GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGG.

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1401

COURSE TITLE : THERMAL ENGINEERING

PREREQUISITE : NIL

TEACHING SCHEME: TH :04; TU : 00; PR :02; TOTAL CREDITS:06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	--	--	50#	150
MIN.	32	--	40	--	--	20	--

(@ - Internal Assessment ; # - External &Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

RATIONALE:

Mechanical engineers have to work with various power producing & power absorbing devices like boilers, turbines, compressors, pumps etc and. Thermal Engg. Form an essential element of any Mechanical Engg. Course 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 subject of Thermal Engineering which is a core subject. It includes the study of basic laws & concept of thermodynamics, gas laws, properties of steam & generation. 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.

SKILLS:-

1. Apply fundamental concepts of thermodynamics to thermodynamic systems.
2. Understand various laws of thermodynamics.
3. Apply various Gas laws & ideal gas processes to various thermodynamic systems.
4. Calculate properties of two phase system by using steam tables/ Mollier charts.
5. Explain construction & working of boilers, mountings & accessories.
6. Understand various thermodynamic cycles.
7. Understand working of modern steam turbines, condensers and their importance

OBJECTIVES:-

1) To study the basic laws and concepts of thermodynamics.
2) To understand the concept of Energy, Work, Heat and conversion between them.
3) To understand the principles, construction and working of various Power absorbing Devices like Boilers, Turbines, and Condensers etc.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**BASIC CONCEPTS**		**30**	**26**
	1.1	Thermodynamic system, boundary, surrounding, Thermodynamic properties, state, process, path of the system, Reversible and irreversible processes, Energy, Work and heat. Reversible work. Zeroth Law of Thermodynamic. (Simple Numerical).		
	1.2	First Law of Thermodynamic Concept of perpetual Motion machine 1, Application of first law of Thermodynamic to Non flow or closed system. And steady flow process, Enthalpy, Ideal gas equation. Characteristic & universal gas constants. Specific heat at constant pressure & constant volume, ratio of specific heats. (Simple Numerical).		
	1.3	Limitation of first law of thermodynamics, Second Law Of Thermodynamics, Kelvin Plank & Clausius statement, clausius Inequality, Application of Second law to Heat Engine, Heat Pump and refrigerator, COP of Refrigerator, PMM-II, and Entropy, Entropy change in reversible and irreversible processes (Simple Numerical).		
2.	**STEAM GENERATION**		**16**	**12**
	2.1	Principles of steam generation in modern steam power plants, classification of boilers , Lamont, Loffler , Velox & Benson boilers, , Boiler draught- natural & artificial, relative merits & demerits, list of boiler mountings and Accessories & its function (No Numerical).		
	2.2	Formation of steam, Properties of steam, Triple point of water ,critical temp & pressure, saturation temperature and pressure of water& steam , T-S and H-S diagram, steam table and Molliers charts .(simple numerical)		
3.	**AIR STANDARD CYCLE**		**06**	**04**
	3.1	Definition of cycle, Otto cycle, Diesel cycle.		
	3.2	Dual cycle, Air Standard Efficiency Brayton or Joules cycle. (No Numerical).		
4.	**VAPOUR CYCLE**		**06**	**04**
	4.1	Carnot cycle, Rankine cycle, Its Thermal Efficiency,		
	4.2	Modified Rankine cycle for steam engine, (No Numerical).		
5.	**CONDENSERS & COOLING TOWERS**		**10**	**08**
	5.1	Dalton Law of partial pressure Functions of condensers, classification of condensers, jet and surface condensers, Vacuum efficiency.(No numerical)		
	5.2	Condensing systems, air extraction, steam jet & water jet pump, air ejectors, cooling towers and spray ponds,		
6.	**STEAM NOZZLE & TURBINE**			
	6.1	Steam nozzle: - Continuity equation, types of nozzles, equation for exit velocity, Application of steam nozzles. Efficiency of nozzles.(no numerical)		
	6.2	Steam turbine: - Classification of turbines, Principle of operation, working of Impulse and Reaction turbine. Basic difference between Impulse and reaction Turbine, Compounding of turbines. (No numerical)	**12**	**10**
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Title of Practical/Lab. Work/Assignments	Hrs.
1.	Study of steady flow energy equation applied to boiler, turbine, engine, condenser, pump & compressor	**04**
2.	Visit to industry and report writing (Thermal Power Plant)	**06**
3.	Demonstration of boiler mountings & accessories.	**04**
4.	Demonstration of high-pressure boiler.	**04**
5.	Study of various types of condensers and its applications.	**04**
6.	Study of various types of steam turbines and its applications.	**04**
7.	Visit to ice factory and report writing on evaporating Condenser.	**06**
		32

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of Term Work and Term end oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**
7. **Field visit**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT:** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transparences / Charts

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Basic Concepts	**45**	**15**	**15**	**15**	**45**
2.	Steam Generation	**24**	**08**	**08**	**08**	**24**
3.	Air Standard Cycle	**09**	**03**	**03**	**03**	**09**
4.	Vapour Cycle	**09**	**03**	**03**	**03**	**09**
5.	Condensers & Cooling Towers	**15**	**05**	**05**	**05**	**15**
6.	Steam Nozzle & Turbine	**18**	**06**	**06**	**06**	**18**
	Total	**120**	**40**	**40**	**40**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Thermal Engineering	P.L. Ballaney	8174090312
2.	Thermal Engineering	R. K.Rajput	978-81- 318-0448-3
3.	Thermodynamics	T.Roy & Choudhari	10- 0070965889
4.	Thermal Engineering	S. Domkundwar	9788177000214
5.	Thermal Engineering	B.K.Sarkar	9780074633632
6.	Thermal Engineering	R.S. Khurmi	8121913373

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	M.P.Danial	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	M.M. Dangare	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ME/PK

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1402

COURSE TITLE : MACHINE DRAWING

PREREQUISITE : ME1302

TEACHING SCHEME: **TH : 03 ; TU : 00 ; PR : 04 ; TOTAL CREDITS: 07 (Hrs/Week)**

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	--	---	25@	25#	150
MIN.	32	--	--	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 04 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 02 HRS

❖ RATIONALE :

A Mechanical Engineering Diploma holder, 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 production drawings. Besides, he is also expected to possess certain degree of drafting skills depending upon his job function, to perform his day to day activity i.e. communicating and discussing ideas with his supervisors and passing instructions to his subordinates unambiguously. This course envisages reinforcing and enhancing the knowledge and skill acquired in the earlier two courses viz. Engineering Graphics & Engineering Drawing.

