep pace with the power demand. The resources required for the generation of power are gradually getting exhausted. Therefore it becomes necessary to investigate the possibility of producing energy from non – conventional sources. Researches and efforts are being made to utilize the non conventional energy for power generation which in turn can meet the power demand. It is also necessary to know the basics of energy conservation. Looking into this need, this course has been introduced at the final year level as an optional course.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME 615 RENEWABLE ENERGY SOURCES	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/ OR**	**TW**	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The student should be able to develop awareness for effective utilization of renewable energy sources, identify different components of solar energy devices, wind energy devices and biomass plant and apply principles of energy conservation and energy audit.

4. DETAILED COURSE CONTENT

Unit 1 Introductionto Energy Sources Introduction. Major sources of energy: Renewable and Non–renewable. Primary and secondary energy sources. Energy scenario in India . Prospects of renewable energy sources. Need of renewable energy sources.
Unit 2 Solar Energy Solar Radiation: Solar Radiations at earth's surface. Flat plate Collectors: Construction and working of typical liquid collector and typical air

collector. Concentrating collectors: Construction and working of parabolic trough reflector, mirror strip reflector, Fresnel lens collector.

Solar energy storage systems: Need for energy storage. Thermal storage:- packed bed storage type, Electrical Storage: - battery storage type, Mechanical storage:- pumped hydroelectric storage, compressed air storage, flywheel storage. Solar pond:- principle of operation, description of non-convective solar pond, applications.

Applications of Solar energy:- Space heating-passive and active heating systems. Solar photovoltaic's- principle, basic photovoltaic system for power generation, applications. Solar water heater, solar distillation, solar cooker (box type), solar furnace, solar pumping, solar drier. Agriculture and Industrial process heat. (No derivations and numericals)

Unit 3 Wind Energy

Basic principle of wind energy conversion. Power in wind, Available wind power formulation, Power coefficient, Maximum power. Main considerations in selecting a site for wind mills. Advantages and limitations of wind energy conversion. Classification of wind mills. Basic components of a wind energy conversion system. Construction and working of horizontal axis wind mill. Applications of wind energy:-Basic wind energy conversion system with energy storage; wind assisted gas turbine generating unit; wind energy system with battery storage. Environmental aspects of wind energy system.

Unit 4 Energy from Biomass

Introduction. Biomass resources. Biomass conversion technologies:-direct combustion, thermo-chemical conversion, bio-chemical conversion. Biogas generation. Types of biogas plants:- floating drum type and fixed dome type,their construction and working. Factors affecting biogas generation. Thermal gasification of biomass. Gasifiers: - a) fixed bed gasifier -updraught,downdraught and cross draught b)fluidized bed gasifier. Applications of gasifier.

Unit 5 Energy Conservation

Global and Indian energy market. Need and importance of energy conservation. Principles of energy conservation. Energy audit. Types of Energy Audit. Concept of Green Building, Carbon footprints, Star Rating of Appliances.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	Introduction to Energy Sources	04	6
2.	Solar Energy	19	32
3.	Wind Energy	11	15
4.	Energy from Biomass	08	12
5.	Energy Conservation	06	10
	Total	**48**	**75**

6. SUGGESTED LIST OF ASSIGNMENTS

Term work shall consist of the record of the following assignments:

S. No.	Unit No.	Assignments
1	**1, 5**	To collect information about global and Indian energy market.
2	**2**	To perform an experiment on solar flat plate collector used for water heating.
3	**2**	Setting up a photovoltaic cell for lighting with focus on orientation of panels and measuring output in terms of voltage & current.
4	**2**	Perform an experiment using a solar cooker.
5	**2**	Visit to plant of solar heating system for hotel/hostel/railway stations etc and write a brief report on the visit.
6	**3**	To study construction and working of horizontal axis wind mill or to visit nearest wind farm.
7	**4**	To visit biomass / biogas plant of Municipal waste or elsewhere and

S. No.	Unit No.	Assignments
		write a brief report on the visit.
8	**5**	Perform energy audit for workshop / Office / SSI unit.

7. SUGGESTED LEARNING RESOURCES

S. No.	Name of Author	Title of the Books	Name of the Publisher
1	Dr. B. H. Khan	Non Conventional Energy Resources	Tata McGraw Hill
2	G. D. Rai	Non conventional energy sources	Khanna Publishers
3	S. P. Sukhatme	Solar energy Principles	Tata McGraw Hill
4	P. H. Henderson	India – The Energy Sector	University Press
5	D. A. Ray	Industrial Energy conservation	Pergaman Press
6	W. C. Turner	Energy Management handbook	Wiley Press
7	S,Rao,B. Parulekar	Energy Technology	Khanna Publishers

(ME616)WELDING ENGINEERING

1. RATIONALE:-

Welding engineering is a field that has applications in various aspects. Welding is essential for technicians desirous of taking up career in welding design and fabrication. The content of this course aims at achieving the objective of training the technician at a higher level of technology.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME616 Welding Engineering	L	T	P	C	TH	TM	TW	PR/OR	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be thought and implemented with the aim to develop different types of skill leading to the achievement of competency – To understand the Metallurgy of Welding, Types of Joints, Welds and Welding Positions, Gas Welding, Welding Process, Defects in Welding, Inspection and Testing of Welds, Safety Precautions in Welding.

4. COURSE CONTENTS

Unit 1 Introduction Classification of welding process, Introduction to other joining process; Metal cutting Process; Factors affecting selection of welding process.
Unit 2: Metallurgy of Welding Introduction, Heat flow in and around weld metal, Metallurgical effects due to welding, Influence of gases on welding metals.
Unit 3: Types of Joints, Types of Edge Preparation And Welding Positions] Brief description regarding various types of joints like butt, lap, T, corner, edge joints etc Types of edge preparations like square butt, single and double V, U, J, bevel etc. Types of welding positions like flat, horizontal, vertical, overhead, pipe horizontal and pipe

Inclined.

Unit 4Gas Welding

Equipment, tools, accessories and their setup; Consumables such as gases, fluxes, filler metals and their selection; Gas flame characteristics and applications; Torch manipulation and movements.

Unit 5. Arc Welding

Arc welding set up, Selection of Power source, tool & accessories. Classification & selection of electrodes, selection of operating parameters like current & voltage.
Polarity in welding, Factors influencing welds like speed, voltage & current.
Special process of arc welding: 1) TIG, 2) MIG, 3) SAW, 4) CO2, 5) Plasma Arc Welding.

Unit 6. Special Welding Processes

Introduction to welding process with respect to working principal, equipment, applications, merit and demerits; (A) Resistance welding, 1) Spot welding, 2)Seam welding. (B) Solid State welding, 1) Ultrasonic, 2) Friction (C) Thermit welding, (D) Brazing and Soldering.

Unit 7. Defects In Welding

Definition, Causes and Remedies: 1. Cracks, 2. Incomplete penetration, 3. Slag Inclusion

4. Porosity, 5. Blowholes, 6. Spatter, 7. Under cutting, 8. Overlapping.

Unit 8. Welding Distortion

Concept of distortion; Types of distortion and their control; Pre-heating and

Post- weld heat treatment.

Unit 9. Inspection And Testing Of Welds

Stages in weld inspection and testing;

Non-destructive tests: Visual inspection, X-Ray and X-Ray radiography, Dye Penetrant test, Magnetic particle inspection, Ultrasonic test.

Destructive tests: 1) Tensile Test, 2) Bend Test, 3) Impact Test, 4) Hardness Test.

Unit 10.Safe Working practices in Welding

Personal safety like Protective clothing: Head protection, Foot protection, Eye protection etc.

Ensuring Safe working environment – Possible fire hazards, working at heights. Requirement of welding in confined spaces. Need of fire extinguishers etc.

5. SPECIFICATION TABLE WITH HOURS &MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1.	Introduction	**03**	**03**
2.	Metallurgy of Welding	**03**	**03**
3.	Types of Joints, Welds And Welding Positions	**03**	**06**
4.	Gas Welding	**06**	**09**
5.	Arc Welding	**08**	**15**
6.	Welding Process	**07**	**12**
7.	Defects in Welding	**04**	**06**
8.	Welding Distortion	**04**	**06**
9.	Inspection and Testing Of Welds	**06**	**09**
10.	Safety Precautions in Welding	**04**	**06**
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of the competency.

Sr. No.	Unit No.	Assignment	No of Turns
1		**Setting up of equipments for arc welding & striking of Arc.**	1
2	3	One job lap joint in Horizontal position.	3
3	3	One job stringer beading in vertical Position	3
4		Setting up of Gas welding unit & demonstration of Various types of Flames	1

3	3	Demonstration of pipe welding on T I G	1
4	9	Demonstration of inspection and testing techniques.	1

7. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title of book	Publication
1	James E. Brumbangh	Welders guide and Hand book (Audels Services)	R.F. Jennings Mc. Kinght
2	Shri O.P. Khanna.	A Text book of welding Technology	DhanpatRai Publications
3	F.J.M Smith.	Basic Fabrication and Welding Engineering	Longman

(ME617) MODERN MARKETING MANAGEMENT

1. RATIONALE

In this day of competitive business, a course in marketing management is of great importance to the entrepreneur, industrialists, and person working in marketing related department. It is said that producing itself is not difficult, but to make people buy the produce is. Marketing begins before the product exists and continues long after the product is sold. The student will be able to understand the nature and scope of marketing management.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME617 Modern Marketing Management	L	T	P	C	TH	TM	PR/ OR	TW	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency – ***Apply the principles of marketing management to enhance the market and sale of the product.***

4. DETAILED COURSE CONTENT

Unit 1 Fundamentals of Marketing Management

- Define: marketing, market and marketing management

- Explain simple model of marketing process

- Understand various stakeholders of business: customers, employees, shareholders, society, government, suppliers, distributors , etc

- Marketing Management orientations:- Discuss :(a) production concept (b) the product concept (c) the selling concept (d) the marketing concept (e) the societal marketing concept

- Building customer relationships: Definition of Customer relationship management (CRM), importance of CRM, customer value and customer satisfaction

- Discuss about Customer loyalty programs and customer retention programes with few examples

- Importance of retaining existing customer v/s acquiring new customer

- Changing nature of customer relationship in modern times: discuss with examples (a)selective relationship management (b) long term relationships (c)relating directly

-Importance of ethics and social responsibility while marketing

- discuss the growth of not-for-profit marketing with examples

Unit 2 Marketing segmentation, Targeting, Positioning and Marketing Mix

- Discussion on segmentation based on (a)geographic factors (b) demographic factors (c) psychographic factors (d) behavioral factors. Explain with real world examples.

- Definition of target marketing. Brief discussion on target marketing with examples.

- Understand the concept of Market Positioning with examples from corporate world

- Marketing Mix: discuss in detail, with examples, the four P's of marketing.

- Marketing Environment: discuss in detail, with examples, (a)Political environment, (b)economic environment, (c) social environment, (d) technological environment and (e) natural environment

Unit 3Marketing research

-Definition and scope of Marketing research

- discuss various steps involved in marketing research

(a) defining the problems and research objectives

(b) developing the research plan

(c) gathering and analyzing the data

(d) interpreting and reporting the findings

- Brief discussion on gathering of secondary data and primary data

- Research approaches for gathering primary data, which shall include: observational research, survey research, marketing research and online marketing research.

Unit 4 Consumer Behavior

- Discuss, with examples or case studies, various factors influencing consumer behavior: Cultural factors, social factors, personal factors, psychological factors.

- Discuss in detail ,with examples, following types of buying decision behavior:

(a) Complex buying behavior

(b) Dissonance –reducing buying behavior

(c) Habitual Buying behavior

(d) Variety seeking buying behavior

-Brief discussion on stages in buyer decision process: recognition of need, information search, evaluation of

alternatives, purchase decision, post purchase behavior.

Unit 5 Business to Business Marketing (Industrial Marketing)

- Define business markets and explain how business markets differ from consumer markets.

- Discuss buying situations in industry- straight rebuy, new task, modified rebuy.

-Discuss in detail "buying centers"

-Major influences on Business buyers

Unit 6 Product , Services and Branding

- Difference between product and services

- Classification of products: consumer products and industrial products

- Product life cycle and various stages involved in it

- Discuss in brief product and service decisions: product attributes, branding, packaging, and labeling and product support services.

- Branding Strategy: Brief introduction to brand positioning, brand name selection, brand sponsorship and brand development.

Unit 7 Marketing Channels (Distribution Channels)

-The nature and importance of Marketing Channels
-Number of Channel Levels: Understand levels in Direct Marketing Channels and Indirect marketing Channels
-Understand Consumer marketing channels and Business marketing channels
-Nature and importance of Marketing Logistics
-Goals of Logistics system
-Major Logistics Function: Warehousing, Inventory Management, Transportation, Logistics Information Management
-Discuss the concept of Third Party Logistics (3PL) with the help of examples.

Unit 8 Sales Management

-Discuss functions of salespeople: Prospecting, targeting, communicating, selling, servicing, information gathering, allocating
- What makes a good sales representative
- Understand in detail various steps in selling process: Prospecting and qualifying, pre approach, approach, presentation and demonstration, handling objections, closing, follow-up
-Direct Marketing:

- Definition and concept of direct marketing
- Benefits and growth of direct marketing
- Use of customer database in direct marketing
- Forms of direct marketing: telephone marketing, direct mail marketing, catalog

marketing, direct response television marketing, kiosk marketing

- Ethical issues in direct marketing: (a) Irritation, unfairness, deception and fraud (b) Invasion of privacy, etc.

Unit 9 Marketing in the digital age

-Brief discussion on major force shaping the digital age: digitalization and connectivity, the explosion of the internet, new types of intermediaries, customization, etc.

-Definition of E-business, E-commerce and E-marketing

-Understand benefits of E-commerce to the buyers

- Understand benefits of E-commerce to the sellers

-E-marketing domains (discuss each domain with examples)

- Business- to- Consumer (B2C)
- Business-to- Business (B2B)
- Consumer –to- Consumer (C2C)
- Consumer –to – business (C2B)

-Sources of E-commerce revenue: Income from sale of product and services, advertising income, sponsorship income, alliance income, membership and subscription income, transaction commissions and fees, market research and information fees, referral income, etc.

-Discuss about Setting up an E-marketing presence: creating a website,online advertising, creating or participating in web communities, using email

-Discuss the promise, challenges and issues in E-commerce

-Mobile Commerce (M-Commerce): Concept of M-Commerce, Market size of M-commerce, Examples of successful M commerce businesses,

-Latest trends in digital marketing

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1	Fundamentals of marketing management	5	9
2.	Marketing segmentation, targeting , positioning and marketing mix	9	12
3.	Marketing research	5	6
4.	Consumer behavior	5	6
5.	Business to business marketing (Industrial Marketing)	3	6
6.	Product, services and branding	4	6
7.	Marketing Channels	3	6
8.	Sales Management	8	12
9.	Marketing in the digital age	6	12
	Total	**48**	**75**

6. SUGGESTED LIST OF EXPERIMENT

Sr no	Unit no	assignments
1.	1	Visit a Marketing department of a business firm.
2.	3	Prepare a report on resources available at the above firm.
3.	4	List out the roles of various staff from the firm.
4.	6	What products are they marketing?
5.	7	Give your detailed list of success of the products.