❖ OBJECTIVES :

The Student should be able to -

1. Understand industrial drawings.
2. Interpret instructions related to manufacturing of components.
3. Get familiar with the use of IS convention of representing various machine components.
4. Visualize the assembly of a given set of details of machine components.
5. Understand the significance & use of tolerances of size, forms & positions.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**AUXILIARY VIEWS**		12	08
	1.1	Study of auxiliary planes, Projection of objects on auxiliary planes. Completing the regular views with the help of given auxiliary views		
	1.2	Welding Drawing:-		

		Types of welded joints, welding symbols-elementary, supplementary And combinations. Dimensioning of welds and preparing working Drawing showing the size, length, and finish etc.of weld. Around weld, finish and flush finish weld		
2.	**DEVELOPMENT OF SURFACES OF SOLIDS.**			
	2.1	Development of lateral surfaces of regular solids (cone, cylinder, pyramid & prism)	**12**	**08**
	2.2	Development of surfaces of solids in section & solids with holes & slots		
	2.3	Development of surfaces of solids in combination such as conical hoppers, pipes in inclined positions (Development of transition pieces to be excluded).		
3.	**INTERSECTION OF SOLIDS**			
	3.1	Curves of intersection of the surfaces of the solids in the following cases - Prism with prism, Cylinder with cylinder, Prism with Cylinder When (i) the axes are at 90° and intersect (ii) The axes are at 90° and Offset	**12**	**08**
	3.2	Cylinder with Cone When axis of cylinder is parallel to both the reference planes and cone resting on base on HP and with axis intersecting and offset from axis of cylinder		
4.	**CONVENTIONAL REPRESENTATION**			
	4.1	Standard convention using SP – 46 (1988) Materials C.I., M.S, Brass, Bronze, Aluminum, wood, Glass, Concrete and Rubber	**10**	**06**
	4.2	Long and short break in pipe, rod and shaft.		
	4.3	Ball and Roller bearing, pipe joints, cocks, valves, internal / external threads.		
	4.4	Various sections- Half, removed, revolved, offset, partial and aligned sections.		
	4.5	Knurling, serrated shafts, splined shafts, and chain wheels.		
	4.6	Springs with square and flat ends, Gears, sprocket wheel		
	4.7	Countersunk & counter bore. Tapers		
5.	**PRODUCTION DRAWINGS**			
	5.1	Preparation of detailed working drawing from the given assembly The objects may be selected from the following. • Couplings – Universal couplings & GearCoupling • Bearing – Foot Step Bearing & Pedestal Bearing • Lathe tool Post, Machine vice & Pipe Vice • Screw Jack • Steam Stop Valve • Gland & stuffing box assembly. • Cross head • Connecting rod & piston of I.C. Engine. • Tailstock. • Valve assembly (max. 8 parts). • Jigs & fixtures (max. 8 components.) • Machining symbol and surface finish.	**16**	**03**
	5.2	Preparation of assembly drawing from the given drawings of details of components given in 5.1 above.		

6.	**FREE HAND SKETCHES**			
	6.1	Proportionate working drawing &Free hand sketches of following 1. Connecting rod, 2. Over Hung Crank 3. Disk Crank 4. Gland & stuffing box. 5. Simple stop valves 6. Non-return valves 7. Gear Coupling 8. Universal couplings 9. Journal bearings, Pedestal bearings, Plummer 10. Block & Foot step bearing. (Actual demonstration of models, giving information about materials used and applications of component/unit.)	**15**	**06**
7.	**CAD**			
	7.1	2D: - Isoplanes, layers and layer control, Blocks and attributes. 3D: - Surface modelling, solid modelling, Rendering, file management.	**03**	**09**
		Total	**80**	**48**

B. **LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**
(Use first angle method of projection)

S.No.	Title of Practical/Lab. Work/Assignments	Hrs.
1.	Auxiliary views • One sheet containing two problems. • Atleast four problems for home assignment in sketch book.	**08**
2.	Development of lateral surfaces of solid. • One sheet containing two problems • Atleast four problems for home assignment in sketch book	**08**
3.	Intersection of Solids • One Sheet containing atleast two problems • Atleast four problems for home assignment in sketch book	**08**
4.	Conventional Representation - one sheet	**08**
5.	Assembly to details • One sheet Covering any one assembly and its details • Atleast two problems as home assignment in sketch book	**12**
6.	Details to Assembly • One sheet Covering details of any one assembly • Atleast two problems as home assignment in sketch book	**12**
7.	Free hand sketches • One sheet containing four problems • Atleast four problems as home assignment in sketch book	**04**
8.	Two sheets on any topic from syllabus using CAD Package **Note:** - Drawings are to be prepared with all characteristics of production drawing.	**04**
	Total	**64**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term End oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**

3. **Q & A technique.**
4. **Demonstration**
5. **Case study**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models.