Reference books: -

Sr no	Name of author	Title of books	Name of publisher
1.	Philip Kotler.	Principles of marketing	prentice Hill (I) Ltd
2	J. C. Gandhi,	Marketing a managerial introduction	Tata McGraw Hil
3	R. S.Davar	Modern Marketing Management .	progressive corporation pvt. Ltd
4	Philip-Kotler-	Marketing Management –.	prentice (I) Ltd
5	Alexander	Industrial Marketing	cross& still-d. B. TaraporewalaPvt. Ltd
6	Charles Kirkpatrick	Salesmanship	
7.	R. S. Davar	Salesmanship and publicity	Progressive Corporation Pvt. Ltd
8	Boyd, Westfall and Stasch	Marketing Research	all India Traveller Book Seller, Delhi

(ME618) SAFETY ENGINEERING

1. RATIONALE

With rapid advances in industrial processes, new types of danger to life and health are being increasingly introduced.Safety of life and assets has always been at a top precedence in oil and gas industry. Keeping in mind this course is designed in such a way that aspirants, who wish to get into designing, may get a broad overview of safety norms and related engineering practices**.** Therefore an attempt has been made in this subject to highlight the different safety aspects, laws and rules to combat the cause of accidents.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME618 SAFETY ENGINNERING	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	150
	3	-	2	5	75	25	25	25	

Minimum passing %: Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency.

4. DETAILED COURSE CONTENT

Unit 1 INTRODUCTION TO INDUSTRIAL SAFETY

Introduction-Safety -Goals of safety engineering. Need for safety. Safety and productivity.

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety, Safety policy,Safety Officer-responsibilities& authority. Safety committee-need, types& advantages.

Unit 2 ACCIDENT CAUSES AND COSTS

Definition of accidents,Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents.

Classification of accidents, Causes of accidents and factors affecting it, Cost of accident to the management, Accident prevention method-Engineering, Education and Enforcement.

Unit 3 SAFETY EDUCATION , TRAINING & HOUSING KEEPING

Safety Education & Training -Importance, Various training methods, Effectiveness of training, Behaviour oriented training. Communication- purpose, barrier to communication. Role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

Housekeeping: Responsibility of management and employees,Advantages of good housekeeping, 5 s of housekeeping.

Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Unit 4 SAFETY IN MATERIAL HANDLING

Classification of safety in Material Handling; Manual Handling; Effective methods of lifting ; Fall- Definitions; Causes of common fall – preventive measures; Types of falls and safety regarding falls.

Inbuilt safety in cranes,hoist& lift, chain pulley blocks, mixers, conveyors etc.

Unit 5 HAZARD IN INDUSTRY & THEIR PREVENTION

Fire hazards and prevention: Fire detection and control; Common safeguarding methods and devices; pressure vessel hazards; causes of pressure vessel accidents; controlling fire in pressure vessel; common explosions, need for a safety valve and introduction to boiler acts.

Hazards in chemical industry: classification of hazardous chemicals; properties of flammable chemicals; safety in storage and transportation of flammable liquids; types of chemical emergencies and their prevention.

Noise: Introduction to noise; Effect of noise; Remedial measures to combat noise.

Unit 6 ACCIDENT REPORT & INSURANCE COVERAGE

Benefits of accident report; Accident report forms; Cost of accidents-Computation of Costs-Utility of Cost data.

Accident investigation –Why? When? Where? Who? & How?

.Process of Investigation –Tools-Data Collection-Handling witnesses- Case study.

Accident analysis –Analytical Techniques like change ,barrier and tree analysis

Plant safety inspection, types, inspection procedure, Safety sampling techniques, Job safety analysis (JSA), Safety surveys and Safety audits.

Definition of insurance; Types of insurance; Advantages of insurance; Life insurance; Advantages of life insurance; kinds of life insurance policies; procedure of making LIC; settlement of life insurance claims
Unit 7 PERSONAL SAFETY Personal protection in the work environment, Types of PPEs, Personal protective equipment-respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate.
Unit 8 WELFARE PROVISIONS &ROLE OF FACTORY INSPECTOR Labour welfare provisions; Working Hours; Definition of inspection; objectives of factory inspector; powers of inspectors; penalties etc

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	**Topic**	**Teaching Hours**	**Total Marks**
1.	Introduction to industrial safety	04	05
2.	Accidents- causes and costs	03	05
3.	Safety Education ,Training & Housekeeping	08	12
4.	Safety in Material Handling	06	12
5.	Hazards in Industry and their prevention	07	12
6.	Accident Report & Insurance Coverage	10	15
7.	Personnel Safety	06	08
8.	Welfare provisions and Role of Factory Inspector	04	06
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency.

S. No.	Experiment
1.	Write report on all the personnel safety and machine safety students are observing while working in mechanical workshop.
2.	Visit the industry and Prepare the Detail report on safety measures observed in industry.
3.	Prepare the Escape Route Layout of your school Building or House.
4.	Survey a nearby market and prepare a report on safety equipment and their specification available in market.
5.	To prepare at least one safety poster or safety Display that can be used in surrounding area.
6.	Show the video containing fire accidents in various situations and an exercise to select the fire extinguisher to prevent the accident.
7.	Compile information from internet regarding accidents occurred in industries due to lack of safety measures.
8.	Collect information and prepare a report about the different types of insurance companies and policies available in Goa.

7. SUGGESTED LEARNING RESOURCES

Sr.no.	Author	Title of Books	Publication & Year
1		Relevant India Acts and Rules	Government of India.
2	Ronald P. Blake	Industrial Safety	Prentice Hall, New Delhi, 1973
3	Ted S. Ferry	Modern Accident Investigation and Analysis	John Wiley & Sons
4	NaseerElahi	Industrial Safety Management	Kalpaz Publication 2006
5	H.l. kalia	Industrial Safety And Human Behaviour	Aitbs Publishers, India 2011
6	A. N. Saxena	Industrial Safety	National Productivity Council, 1978

(ME619)MAINTENANCE ENGINEERING

1. RATIONALE:-

Every Mechanical engineer he works in the field of design, Production, projects, planning etc. has to have reasonable exposure to maintenance. As an Engineer working in the field of maintenance he should have thorough knowledge of the subject matter. A maintenance engineer should be accustomed to both the aspects of maintenance, namely field maintenance and maintenance management. This subject is aimed at imparting knowledge to students of mechanical engineering in both these areas.

2.TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME619	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Maintenance Engineering	3	-	2	5	75	25	25	25	**150**

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be thought and implemented with the aim to develop different types of skill leading to the achievement of competency – To understand the Concept, Predictive Maintenance & Condition Monitoring, Planning & Scheduling Maintenance Work, Maintenance Stores and Control, maintenance practices.