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Auxiliary Views	18	--	12	06	18
2	Development Of Surfaces Of Solids.	18	--	12	06	18
3	Intersection Of Solids	18	--	12	06	18
4	Conventional Representation	15	06	--	06	12
5	Production Drawings	24	03	18	03	24
6	Free Hand Sketches	23	06	12	05	23
7	CAD	04	04	--	--	04
Total		**120**	**19**	**66**	**32**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
01	Machine Drawing	N.D.Bhatt , Charotar Publication, Anand	978-93-80358-17-8
02	IS Code SP 46 (1988) Engineering Drawing Practice for School and colleges		8170610192
03	Production Drawing	L.K.Narayanan, P.Kannaich, K.VenkatReddy New Age Int. Publication	13-978-81-224-2518-5
04	Machine Drawing	P.S.Gill, S.K.Kataria and Sons	9788185749792
05	Engineering Graphics (For Topic on Auxiliary Views)	M.L.Dabhade	978-93-80064-38-3.
06	Machine Drawing	Sidheshwar,Tata McGraw Hill	9780074603376

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof.R.E. Gajbhiye	HOD Mechanical Engg.	Govt.Poly. Nagpur
2.	Prof.M.G.Thote	Lecturer Mechanical Engg.	Govt.Poly. Nagpur
3.	Prof. M. P Daniel	Lecturer Mechanical Engg.	Govt.Poly. Nagpur

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ME/PK

LEVEL NAME : APPLIED TECHNOLOGY COURSE

COURSE CODE : ME1403

COURSE TITLE : THEORY OF MACHINE

PREREQUISITE : NIL

TEACHING SCHEME: **TH :03; TU : 00; PR :02; TOTAL CREDITS:05 (Hrs/Week)**

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	---	25@	25@	150
MIN.	32	---	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01HRS.

❖ RATIONALE :

Mechanical engineering technicians primarily work as production, maintenance & design supervisors. In order to perform such jobs they should have ability to analyze, identify and interpret various mechanisms and the machines. Operation & maintenance of machines need detail information of relative motions and the functional aspect of mechanism used in the machinery and the forces and couples on the members of the machine due to external forces. The course imparts the facts, concepts, principles, procedure, kinematics analysis of four bar mechanism, cams, power transmission device, flywheel & Governor, Brake & Dynamometer, bearing, clutches, etc. Detail knowledge of above mentioned aspects with deep insight to the practical applications develop a professional confidence in them to become successful engineers.

❖ OBJECTIVES :

After completing this course students will

1. Know different machine elements & mechanisms.
2. Analyze velocities & accelerations of different points on links of four-bar mechanism at different position of crank angles.
3. Analyze the fluctuation of speed & its regulation at the governing by different types of flywheels & governors.
4. Construct cam profile & appreciate concept of pressure angle.
5. Select suitable drives & mechanisms for a particular application.
6. Appreciate concepts of balancing & vibration.

❖ SKILLS :

1. To develop ability to distinguish between mechanism, machine & structure.
2. To develop ability to identify & select suitable mechanism for particular application.
3. To develop ability to understand kinematic analysis of mechanisms.
4. To develop ability to observe critically the various relative motions in a mechanism
5. To develop ability to design cam profile.
6. To develop ability to understand the study of mechanism is the initial venture in

machine design.

7. To develop ability to come up with innovative ideas.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**INTRODUCTION TO KINEMATICS AND MECHANISM**		**08**	**08**
	1.1	Basic kinematic concept: - Definitions of Kinematics, Dynamics, Static's, Kinetics, Kinematic link, Kinematic pairs and it's type, Constrained motion and it's type, Kinematic chain and it's type, Mechanism, Gruebler's criterion, Inversion, Machine & structure, Analysis and Synthesis of mechanism.		
	1.2	Inversions of Kinematic Chain: -		
		a) Inversion of four bar chain, coupled wheels of Locomotive & Pantograph.		
		b) Inversion of Single Slider Crank chain- Rotary I.C.Engines mechanism, Whitworth quick return mechanism, Crank and Slotted lever quick return mechanism.		
		c) Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism & Oldham's coupling.		
	1.3	Spatial mechanism, Introduction to Industrial robot. (Fig: - Industrial robot has 6 degree of freedom & brief description.)		
2.	**VELOCITIES AND ACCELERATION**		**10**	**08**
	2.1	Linear displacement, Angular displacement		
	2.2	Concept of relative velocity & relative acceleration of a point on link, angular velocity & angular acceleration, inter relation between linear & angular velocity & acceleration.		
	2.3	Drawing of velocity & acceleration diagrams of given configuration, diagrams of simple mechanism. Determination of velocity & acceleration of a point on link by relative velocity method (excluding Coriollis component of acceleration).		
	2.4	Analytical method (No derivation) & Klein's construction to determine velocity & acceleration of different links in reciprocating engine mechanism.		
3.	**CAMS**		**10**	**05**
	3.1	Types of Cams & followers, Cam terminology, Applications.		
	3.2	Displacement diagram when the follower moves with (i) Uniform Velocity (ii) S.H.M. (iii) Uniform acceleration & retardation. Construction of Radial/disc/plate cam profiles with Knife-edge & Roller followers with & without offset (Graphical method).		
4.	**FLYWHEEL & GOVERNORS**		**10**	**05**
	4.1	Turning moment diagram, Function & application of Flywheel with the help of turning moment diagram for reciprocating engine (No numerical problems).		
	4.2	Function & application of governor, its comparison with flywheel, Centrifugal & inertia type governors & governor terminology (No numerical problems).		
	4.3	Coefficient of fluctuation of energy, Coefficient of fluctuation of speed & it's significance (No numerical)		
5.	**FRICTION**		**10**	**05**
	5.1	Uniform pressure & Uniform wear assumptions		

	5.2	Derivation & simple numerical problems to determine power transmitted in a single plate, multiplate & cone clutch and power absorbed in friction for flat collared & pivot bearings.		
6.	**POWER TRANSMISSION**		**12**	**06**
	6.1	Types of Drives – Belt, Chain, Rope, Gear drives & their comparison.		
	6.2	Belt Drives - flat belt, V– belt & its applications, material for flat and V-belt, angle of lap, belt length (No derivation). Slip and creep. Determination of velocity ratio, ratio of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission (Simple numerical Problems)		
	6.3	Chain Drives – Advantages & Disadvantages, Terms used in chain drive, classification of chain, Power-transmitting chain.		
	6.4	Gear terminology, types of gears & gear trains, and their selection for different applications. Train value for simple, compound & epicyclic gear train.		
	6.5	Rope Drives – Types, applications, advantages & limitations of Steel ropes.		
7	**BRAKES AND DYNAMOMETERS:**		**10**	**05**
	7.1	Definition, Classification & comparison between brakes & dynamometers.		
	7.2	Construction & working of (i) Block brake (ii) Band brake (iii) Combined band & block brake. Numerical problems to find braking force & braking torque. No derivation for ratio of tensions in combined band & block brake. Internal expanding shoe brake & line diagrams for hydraulic, vacuum & air brake systems.		
	7.3	Construction & working of - (i) Prony brake dynamometer. (ii) Rope brake dynamometer. (iii) Hydraulic dynamometer. (iv) Belt type transmission dynamometer. (No numerical problems)		
8.	**BALANCING**		**05**	**03**
	8.1	Concept of balancing		
	8.2	Balancing of single rotating mass.		
	8.3	Balancing of several masses rotating in the same plane, Analytical & graphical methods		
	8.4	Balancing of several masses rotating in four planes parallel to each other, Graphical method		
	8.5	Familiarity with various balancing grades and their applications (charts), ISO 1940		
9.	**VIBRATIONS**		**05**	**03**
	9.1	Terminology used in vibration, types of vibration.		
	9.2	Causes of vibrations in machines their harmful effects & remedies		
	9.3	Critical or whirling speed of shaft.		
	9.4	Vibration Isolation, Transmissibility and its application (No derivation, numerical)		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

The Term work (Journal & A4- size Sketch book) shall consist of the following. Oral is based on Term Work-

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	Observation & demonstration of working models & actual mechanisms available in the institute such as-	

	a) Quick return motion mechanism in shaper & slotted machines.	**05**
	b) Steering system of 4- wheeler.	
	c) I.C. engine mechanism.	
	d) Coupling rod of locomotive.	
	e) Oldham's coupling.	
	f) Elliptical Trammel.	
	g) Water hand pumps mechanism.	
	h)Geneva mechanism	

- **Note**: - Students shall identify links, and types of links, joint, and types of joints, kinematic chain, degree of freedom, mechanism or structure. Drawing of proportionate sketches of mechanisms & models observed on sketchbook only (at least five).
  Home assignment - Numerical Problem on Find the ratio of time of cutting stroke to the time of return stroke for quick return mechanism of a shaper machine.

2.	To solve three problems graphically on drawing sheets employing velocity & acceleration by relative velocity method & 0ne by Klien's construction method. (On sketchbook). Home assignment on sketchbook – three problems by relative velocity method, Klien's construction method & analytical method. (Other than above three).	**05**
3.	Determination of velocity and acceleration of piston in single slider crank mechanism for different position of crank from 0^0 to 360^0 (one revolution of crank).	**06**
	a) Compare the velocity of piston at different position of crank. By different method (Graphically & Analytically).	
	b) Represent on graph variation in velocity & acceleration of piston v/s crank angle.	
	c) Determine maximum velocity & acceleration (Analytically Method).	

Enroll. No.	Crank Angle Ø degree	Relative velocity & acceleration method.		Klien's construction thod		Analytically method	
		V in m/s	a m/s^2	V in m/s	a in m/s^2	V in m/s	a in m/s^2
	0^0 .. 360^0						

Note: - Calculate velocities & acceleration of the piston at equal interval of crank angle. Assign one crank angle (a crank position) to each student to solve above problem.

4.	Construct cam profiles on drawing sheets for specified stroke viz. cam rotation relationship with & without offset for knife-edge & roller follower. (Four numerical Problem)Home assignment on sketch book – 04 problems on construction of cam profiles (other than above)	**06**
5.	To determine balancing of rotating mass rotating in single planes on an experimental four plane balancing machine. OR Determine graphically balancing of several masses rotating in the same plane and in different planes (Two numerical problems).	**05**
6.	To sketch free hand the constructional details of different types of brakes & dynamometers by observing the models or actual systems available in various laboratories in the institution.	**05**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of Term Work and Term End oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**

2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Introduction To Kinematics And Mechanism	12	06	06	-	12
2	Velocities And Acceleration	15	-	06	09	15
3	Cams	15	-	06	09	15
4	Flywheel & Governors:	15	06	09	-	15
5	Friction	15	03	06	06	15
6	Power Transmission	18	06	06	06	18
7	Brakes And Dynamometers:	15	03	06	06	15
8	Balancing	08	02	06	-	08
9	Vibrations	07	01	06	-	07
Total		**120**	**27**	**57**	**36**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Mechanism Design: Analysis and Synthesis, vol.-I & Advance Mechanism Design: Analysis and Synthesis, vol.-II	G.N. Sandor & A.G. Erdman, Prentice Hall, Inc., New Jersey, 1984	**9780130114372**
2.	Theory of Machines and mechanism.	J.E. Shigley & J.J. Uicker, Jr., McGraw-Hill international edition	**019515598**
3.	Mechanism and Machine Theory.	J.S. Rao, R.V. Dukkipati, Wisey Eastern limited.	**812240426**
4.	Theory of Machines.	S.S. Ratan, McGraw-Hill Companies.	**1-894893-57-3**
5.	Theory of Machines.	R.S. Khurmi & J.K. Gupta, S Chand and company ltd.	**81 219 0132 4**
6.	Mechanism & Dynamics of machinery.	Mabie, Reinholtz, Wiley John Wiley Publishers.	**0471023809,**

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. S. V. Joshi	Lecturer	Govt. Polytechnic Nagpur
2.	Prof. R A. Gadekar	Lecturer	Govt. Polytechnic Nagpur
3.	Prof. K.S.Thekedar.	Lecturer	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1404 ($)

COURSE TITLE : PRODUCTION MANAGEMENT

PREREQUISITE : 80 CR

TEACHING SCHEME: TH : 03 ; TU : 01 ; PR : 00 ; TOTAL CREDITS: 04 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	50@	NIL	150
MIN.	32	--	40	---	20	---	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award of class course)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

❖ RATIONALE :

Modern manufacturing industries have complex production processes. A technician entering into such field comes across various problems involving production processes, methods, planning, scheduling etc. One has to effectively use the industrial engineering techniques for increasing productivity of men, machines, equipments and materials. Therefore, knowledge of work study, design of jigs and fixtures, changing manufacturing processes to increase the output, maintenance of equipments is very essential. The effective control of inventory of material and equipments also plays a vital role. This course helps to impart the knowledge of a technician for increasing productivity.