4. COURSE CONTENTS

Unit 1. Concept of Maintenance

1. Introduction to concept of maintenance: 1. Need for maintenance, Types of maintenance practices: Breakdown, preventive, predictive. Their comparison and areas of application.
2. Preventive maintenance, Importance of preventive maintenance, Schedules of preventive maintenance, Preventive maintenance programming, Manpower & machine scheduling, Colour coding, Case studies (any two)
3. Concept of online maintenance: Online maintenance: Need for online maintenance, safety aspects in online maintenance, Attending to joints, valves and pump leakage, Developing codes for temporary and safe closures of parts of machine or plants.
4. Shutdown maintenance: Planning for a shutdown by using Pert and CPM technician, efficient use of manpower & machinery during shut down period, need for external maintenance services.
5. Concept of corrective maintenance. Systematic recording of maintenance viz. Maintaining log Books, history cards etc.

Unit 2: Predictive Maintenance & Condition Monitoring

1. Importance of predictive maintenance
2. Introduction to programming of predictive maintenance: Detection, analysis and correction, Organising predictive maintenance programme,
3. Vibration as a parameter for condition monitoring, Introduction to vibration of simple spring mass system., Terminology used in vibration monitoring, vibration amplitudes, Displacement, Velocity, Acceleration, Use & selection of vibration amplitude parameter, Detection of defects in rolling elements bearing & gear, Establishing levels of vibration, Baseline, warning & danger limits, Reference standards & charts used in defining levels, Introduction to concept of raw data & filtered data. Instruments used in vibration monitoring.
4. Displacement pickups: Velocity pickups, Accelerometers, Spike energy meter, Stroboscope etc.
5. Vibration analysis. Introduction to machine signatures, Analysis of common defects using vibration monitoring instruments viz Unbalance, misalignment, looseness & Defects in RC bearings.
6. Introduction to noise monitoring (no question to be asked in examination)

Unit 3: Planning & Scheduling Maintenance Work:

Work authorisation and control, Standard times for maintenance work, Work simplification in maintenance.

Unit 4Maintenance Stores and Control

Maintenance stores control, Maintenance store rooms, Inventory & classification of inventory related to maintenance, Standardisation of maintenance parts.

Unit 5. Maintenance Estimates

Approach to maintenance estimation. Classification of jobs, Preparation of estimates, Estimating techniques and selection of estimating method.

Unit 6. Maintenance, Manual and Reports:

Need for manuals and types of manual, Contents of maintenance manuals, Manual writing or reporting, Maintenance practices.

B. MAINTENANCE PRACTICES

Unit 7. **Reconditioning Of Worn Out Components:**

Why and when to recondition; Reconditioning and repair of: a. Flat surfaces, b. Shafts and spindles, c. Bushes, d. Keys, Gears, e. Valves; Metal spraying, welding, grinding and re-boring for reconditioning, Balancing of reconditioned components

Unit 8**. LUBRICATION**:

Types of lubricants : Liquid, semi fluid and solid, Requirements of lubricants, Selection of lubricants for various applications using some, available commercial grades, use of equivalence charts, Various modes of lubrication, Lubrication methods: Drip feed Ring type, Cup type, Wick, Forced lubrication; Lubrications schedules; Grease cups
and greasing nipples; Use of grease gum/pressurised greasing

Unit 9**. MAINTENANCE OF MACHINE COMPONENTS:**

Bearings: Pulling out and installing RC bearings, maintenance of journal bearings, Seals: Changing of oil seals, Attending a leaking gland, mechanical seals, Adjusting coupling, adjusting belt tensioners, Greasing of bearings, Clearing of filters, Keys: Removal & replacement of a broken key, Servicing of hydraulic pistons cylinder arrangement, Servicing of hydraulic and pneumatic valves

Unit 10. **GAUGES IN MAINTENANCE:**

Linear measurement: Joint callipers, dividers, Vernier callipers, micrometers, vemier height gauge, bore gauge, and depth gauge; Angular measurement: Bevel protractor; angle gauges; Measurement of surface finish: Stylus probe instruments. Tomilson's surface meter, straight edge.

5.SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1	Concept of Maintenance	**05**	**09**
2	Predictive Maintenance & Condition Monitoring	**06**	**12**
3	Planning & Scheduling Maintenance Work	**03**	**03**
4	Maintenance Stores and Control	**06**	**09**
5	Maintenance Estimates	**03**	**03**
6	*Maintenance, Manual and Reports*	**03**	**03**
7	*Reconditioning Of Worn Out Components*	**04**	**06**
8	*Lubrication*	**04**	**09**
9	*Maintenance Of Machine Components*	**10**	**15**
10	*Gauges In Maintenance*	**04**	**06**
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of the competency — To understand the Valves, boilers, diesel engine terminology, components, systems and other systems like deck machinery, steering gear.

Sr. No.	Unit No.	Assignment
1	1	One assignment on preparing maintenance schedule using pert and C.P.M. Technique.
2	2	One assignment on analysis of failure using condition monitoring (data given)
3	5	One assignment on preparing maintenance estimate.
4	8	One assignment on study lubrication practices.
5	6	One assignment on use of maintenance manual
6	10	Study and demonstration of angle gauges.
7	10	Demonstration of stylus probe instrument.
8	9	Use of puller in pulling out gears, bearings, etc.
9	9	Study of different types of spanners and jacks used in maintenance.
10	2	To do static & dynamic balancing of rotating masses.
11	9	To replace gland packaging of a gland and stuffing box provided in a machine such as a pump.
12	7	Dismantling and assembly of different types of valves such as : i)Ping valve, ii) Feed valve, iii) Check valve, iv) Globe valve

13	9	Alignment of two rotating shafts connected through a coupling using different maintenance equipment.

7. SUGGESTED LEARNING RESOURCES

Sr. No.	Author	Title of book	Publication
1	S. N. Bhattacharya	Installation, Servicing & Maintenance	S. Chand & Co
2	Lindley R. Higgins	Maintenance Engineering Handbook	Tata McGraw Hill Publisher
3	K. C. Jain &Agarwal	PERT & CPM	Khanna
4	Garg	Industrial maintenance	S. Chand Limited

(ME621)MATERIAL HANDLING DESIGN CONCEPT

1. RATIONALE:-

Material handling does not add value but it is usually adds a significant element of cost. In some industries cost of materials handling is quite significant. In order to cut down on handling cost a systems approach to material handling is a must. This subject is aimed to provide sufficient knowledge to a material-handling technician to study and analyse the material handling problems.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME621	**L**	**T**	**P**	**C**	**TH**	**TM**	**TW**	**PR/OR**	
Material Handling Design Concept	3	-	2	5	75	25	25	25	**150**

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be thought and implemented with the aim to develop different types of skill leading to the achievement of competency – To understand the facilities design, designing material flow, techniques for analysing material flow, designing the process, designing the handling system.

4. COURSE CONTENTS

Unit 1. THE FACILITIES DESIGN

Definition, Scope, Importance, Facilities design and process, The continuing need for facilities design work, Types of layout problems, A good layout for consideration in facilities, Design procedure. '

Unit 2. DESIGNING MATERIAL FLOW

Introduction, The overall system flow cycle, Advantages of planned material flow, Need for such flow patterns, Factors for consideration in planning material flow, Flow patterns, Designing the flow patterns.

Unit 3: THE SYSTEM CONCEPT IN MATERIAL HANDLING

Meaning of system concept; Basic handling systems; System concept in theory and practice; Ideal system approach; Importance of systems concept in material handling; Steps in systems development, system design and system implementation, The role of computer in the systems concept.

Unit 4TECHNIQUES FOR ANALYSING MATERIAL FLOW

Sources of data required; Flow planning and analysing techniques; Assembly chart; Operation process chart; Multi product process chart; String diagram; Process chart, Flow diagrams; Flow process chart; From to chart; Procedure chart; Critical path
method.