❖ OBJECTIVES :

The students will be able to:

- Understand the basic principles of production management.
- Use effectively various techniques for increasing productivity.
- Implement inventory control to achieve economy in production.
- Workout time and motion study for a product.
- Apply suitable material handling techniques in a plant.
- Decide appropriate maintenance schedule for machines & equipments.

❖ SKILLS :

- To develop ability to understand and interpret the layout of facilities on shop floor
- To develop ability to collect the information from industry and analyse it.
- To develop ability to appraise the various procedures for maintenance in industry.
- To develop attitude of safe working through adoption of safety procedures.
- To get acquainted with modern techniques in the industrial field with reference to production techniques.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HRS.
1.	**PROCESS ENGINEERING**		**12**	**06**
	1.1	Process planning of a product from raw material to finished product for dispatch, operation planning.		
	1.2	Determination of inspection stages.		
	1.3	Machine selection, machine capacity, machine requirement calculations (Numerical expected).		
2.	**PRODUCTION PLANNING & CONTROL**		**12**	**06**
	2.1	System of production – batch, job, mass & continuous.		
	2.2	Functions of PPC. Forecasting, order writing, product design, planning, routing scheduling, dispatching & controlling.		
3.	**PLANT LAYOUT & MATERIAL HANDLING**		**12**	**06**
	3.1	Necessity for optimum utilization of plant layout		
	3.2	Types of layouts & their comparison.		
	3.3	Need for material handling in industries.		
	3.4	Different types of M.H. devices & their comparison		
	3.5	Suitability and application of plant layout & M.H. devices in industries.		
4.	**INVENTORY MANAGEMENT**		**10**	**08**
	4.1	Stock control methods, ABC analysis.		
	4.2	Concept of JIT in inventory management.		
	4.3	Preservation techniques for different inventory items		
	4.4	KANBAN,Procurement procedure.		
5.	**MAINTENANCE & SAFETY**		**10**	**06**
	5.1	Definition of maintenance, need.		
	5.2	Types of maintenance. Breakdown, preventive, predictive, CBM.		
	5.3	Relation between maintenance & safety.		
	5.4	Definition of safety, causes of accidents.		
	5.5	Safety measures to be adapted in industries.		
	5.6	Machine history cards, logbooks, their need & importance.		
	5.7	Industrial waste control.		
6.	**INDUSTRIAL ENGINEERING**		**14**	**08**
	6.1	Productivity definition & concept.		
	6.2	Methods of productivity measurement and improvement.		
	6.3	Method study : – Terminology used, aims & objectives, steps in method study & method improvement, various recording techniques.		
	6.4	Work Measurement**: -** Definition, aims, objectives, Time study equipment, Scientific methods of work measurement, advanced methods in work measurement, normal time, standard time, allowances (Numerical).		
	6.5	Productivity definition & concept.		
	6.6	Methods of productivity measurement and improvement.		
7.	**NEW CONCEPTS IN PRODUCTION MANAGEMENT**		**10**	**08**
	7.1	Computer Aided Process Planning (CAPP)		
	7.2	Single minute exchange of dies		
	7.3	Automation in Production–cellular concept , direct on line , logistic management, etc		

	7.4	Concept of 5 S Principle		
	7.5	KAIZEN		
	7.6	JIT in production		
	7.7	Lean technology.		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	To observe and draw a layout of machines & facilities used in industry.	**02**
2.	To observe and collect information regarding different material handling equipments used in industry.	**02**
3.	To collect information regarding inventory control system in industry.	**02**
4.	To collect information regarding maintenance system & maintenance scheduling from industry.	**04**
5.	To collect information regarding safety from field.	**04**
6.	To collect information regarding at least one of the new techniques used in industry.	**02**
	Total	**16**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term End Practical examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	**Marks** (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Know ledge	**Comprehension**	**Application**	**Total**
1	Process Engineering	18	03	12	03	18
2	Production Planning & Control	18	03	12	03	18
3	Plant Layout & Material Handling	18	03	12	03	18
4	Inventory Management	15	03	09	03	15

5	Maintenance & Safety	15	03	09	03	15
6	Industrial Engineering	21	06	12	03	21
7	New Concepts In Production Management	15	03	12	-	15
	Total	**120**	**21**	**78**	**18**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Production Engineering	P.C.Sharma	13: 9788121901116,
2.	Production & Operations Management	**C**hunawala & Patel	0 -945116-08-X
3.	Computer Aided Production Management	Mahapatra	8120317424
4.	Production Planning Control & Industrial Management	R.K.Jain & Agrawal	0333-92394-4

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. . S. V. Joshi	Lecturer Mechanical Engg.	Govt. Polytechnic Nagpur
2.	Prof. Dr. V.M.Athawale	Lecturer Mechanical Engg.	Govt. Polytechnic Nagpur
3.	Prof. S. R. Kaduskar	Lecturer Mechanical Engg.	Govt. Polytechnic nagpur

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1405 ($)

COURSE TITLE : INTERNAL COMBUSTION ENGINES

PREREQUISITE : ME1401

TEACHING SCHEME: TH : 04 ; TU : 00 ; PR : 02 ; TOTAL CREDITS: 06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	25@	25#	150
MIN.	32	--	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award of class course)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

- **RATIONALE :**

  Whatever be the nature of industry, keeping a standby diesel generating set is becoming a common practice these days. The life is becoming so fast that the automobile has become the necessity. The growth of automobile industry for transportation of goods & people is increasing day by day. Therefore, Internal Combustion Engines course has been considered highly relevant for mechanical technicians.

- **SKILLS :**

  1. To develop ability to use measuring instruments.
  2. To develop ability to operate engine.
  3. To develop ability to diagnose faults and suggest remedial measures.
  4. To develop ability to analyse the performance of various engines.
  5. To develop attitude towards safety
  6. To develop ability to select the engine for the requisite application.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HRS.
1.	**INTRODUCTION**		10	08
	1.1	Classification of I.C. engines. Construction & working principles of two & four stroke petrol and diesel engines, their comparison and applications. Indicator diagrams, valve/port timings diagrams, scavenging & types of governing.		
2.	**SPARK IGNITION ENGINES**		12	08
	2.1	**Carburetion**: Engine requirements, simple carburetor, types of carburetors, limitations of simple carburetor, choke, idling jet, compensation devices, effect of nozzle tip, altitude problems in carburetion, types of fuel pump, MPFI system concept.		
	2.2	**Ignition**: Requirements for ignition, battery, magnetic, electronic ignition systems, their applications & comparisons hot & cold spark plugs.		

	2.3	**Knocking**: Combustion in S.I. engine, factors affecting knocking results of knocking		
	2.4	Aviation turbine, general layout, applications and advantages/limitations. CNG: concepts, applications, merits/demerits.		
3.	**COMPRESSION IGNITION ENGINES**		**12**	**10**
	3.1	**Fuel injection**: Fuel filters, methods of fuel injection systems, CRDI concept, description of fuel pump, fuel injector, atomizer, feed pumps.		
	3.2	**Combustion**: Phases of combustion, delay period of rapid combustion, controlled combustion, knocking, controlling diesel knock, comparison between knocking in S.I. & C.I. engines.		
	3.3	Supercharging & turbo charging, their purposes, methods & advantages.		
4.	**COOLING & LUBRICATION**		**10**	**10**
	4.1	**Cooling**: - Air cooling, its applications, advantages, water /liquid cooling, natural & forced circulation of water, application, advantages and comparison with air cooling, types of radiators.		
	4.2	**Lubrication**: - Properties of lubricating oils, parts of internal combustion engine required to be lubricate, lubrication systems function of lubricating oil, oil pump & oil filter.		
5.	**TESTING OF I.C. ENGINES**		**09**	**06**
	5.1	Engine power, indicated & brake, compression ratio, methods of determination of indicated and brake power, Morse test, calculation of I.P.B.P, mechanical efficiency, thermal and relative efficiencies, heat balance sheet, testing of I.C. engine as per B.I.S. specifications, performance characteristic curves.		
6.	**AIR COMPRESSORS**		**10**	**08**
	6.1	Uses of compressed air, classification of air compressors, construction & working of single stage, single acting air compression, and free air delivered compressor capacity, compressor displacement, and volumetric, isothermal & mechanical efficiencies. Effect of clearance & pressure ratio on volumetric efficiency. Necessity of multistage compressor, inter cooling – perfect & imperfect. Advantages of multistage & after coolers. (No derivations) effect of discharge pressure on power consumption (isothermal condition)		
7.	**POLLUTION CONTROL**		**04**	**04**
	7.1	Flue gas analysis & Pollution measurement, Emission measurement, Methods of controlling pollutants, standard specifications of EURO-I & EURO-II.		
8.	**GAS TURBINES & JET PROPULSION**		**08**	**05**
	8.1	Working cycle, elements of gas turbine, closed cycle, open cycle gas turbines, their comparison & applications		
9.	**MICROPROCESSOR CONTROL IN I.C.ENGINES**		**05**	**05**
	9.1	Introduction, Advantages and disadvantage		
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	Dismantling of 4-stroke petrol engine, studying different parts and assembling.	**04**
2.	Dismantling 2-stroke petrol engine, studying different parts and assembling.	**04**
3.	Dismantling 4-stroke diesel engine, studying different parts and assembling.	**04**
4.	Observe & report writing of fuel pump, feed pump and fuel injector.	**04**
5.	Observe & report writing of carburetor & diaphragm type petrol pump.	**02**
6.	Observe & report writing of ignition system in S.I. engines. (Magnetic, Battery & electronic)	**02**
7.	Common faults in operation of diesel and petrol engines, operation, their detection and remedies.	**04**
8.	Trial on two or four-stroke petrol engine & preparation of heat balance sheet (Morse test).	**04**
9.	Trial on four-stroke diesel engine & preparation of heat balance sheet.	**04**
	Total	**32**

❖ ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :

Continuous assessment of Term Work and Term End oral examination.

❖ SUGGESTED IMPLEMENTATION STRATEGIES :

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**

❖ SUGGESTED LEARNING RESOURCES :

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	**Marks** (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Know ledge	**Comprehension**	**Application**	**Total**
1	Introduction	15	05	05	05	15
2	Spark Ignition Engines	18	06	06	06	18
3	Compression Ignition Engines	18	06	06	06	18
4	Cooling & Lubrication	15	05	05	05	15
5	Testing Of I.C. Engines	14	05	05	04	14
6	Air Compressors	15	05	05	05	15
7	Pollution Control	06	02	02	02	06
8	Gas Turbines & Jet Propulsion	12	04	04	04	12

9	Microprocessor Control In I.C.Engines	07	02	02	03	07
	Total	**120**	**40**	**40**	**40**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Internal Combustion Engines	Mathur & Sharma. Dhanpatrai Publications	0807834386
2.	I.C. Engine	Keswani.	0807834386
3.	Thermal Engineering and Heat Engines	P.L. Ballaney Khanna Publiction	10-8174090150
4.	I.C. Engine	S. Domkundwar	8131800660

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	M.P.Danial	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	M.M.Dangare	Lecturer in Mechanical Engineering.	Government Polytechnic, Nagpur.
3.	A.R.Sheikh	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1406 ($)

COURSE TITLE : MACHINE DESIGN

PREREQUISITE : ME 1402, AM 1307

TEACHING SCHEME : TH : 04; TU : 00 ; PR : 02 ; TOTAL CREDITS: 06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	----	25@	25#	150
MIN.	32	----	40	----	10	10	----

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : 04 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

❖ RATIONALE :

Machine is a device that does useful work. The machine is composed of different elements, which are subjected to variety of forces & therefore have to resist different stresses. Hence these machine elements have to be designed properly so that the machine performs expected functions for a long time with precision and without much of wear & tear. Thus machine design is defined as the use of scientific principles, technical information & imagination in the description of a machine or a mechanical system to perform specific functions with maximum economy and efficiency. The description is in the form of drawing or blue prints.

Through this course, a student is introduced to the simple design of machine elements like cotter & knuckle joint, couplings, levers, springs etc. While designing it is expected to make use of design data book, hand books BIS specification etc.