Unit 5. DESIGNING THE PROCESS

The production design procedure, Factors for consideration in process design, Preliminary production planning, Product analysis, Methods of production, The unit process concept The process design procedure , Computerized process planning.

Unit 6SPACE DETERMINATION.

Factors for consideration in space planning. Establishing total space requirements

Unit 7. DESIGNING THE HANDLING SYSTEM

Designing the handling system into the layout.

5. SPECIFICATION TABLE WITH HOURS &MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1	THE FACILITIES DESIGN	**09**	**15**
2	DESIGNING MATERIAL FLOW	**06**	**12**
3	THE SYSTEM CONCEPT IN MATERIAL HANDLING	**09**	**15**
4	TECHNIQUES FOR ANALYSING MATERIAL FLOW	**06**	**09**
5	DESIGNING THE PROCESS	**09**	**12**
6	SPACE DETERMINATION.	**05**	**06**
7	DESIGNING THE HANDLING SYSTEM	**04**	**06**
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of the competency — To understand the Valves, boilers, diesel engine terminology, components, systems and other systems like deck machinery, steering gear.

Sr. No.	Unit No.	Assignment
1	2	Study of flow patterns of at least one organisation.
2	2	Analysing Material flow at 1. By using various techniques for analysis.
3	4	Designing the process for a selected product by using a systematic step by step approach
4	3	Establishing total space requirement for process at, 3.

7. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title of book	Publication
1	James M. Apple.	Material handling system design	Ronald Press Co., 1972.
2	S.C.Sharma	Material management and material Handling	Khanna
3		Material handling Handbook	
4	James M. Apple.	Plant layout and material handling	Malabar Fl.Krieger

(ME623)POWER PLANT ENGINEERING

1. RATIONALE:-

More and more industries set up own captive power plant in order to be self sufficient as far as their power requirement is concerned. Depending upon the type of industry, the generating plants are set up. Similarly more and more power plants are set up to meet the ever-growing power requirement in the industry. A technician in a industry will be associated to with the operation and maintenance of such power plants and this subject aim in providing them the insight into the aspect of various types of power plants that are being set up.

2. TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME623 Power Plant Engineering	L	T	P	C	TH	TM	TW	PR/OR	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be thought and implemented with the aim to develop different types of skill leading to the achievement of competency – To understand the constructional details of components of various Power Plants (Hydroelectric Power Plant, Diesel Electric Power Plant, Gas Turbine Power Plant, Gas Turbine Power Plant, Nuclear Power Plant),working ofvarious power plants and maintainence procedures.

4. COURSE CONTENTS

Unit 1. Development Of Power Resources In India

Introduction, Hydel power development, Thermal power development, Nuclear power development .The different power plants in India & their present power development status, .Future planning in India.

Unit 2: Fluctuating Loads On Power Plants

Introduction, Load curves, Terms and factors, Connected load, Maximum demand, Demand factor, Average load, Peak load, Load factor, Diversity, Plant use factor, Plant capacity factor. Effect of variable load on power plant design and operation. Selection of

the number and size of units.
Unit 3: Hydroelectric Power Plant Introduction, Site selections for hydroelectric power plant. Classification of hydroelectric power plant General arrangement of storage type. Hydro-eletric power plant and its operation. Advantages of hydro-electric power plant.
Unit 4Diesel Electric Power Plant Introduction,.Applications of diesel engines in power fields,.Components of Diesel Electric Power plant, Classification of diesel power plants ..Layout of medium capacity diesel power plant...Advantages of diesel power plant and limitations of diesel power plant
Unit 5. Gas Turbine Power Plant .Introduction.,.The simple gas turbine plant ,Classification and comparison of different types of gas turbine power plant – i)open cycle and ii) closed cycle gas turbines ,Advantages of gas turbine plant over diesel and thermal power plant
Unit 6. The Steam Power Plant Introduction, General layout of modern coal based steam power plant, Working of steam power plant,.Site selection for thermal power plant, Different types of fuels(coal) used for steam generations, Coal handling systems- i)Pulverised coal handling system,ii) Bin system, Coal burning methods-i)chain grate stoker,.Pulverised fuel burners- i)Cyclone burners.
Unit 7. The Feed Water Loop Functions of the feed water loop,.Water contamination – its effects, Water tests and analysis,.De concentration or blow downs, General layout of water treatment plant, Water treatment methods- i)Ion exchange process, ii)Demineralization process, iii)Aeration process..A brief introduction to BFW pump
Unit 8. The Gas Loop Function of gas loop, Oil and gas supply systems, Flue gas cleaning, .Mechanical dust collectors, Electrostatic precipitates, General layout of ash handling plant,. Draft:-i) Natural and ii) Mechanical
Unit 9. Cooling Towers :essity of cooling condenser water , Condenser water cooling system, .Mechanism of cooling,. Cooling towers :i)Natural draft cooling tower (hyperbolic cooling tower), ii)Mechanical draft cooling tower ,Water distribution system used in cooling tower , Prevention of carryover losses and fog formation from cooling tower.
Unit 10. Nuclear Power Plant Principal of release of energy by nuclear reaction,.Nuclear fuels used in the reactors,.General components of nuclear reactor, Different types of reactors- i)Pressurized water reactor, ii)Breeder reactor, Layout of PWR nuclear power plant, PWR with vapour type pressurizer system,Radiation hazard, Ratio active waste disposal.

5. SPECIFICATION TABLE WITH HOURS &MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1	Resources Development Of Power In India	02	00
2	Fluctuating Loads On Power Plants	04	07
3	Hydroelectric Power Plant	04	08
4	Diesel Electric Power Plant	04	07
5	Gas Turbine Power Plant	03	08
6	The Steam Power Plant	10	15
7	The Feed Water Loop	05	06
8	The Gas Loop	05	07
9	Cooling Towers	05	08
10	Nuclear Power Plant	06	09
		48	75

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of the competency of understanding the constructional details of components ,working of various Power Plants and their mantainence procedures.

Sr. No.	Unit No.	Assignment
1	3	Major maintenance problems and suggesting remedial measures to be taken for one of the components (eg:-water turbines) used in hydro-electric plants
2	6	Operation and Maintenance of Coal Handling System and ash Handling System
3	6	With help of audio –visual aid study the operation and maintenance procedures of one of the sections (eg:- boiler) in a thermal power plant.
4	9	Typical problems,causes and trouble shooting methods for a cooling towers in power plant.
5	9	Performance test of an experimental cooling tower.
6	4	Starting procedure of diesel engine power plant and monitoring its performance.
7	10	Operation and maintenance of a nuclear reactor.

8	-	Field visit to a nearby power plant and write a detailed report giving the layout, operational processes, safety procedures, and preventive maintenance that includes Inspections, Repairs, replacements and Overhauls/refurbish in the plant.
9	-	Make a model of any one power generating plant giving detailed specifications of all the components.
10		Synchronization of diesel engine power plant with main supply

7. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title of book	Publication
1	F. T. Morse	Power Plant Engineering	D. van nostrand company
2	S. Domkundwar& S. C. Arora	A Course in Power Plant Engineering	DhantpatRai& Sons
3.	K.L.Rajput	A Text Book of Power Plant Engineering	Laxmi Publications
4.	P.C.Sharma / S.K.Kataria	Power Plant Engineering	
5.	Duncan C. Richardson	Plant Equipment and Maintenance Engineering Handbook	McGraw-Hill Education
6.	L wakil	Power plant technology	Wiley eastern publisher

(ME624)MARINE ENGINEERING

1. RATIONALE:-

Engineers involved in shipbuilding, ship repairs, and operation, are required to have a thorough knowledge of diesel engines, steam turbine, marine gears, stern gears. Having studied this subject, student shall be able to prepare sketches of diesel engine components and trace system integral with diesel engine. They should understand principle of operation, constructional details of steam turbines. They should study types of stern gear for inland & ocean going vessels. Engineers involved in shipbuilding should understand various types of deck machinery drives and their positions and installations. Due importance has also been given to fire protection system, ventilation, air-conditioning and refrigeration system. They should know different types of Valves, boilers, diesel engine terminology, components, systems and other systems like deck machinery, steering gear.

2.TEACHING AND EXAMINATION SCHEME:

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME624 Marine Engineering	L	T	P	C	TH	TM	TW	PR/OR	150
	3	-	2	5	75	25	25	25	

Minimum passing % : Theory 40% *Duration of Theory Paper: 3 Hrs.*

Legends:

***L**-Lecture; **T**- Tutorial; **P**-Practical; **C**-Credit; **TH**-End Semester Theory; **TM**– Test Marks:*

***PR/OR** -End Semester Practical / Oral Examinations; **TW-** Term Work*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

Course content should be thought and implemented with the aim to develop different types of skill leading to the achievement of competency – To understand the Valves, boilers, diesel engine terminology, components, systems and other systems like deck machinery, steering gear.

4. COURSE CONTENTS

Unit 1. Ship Systems

Ship piping systems i.e. bilge and ballast, fresh water, hydrophore, steam piping, fuel oil and lubrication oil systems, compressed air piping, fire fighting mains.

Unit 2: Marine boilers

Classification of boilers in Marine applications-Main, Auxiliary, Exhaust gas, Composite boilers and Packaged boilers (detailed construction not included). Fire tube and water tube boilers. Mountings and accessories and safety features. Air supply and fuel supply.

Unit 3: Valves

Types of valves used-on-board and their applications- globe valve, gate valve, relief valve, reducing valve, valve chests, shipside valves and their requirements, storm valve, butterfly valve, ball valve and Cocks. SD and SDNR valve.

Unit 4Marine Diesel Engines

- S
  cope, description, types, marine uses.
- D
  iesel Engine Systems
  Engine Cooling system, engine fuel oil system, engine lubricating oil system, basic engine air starting systems, scavenging and super-charging, methods of supercharging and turbochargers
- B
  asic features of principal components of diesel engines, e.g cylinder head, cylinder liner, pistons, cross-heads, connecting rods, camshafts with drives, crank shafts, tie rods, bed-plate, main bearing, top end and bottom end bearings and thrust bearing.

Unit 5. Deck Machinery

Types of drives- electrical, electro-hydraulic, deck machinery positions and installation, working principle of anchor windlass, cargo and mooring winches, cargo handling crane, capstans, and hatch cover operating machinery.

Unit 6. Steering Gear

Types of steering gear-mechanical, hand hydraulic, and power electro hydraulic-actuators including rotary. Construction and operation, control system and statutory requirements.

5. SPECIFICATION TABLE WITH HOURS &MARKS (THEORY)

Unit No.	Topic	Teaching Hours/Semester	Marks
1	Ship Systems	**10**	**18**
2	Marine boilers	**06**	**09**
3	Valves	**08**	**12**
4	Marine Diesel Engines	**12**	**18**
5	Deck Machinery	**08**	**12**
6	Steering Gear	**04**	**06**
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

The assignment should be properly designed and implemented with an attempt to develop the different type of skills leading to the achievement of the competency — To understand the Valves, boilers, diesel engine terminology, components, systems and other systems like deck machinery, steering gear.

Sr. No.	Unit No.	Assignment
1	4	To prepare sectional sketches of important diesel engine components- bed plate, cylinder liner, piston, and cylinder head. Line sketch of engine structure
2	4	To prepare line sketches of fuel oil, lubricating oil, cooling water and starting air circuits from an actual diesel engine
3	5	To visit inland vessels/ocean going vessels and prepare deck machinery layout with their position, brief description about working, line sketches of systems incorporated.
4	5	To visit inland vessel/ocean going vessel and prepare machinery space layout
5	6	To visit shipyard for sketching of physical arrangement of steering gear for inland/ ocean going vessels.
6	3	To dismantle and assemble various types of valves i.e. globe valve, non return valve, butterfly valve, quick closing valve
7	2	To study boiler mountings

7. SUGGESTED LEARNING RESOURCES

Sr.No.	Author	Title of book	Publication

1	D.A. Taylor	Introduction to Marine Engineering	Butterworths.
2	David D. smith	Marine Auxiliary Machinery	Butterworth, London
3	Dirnie, S-G	Marine Steam Engine & Turbines	Butterworth, London
4	C.C. Pounder	Marine Diesel Engines	Butterworth, London
5	Harrington	Marine Engineering	SNAME – New York

(ME627) FLUID POWER CONTROL

1. RATIONALE

Hydraulic and Pneumatic Control forms a part of various industrial machines and equipment like Hydraulic Presses, CNC machines, Mechatronic systems, Earth Moving Machinery, Job clamping and holding fixtures etc. It is also an important component of industrial automation. The engineers with the knowledge of this subject will be able to design fixtures, diagnose faults, Design basic hydro-pneumatic circuits and maintain hydro-pneumatic equipment.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
ME627	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR /OR**	**TW**	
Fluid Power Control	3	-	2	5	75	25	25	25	**150**

Minimum passing %: Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COMPETENCY TO BE DEVELOPED THROUGH THIS COURSE

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the competency –***'Design simple hydraulic and pneumatic circuits using basic components and diagnose and rectify some common faults in hydraulic and and pneumatic systems.'***

4. DETAILED COURSE CONTENT

Unit 1 Fluid Power Fundamentals

Introduction to fluid power and its scope. Advantages and limitations of fluid power. Basic methods of transmitting power and their comparison – Electrical, Mechanical and fluid power.
Applications of fluid power system. Hydraulic fluids – Functions, Desirable properties, General types, specification. Fluid power symbols – Hydraulic and Pneumatic.

Unit 2 Fluid Power Generation

Basic components of a hydraulic system (Block diagram), Basic components of a pneumatic system (Block diagram), Comparison between a Hydraulic and a Pneumatic system.

Hydraulic power unit – Basic components, Construction (block diagram), working, symbolic representation. Hydraulic pumps – classification, Positive and nonpositive displacement.

Construction and working of Gear pump, Vane pump, Radial Piston Pump, Axial Pump with swash plate, Bent axis Piston Pump.

Compressed air generation and its treatment. Filter Regulator Lubricator (FRL) Unit. Compressed air piping layout – Dead end and Loop type.

Unit 3 Valves and Accessories

Control parameters – Direction, Pressure and Flow. Control valve types – Poppet, Spool, Rotary.

Directional Control Valves – Basic function, Classification, Ports and positions, Methods of actuation, Symbols.

Flow Control Valves – Fixed and Variable flow, Symbols. Check valve. Pressure Control Valves – Pressure Relief Valve, Unloading relief valve, Pressure Regulator Valve, Sequence Valve, Symbols.

Constructional Difference between hydraulic and pneumatic valves. Exhaust port in pneumatic valves. Quick exhaust valve. Shuttle Valve.

Accumulator – Functions and types. Pressure switch and its function.

Unit 4 Actuators

Function of actuators. Linear and Rotary actuators. Cylinders –Single acting, Double Acting, Double Rod, Telescopic. Cushioning, Mounting arrangement and seals in cylinders. Calculation of force on piston rod using area and pressure.