After designing the machine elements drawings of details & assembly are to be drawn on a half imperial drawing sheets as per BIS standards along with machining symbols, tolerances etc.

❖ OBJECTIVES :

After completing this course students will be able to

1. Select proper material & processes to achieve economy & efficiency in design.
2. Analyse the problems from design point of view.
3. Refer design data book & handbook, BIS specification, reference book to get the component design.
4. Understand the design of joints, couplings, springs etc.
5. Design Joints, Couplings, springs etc.
6. Draw dimensional & production drawing as per BIS specifications.

❖ SKILLS :

After completing this course students will be able to

1. To develop ability to draw to the scale various machine components.
2. To develop ability to analyze the stress & strain induced in a component subjected to different types of loads.
3. To develop ability to select suitable material for machine component for required

application, manufacturing process selection.

4. To develop ability to handle design data book.
5. To develop ability to design machine component with the help of design data book.
6. To develop ability to come up with innovative ideas & solutions.
7. To appraise the concept of ergonomics & Aesthetic design.

CONTENTS :

A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**INTRODUCTION TO DESIGN**		15	10
	1.1	Machine Design philosophy and Procedures		
	1.2	General Considerations in Machine Design		
	1.3	Fundamentals-Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion, Principal Stresses,Creep strain and Creep Curve		
	1.4	Fatigue, S-N curve, Endurance Limit		
	1.5	Factor of Safety and Factors governing selection of factor of Safety		
	1.6	Stress Concentration- Causes & Remedies		
	1.7	Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor		
	1.8	Properties of Engineering materials, Designation of materials as per IS and introduction to International standards & advantages of standardization, use of design data book, use of standards in design and preferred numbers series		
	1.9	Theories of Elastic Failures - Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory		
2.	**DESIGN OF SIMPLE MACHINE PARTS**		10	08
	2.1	Cotter Joint, Knuckle Joint, Turnbuckle		
	2.2	Design of Levers-Hand/Foot Lever & Bell Crank Lever, Lever loaded safety valve, Rocker Arm		
	2.3	Design of C-Clamp, Off-set links, Overhang Crank, Arm of Pulley		
3.	**DESIGN OF SHAFTS, KEYS AND COUPLINGS**		14	10
	3.1	Types of Shafts, Shaft materials, Standard Sizes, Design of Shafts (Hollow and Solid) using strength and rigidity criteria, design of line shafts supported between bearings with one or two pulleys in between or one overhung pulley		
	3.2	Design of Sunk Keys, Effect of Keyways on strength of shaft		
	3.3	Design of Couplings – Muff Coupling, Flange Coupling, Bush-pin type flexible coupling		
4.	**DESIGN OF POWER SCREWS**		12	10
	4.1	Thread Profiles used for power Screws, relative merits and demerits of each, Torque required to overcome thread friction, self locking and overhauling property, efficiency of power screws, types of stresses induced, recalculating ball screw		
	4.2	Design of Screw Jack, Toggle Jack		
5.	**DESIGN OF SPRINGS**		08	06
	5.1	Classification of Springs, Application of Springs, Spring – terminology, materials and specifications		
	5.2	Stresses in springs, Wahl's correction factor, Deflection of springs, Energy stored in springs		

	5.3	Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers, and governor springs		
6.	**DESIGN OF FASTENERS**		**10**	**08**
	6.1	Stresses in Screwed fasteners, bolts of Uniform Strength		
	6.2	Design of Bolted Joints subjected to eccentric loading		
	6.3	Design of parallel and transverse fillet welds, axially loaded symmetrical		
7.	**ANTIFRICTION BEARINGS**		**06**	**06**
	7.1	Classification of Bearings – Sliding contact & rolling contact		
	7.2	Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating. Selection of ball bearing using manufacturer's catalogue		
8.	**ERGONOMICS & AESTHETIC CONSIDERATION IN DESIGN**		**05**	**06**
	8.1	Ergonomics of Design – Man –Machine relationship. Design of Equipment for control, environment & safety		
	8.2	Aesthetic considerations regarding shape, size, color & surface finish		
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :

In laboratory work students have to complete designing of following components & a production drawing on half imperial sheets (Term work will consist of drawing sheets & journal).

Each of the following design will consist of following steps–

(i) Problem specifications
(ii) Selection of materials
(iii) Permissible stresses
(iv) Force analysis
(v) Calculation of dimensions
(vi) Production drawing including machining symbols, tolerances & surface finish.

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Design of Cotter joint / Knuckle joint & Turn buckle (Any two)	**06**
2	Design of bolted joint.	**02**
3	Design of levers (Any two) i) Lever loaded safety valve ii) Bell crank lever, iii) Rocker arm.	**04**
4	Design of coupling – (Any One) (To be designed using Design data Book only). * (List of assumptions be clearly specified on the sheets) (i) Rigid flange coupling (ii) Flexible coupling	**04**
5	Design of shaft – (one each) (i) Line shaft supported in bearings with one or two pulleys & a gear (ii) Propeller shaft	**04**
6	Design of springs–(Any one) (To be designed using data book only) * (List of assumptions be clearly specified on the sheets) (i) Helical spring (ii) Leaf spring.	**04**
7	Design of Screw jack or Power Screw	**04**
8	CAD Drawing–Two assignments on preparation of assembly drawing on auto-cad from drawings covered in above sheets.	**04**
9	Case study of actual working machines and design of various components.	**---**

		Total	**32**

Note- Design of above machine component should be done using C-Programming Language batch wise two components per Batch.