Hydraulic motors – Gear type, Vane type, Piston type.

Unit 5 Hydraulic Circuits

Procedure of Drawing hydraulic circuits, Control of single acting and double acting cylinder, Uses of check valve in circuits. Study of Regenerative Circuit, Pump unloading circuit, Sequencing circuit of two double acting cylinders, Meter-in and meter-out circuit, Counter balance Circuit, Accumulator Circuit, Hydraulic intensifier.

Unit 6Pneuamtic Circuits

Construction, working and applications of 2/2-way, 3/2-way, 4/3-way and 5/3-way valves and their circuits, 'AND' and 'OR' logic circuits using Moving Part Logic (MPL) elements. Basic time delay valve circuit. Shuttle valve circuit, Quick exhaust valve circuit. Speed control of cylinders. Two handed safety circuit.

Unit 7Pipes, Hoses and Fittings

Pipe materials, Pipe specification, Common methods of tube joints – Flareless and flared joint, screwed joint, Flanged couplings. Frequently used fittings – Straight coupling, Tee joint, Bend, Elbow, Reducer, Cross Tee. Ferrule type compression fitting. Hydraulic Hoses – Construction, Materials and Reinforcement.

Unit 8Maintenance and Troubleshooting

Hydraulic and Pneumatic system maintenance. Safety measures. Common faults in fluid power systems like – Excessive heat, Excessive Noise, Incorrect flow, Incorrect Pressure (high or Low). Three Probable causes for each of these faults. Trouble shooting of Hydraulic and Pneumatic

systems,

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours	Total Marks
1.	**Fluid Power Fundamentals**	03	06
2.	**Fluid Power Generation**	06	09
3.	**Valves and Accessories**	09	15
4.	**Actuators**	06	12
5.	**Hydraulic Circuits**	09	12
6.	**Pneuamtic Circuits**	09	12
7.	**Pipes, Hoses and Fittings**	03	06
8.	**Maintenance and Troubleshooting**	03	03
		48	**75**

6. SUGGESTED LIST OF EXPERIMENTS

These practicals are to be conducted by using related software like FluidSim or a Hydraulic / Pneumatic Trainer.

S. No.	Experiment
1	Study of Basic Hydraulic / Pneumatic Components.
2	Study of Hydraulic Power Unit / Power Pack.
3	Designing Hydraulic Circuit to Control a single acting Cylinder.
4	Designing Hydraulic Circuit to Control a Double acting Cylinder.
5	Designing Pneumatic Circuit to Control a single acting Cylinder.
6	Designing Pneumatic Circuit to Control a Double acting Cylinder.
7	Designing Speed control Circuit.
8	Designing a circuit with Shuttle Valve or Quick exhaust valve.
9	Field Visit to Study Air generation and Distribution.

7. SUGGESTED LEARNING RESOURCES

Sr.no.	Author	Title of Books	Publication & Year
1	Andrew Parr	Hydraulics and Pneumatics	JAICO
2	S. R. Majumdar	Oil Hydraulic Systems	TMH
3	K. ShanmugaSundaram	Hydraulics and Pneumatics Controlls	S. Chand
4	S. Ilango, V. Soudarajan	Introduction to Hydraulics and Pneumatics	PHI

(ME628) COMPUTER NUMERICAL CONTROL MACHINES

1. **RATIONALE:** - This subject is classified as core technology. It is intended to teach students facts, concepts, principle and procedures of computerized numerical machines, so that he can Supervise and operate CNC Machines.

2. TEACHING AND EXAMINATION SCHEME

Course Code & Course Title	Periods/ Week (In Hours)			Total Credits	Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
	L	T	P	C	TH	TM	PR/ OR	TW	
ME628 CNC Machines	3	-	2	5	75	25	25	25	150

Minimum passing % : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

3. COURSE CONTENTS

1.	**INTRODUCTION.** Automation in Mfg. Industry, Automation in M/c Tools.
2.	**NUMERICAL CONTROL M/C TOOLS.** NC & CNC Machines; Direct Numerical Control; Advantages and Disadvantages of CNC; Parts suitable for CNC Machines; Environmental Control for CNC Machines. **Interpolation methods in CNC machines**
3.	**CLASSIFICATION OF NUMERICAL CONTROAL SYSTEMS.** Classification based on feedback control; Classification based on control system feature; Methods of listing co-ordinates of points in CNC- Absolute Co-ordinate system, Incremental Co-ordinates System; Axis Identification in CNC Machines; Linear axis; Rotary Axis. Identification of fixed zero, floating zero, machine zero and its importance
4.	**MANUAL PART PROGRAMMING** Manual part programming; Procedure for developing; Manual part programming; NC words; Programming Formats; G and M Codes; Part programming for point to point machining;

	Part programming for machining straight line; Part programming for machining along curved surface; Part programming for lathe operations; part programming for milling. Machine operation.
5.	**COMPUTER AIDED PARTPROGRAMMING** Introduction, Types of programming Languages, Basics of APT Program, APT Language structure, APT word definitions, APT program statements/Commands, Compilation control Commands, Repetitive Programming, Complete part program using all statements(Both turning and machining centre)
6.	**PART PROGRAMMING USING SUB-ROUTINES** Part programming using sub- routines, do loops & fixed cycles on turning and machining centres. Use of subordinates for writing part programmes, Use of Do Loops for writing part programmes, Use of fixed cycles for writing part programmes.
7.	**TOOLING FOR CNC MACHINES.** Spindle tooling for Machines Centers; Tooling for CNC turning Machines; Tool presetting equipment; Flexible tooling system. Introduction to AGV,ARS, robotics.

4. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Topic	Teaching Hours/ Semester	Total Marks
1.	INTRODUCTION.	2	3
2.	NUMERICAL CONTROL M/C TOOLS	6	9
3.	CLASSIFICATION OF NUMERICAL CONTROAL SYSTEMS.	9	13
4.	MANUAL PART PROGRAMMING	8	13
5.	COMPUTER AIDED PARTPROGRAMMING	8	13
6.	PART PROGRAMMING USING SUB-ROUTINES	9	15
7.	TOOLING FOR CNC MACHINES.	6	9
	Total	48	75

5. SUGGESTED LIST OF PRACTICAL ASSIGNMENTS

Term work shall consist of the record of the following assignments:

S. No.	Unit No.	Assignments
1	**2**	Industry visits for Numerical Control System.
2	**4**	Exercise on part programme- Writing, entering and editing on CNC machines (Lathe/Machining Center).
3	**6**	Develop a part programme for following lathe operation and make. Plain Turning & facing operation. Taper Turning operation. Thread cutting operation.
4	**6**	Develop a part programme for following milling operation & make the job on CNC milling M/c, Plain milling operation. Slot milling, Rocket milling
5	**7**	Industry visits for tooling for CNC Machine.

6. SUGGESTED LEARNING RESOURCES

S. No.	Name of Author	Title of the Books	Name of the Publisher
1	Kundra, Raop&Tewari	Numerical Control & Computer aided Manufacturing	Tata McGraw Hill, N.D.
2	Adithan, M &Pabla B.S.	Numerical Control of Manufacturing Rev. System-	Wiley Eastern Ltd,
3	Korem, Y. & J.B. Uri-	CNC Machines – Programming & Applications	London; McGraw Hill.
4	Radhakrishna P &Subramanyam	CAD/CAM/CIM	New Age Publishers
5	P.N. Rao	CAD/CAM principles and applications	Tata McGraw Hill, N.D.

(IE651) FIBER RE-INFORCED POLYMERS

RATIONALE: Fibre reinforced polymers (FRP) are composites used in almost every type of advanced engineering structure, with their usage ranging from aircraft, helicopters, spacecraft, boats, ships, offshore platforms, automobiles, sports goods, chemical processing equipment and civil infrastructure such as bridges and buildings. FRP composites are lightweight, noncorrosive, exhibit high specific strength and specific stiffness, are easily constructed and can be tailored to satisfy performance requirements. It is observed that there is a shortage of trained manpower to cater to the needs of ever growing FRP industry. The course is structured to provide adequate technical knowledge about FRP that includes types of matrix resins and reinforcements, various processing and post processing methods, various kinds of inspection tests on raw materials and
finished products, repair techniques, handling and safety in FRP manufacture.

Course Code & Course Title	**Lectures/ Week (In Hours)**			**Total Credits**	**Examination Scheme**				
					Theory Marks		**Practical Marks**		**Total Marks**
IE 651	**L**	**T**	**P**	**C**	**TH**	**TM**	**PR/OR**	**TW**	
Fiber Reinforced Polymers	3	-	2	5	75	25	25	25	**150**

Minimum passing percentage : Theory 40% and Practical 40% *Duration of Theory Paper: 3 Hrs.*

COURSE CONTENT:

1.0 Introduction to composites
- 1.1 Definition of composites
- 1.2 Constituent phases
- 1.3 Classification of composites
- 1.4 Types of matrices and reinforcements
- 1.5 General characteristics of fiber reinforced composites
- 1.6 Fiber reinforced polymer composites
- 1.7 Main features, benefits and drawbacks of composites
- 1.8 Applications of FRP in various industries.

2.0 Fiber reinforcements
- 2.1 Types of fibers and their development
  - 2.1.1 Organic fibers
  - 2.1.2 Glass fibers

2.1.3 Boron fibers

2.1.4 Silicon fibers
2.1.5 Carbon fibers
2.1.6 SiC based fibers
2.1.7 Continuous mono-crystalline filaments
2.1.8 Whiskers
2.1.9 Kevlar fibers.

2.2 Fiber surface treatments for glass fibers, carbon fibers, kevlar fibers.

3.0 Organic matrices
3.1Introduction
3.2Resin structure
3.3Matrix mechanical behavior
3.4 Characteristics and applications of Thermosetting matrix systems
3.4.1 Unsaturated polyester resins
3.4.2 Vinyl ester resins
3.4.3 Epoxy resins
3.4.4 Phenolic resins
3.5 Characteristics and applications of Thermoplastic matrix materials.
3.6 Fillers and other additives
3.7 Accelerators, Promoters and catalysts.

4.0 Composite manufacturing processes
4.1 Introduction
4.2 Reinforcement shapes
4.3 Introduction to mould making
4.4 Resin matrix processes and associated tools, equipments and consumables
4.4.1 Contact molding
4.4.2 Spray up molding
4.4.3 Bag molding and autoclaving
4.4.4 Resin transfer molding
4.4.5 Vacuum molding
4.4.6 Vacuum assisted resin injection/transfer cold press molding
4.4.7 Hot press molding
4.4.8 Injection molding
4.4.9 Rotational molding
4.4.10 Centrifugal casting
4.4.11 Filament winding
4.4.12 Pultrusion
4.4.13 Compression molding
4.4.14 Sandwich construction
4.5 Prepegs and sheet molding compounds (SMC)

5 Post processing methods
5.1 Introduction
5.2 Various post processing methods
5.2.1 Cutting
5.2.2 Trimming
5.2.3 Machining

5.2.4 Joining

5.2.4.1 Mechanical fastening
5.2.4.2 Adhesive bonding
5.2.4.3 Lamination

5.2.5 Painting and coating

6 Inspection and quality control

6.1 Raw material inspection tests

6.1.1 Resin gel time
6.1.2 Resin viscosity
6.1.3 Resin peak exotherm temperature
6.1.4 Resin and hardener refractive index test
6.1.5 Fiber average density
6.1.6 Fiber moisture content
6.1.7 Fiber binder content

6.2 Tests on finished composites

6.2.1 Non destructive tests

6.2.1.1 Visual
6.2.1.2 Tap test
6.2.1.3 Ultrasonic methods
6.2.1.4 X-ray imaging
6.2.1.5 Thermography
6.2.2.6 Barcol hardness test
6.2.2.7 Hydrostatic tests

6.2.2 Other destructive tests

6.2.2.1 Loss on ignition test- to calculate resin and reinforcement percentage.
6.2.2.2 Glass transition temperature test – to verify curing of composite
6.2.2.3 Pipe burst test.
6.2.2.4 Fire endurance test

7.0 Design criteria in FRP product manufacture

7.1 Factors influencing design
7.2 Selection of raw materials
7.3 Selection of processes.

8.0 Repair and maintenance of FRP components

8.1 Tools and materials required.
8.2 Identification of defects as per required standard. eg ISO 14692
8.3 Repair procedure for superficial damage – external and internal
8.4 Major damage – Reject or repair as per manufacturer's recommendation.

9.0 Handling, disposal and safety in FRP manufacture

9.1 Precautions in handling raw materials and finished products.
9.1 Disposal of wastes developed during manufacture of FRP
9.3 Safety precautions during FRP manufacture

List of Practicals:

1. Identification of tools used in FRP repair and in fabrication.
2. Safety precautions and procedures associated with FRP.
3. Identify different resins and reinforcement fibers used in FRP manufacture.
4. Fabricate a panel using hand layup technique.
5. Fabricate a panel using vacuum assisted resin injection.
6. Fabricate a component using bag moulding and autoclave.
7. Carry out a glass fiber skin repair job.
8. Carry out an edge repair to a glass fiber panel.
9. Explain the procedure for recording a FRP repair.

Suggested specifications table with hours and marks:

Unit No.	Topic	Teaching hours per Semester	Total marks
1.0	Introduction to composites	05	09
2.0	Fiber reinforcements	06	09
3.0	Organic matrices	06	09
4.0	Composite manufacturing processes	10	15
5.0	Post processing methods	04	06
6.0	Inspection and quality control	05	09
7.0	Design criteria	05	09
8.0	Repair and maintenance of FRP components	03	03
9.0	Handling. Disposal and safety in FRP manufacture	04	06

List of Text books:

Composite materials: Engineering and science by F.L. Matthews and D. Rawlings, Woodhead Publishing Ltd Cambridge, England

G Lubin, “Hand Book of Composites”, 2nd Ed, Van Nostrand Reinhold, New York, 1982.

L.Holloway “Hand Book of Composites for Engineers”, Technomic, Lancaster, Pa, 1994.

Composite materials: Science and Engineering by Krishan K. Chawla, Springer

List of Reference books

[1] S.M. Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989.

[2] G.Shook, “Reinforced Plastic for Commercial Composites”, Source Book, Asm,1986.

[3] Kevin Potter, “An Introduction to Composites Products”, Chapman and Hall

Madras India 1997.

[4] S.T.Peter, “Hand Book of Composites”, Chapman and Hall Chennai 1998.

[5] Lin / Pearce, “High Performance Thermosets”, Hanser Publishers, Munich, NewYork, 1993.

[6] Harold Belofsky, “Plastics: Product Design And Process Engineering”, Hansen Publisher Munich, New York, 1995,

[7] Introduction to Material Science for Engineers by James F. Shackelford and Madanapalli K. Muralidhara, Pearson

[8] Engineerng Materials by A.K. Bhargava , Eastern Economy Edition