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / sketchbook / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration**
v. **Case study**
vi. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

i. **PRINT:** Text books/Reference books/Manuals/Journals.
ii. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models.
IS/ International Codes

a) IS 4218: 1967 ISO Metric Threads
b) IS 2693: 1964 Cast Iron Flexible Couplings
c) IS 2292: 1963 Taper keys & Keyways
d) IS 2293: 1963 Gib Head Keys & Keyways
e) IS 2389: 1963 Bolts, Screws, Nuts & Lock Nuts
f) IS 4694: 1968 Square threads
g) IS 808: 1967 Structural Steel
h) SKF Catalogue for Bearings

C. SPECIFICATION TABLE :

Chapter No.	**Title of Chapter**	**Marks** (1.5 x Marks allotted to chapter)	**Distribution of Marks**			
			Knowledge	**Comprehension**	**Application**	**Total**
1	Introduction to design	22	10	06	06	22
2	Design of simple machine parts	15	06	06	03	15
3	Design of shafts, keys and couplings	21	09	06	06	21
4	Design of power screws	18	06	06	06	18
5	Design of springs	12	06	03	03	12
6	Design of fasteners	15	06	06	03	15
7	Antifriction bearings	09	03	03	03	09

8	Ergonomics & aesthetic consideration in design	08	03	02	03	08
	Total	**120**	**49**	**38**	**33**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Introduction to Machine Design	V.B.Bhandari, Tata Mc- Graw Hill 2001	**0070434492**
2.	Machine Design	R.K.Jain, Khanna Publication	**8174090991**
3.	Machine design	Pandya & Shah, Dhanpat Rai & Son Third Edition	**81-74009-205-6**
4	Mechanical Engg. Design	Joseph Edward Shigley, Mc-Graw Hill 2004	**0072520361**
5	Design Data Book	PSG Coimbatore.	**1-55798-273-2**
6	Hand Book of Properties of Engineering Materials & Design	Abdulla Shariff, Dhanpat Rai & Sons.2001	**9780210223680**
7	Theory and Problems of Machine Design	Hall, Holowenko, Laughlin, Mc- Graw Hill.1980	**007084352X**

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. M.G.Thote	Lecturer Mechanical Engg.	Govt. Polytechnic Nagpur
2.	Prof. S.V. Joshi	Lecturer Mechanical Engg.	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1407

COURSE TITLE : SEMINAR

PREREQUISITE : 90 CREDITS

TEACHING SCHEME : TH : 00; TU : 02; PR : 00 ; TOTAL CREDITS: 02 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	---	---	---	---	50@	---	50
MIN.	---	---	---	---	20	---	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : --

TIME ALLOTTED FOR PROGRESSIVE TEST : --

- **RATIONALE :**

  Today's competitive world of work demands the upadated knowledge regarding new and upcoming technologies. The student should be made aware about collecting, analysing, deciding and presenting the information about these new trends. This can be achieved through the practice of preapring and presenting seminar on the varied topics. This will also help in improving their communication, presentation skills, problem solving and such other soft skills.

- **OBJECTIVES :**

  The Students will be able to

  1. Appreciate the concept of information search
  2. Know the procedures of preparing a seminar report.
  3. Compile the information, analyze and draw conclusions.
  4. Present the collected/analysed data.
  5. Interact with concerned people for collecting/analysing information or data.

- **SKILLS :**

  After completing this course students will be able to

  1. Develop ability to communicate verbally & in written form.
  2. Develop ability to gather and analyze and present the gathered information/data.
  3. Develop the decision-making ability.
  4. Develop ability to find out solutions to the problems.

A. CONTENTS :

Every student will prepare & deliver the seminar. Evaluation of seminar will be carried out by panel of at least three teaching staff from mechanical/ production /automobile department.

1. Selection of topic for the seminar should be finalized in consultation with teacher guide allotted for the batch to which student belongs.
2. Seminar report should be of min.10 & max. 20 pages & it should be certified by guide teacher and head of the department.
3. for presentation of seminar, following guide lines are expected to be followed,

   a) Time for presentation of seminar: -7 to 10 minutes /student.

   b) Time for question/answer: - 2 to 3 minutes /student

   c) Evaluation of seminar should be as follows:-

   *Presentation: - 25 marks

   Use of A.V.aids:-10 marks

   Question /answer:- 15 marks

   Total:- 50 marks

   d) Use of audio visual aids or power point presentation is desirable.

4. Seminar should be on project selected by batch only with consideration to following points
   a) Purpose of selection
   b) Methodology
   c) Action plan
   d) Element listing
   e) Benefits
   f) Impact on enverionment/ surrounding
   g) Financial impacts
   h) Critics

B. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. S. V. Joshi	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Dr. V. M. Athavale	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Shri. S.R.Kaduskar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1408 ($)

COURSE TITLE : METROLOGY AND QUALITY CONTROL

PREREQUISITE : NIL

TEACHING SCHEME : TH : 04; TU : 00 ; PR : 02 ; TOTAL CREDITS: 06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	25#	25@	---	150
MIN.	32	---	40	10	10	---	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST: 01 HRS.

❖ RATIONALE :

In mechanical engineering, the manufacturing of parts and assembling is the prime work. To maintain the desired accuracy, a strict control on maintaining dimensions is must. For achieving this, adequate knowledge of basic measuring instruments like Vernier callipers, micrometers, comparators, GO-NOGO gauges and advanced equipments like Co-ordinate Measuring Machine, Angle Decor, Taylor Hofsson Tallisurf and their correct methods of using are mandatory requirements.

The contents of this course are designed to cater to above requirements by covering all relevant basic measuring and advanced measuring instruments, their design features, methods of using, cares and maintenance etc.

The practical use of these instruments in the field of quality control and the various relevant techniques regarding the field practices is also to be thought simultaneously, hence this subject is introduced.

❖ OBJECTIVES :

After completing this course students will be able

1. To identify the variables to be measured.
2. To decide the accuracy required.
3. To select a proper equipment.
4. To use correctly the selected instrument.
5. To take proper care of instrument.
6. To collect and analyze data correctly.
7. To draw the various control charts and interpret them.
8. To get acquainted with sampling inspection procedure.

❖ SKILLS :

After completing this course students will be able

1. To develop ability to select proper instrument for measurement.
2. To develop skill in handling various measuring instruments.
3. To develop attitude towards proper handling, care regarding Various metrological instruments.

4. To develop ability to analyze the data.
5. To appraise of the various quality control techniques used on shop floor.

CONTENTS :

A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**METROLOGY FUNDAMENTALS**		06	05
	1.1	Definition of metrology, need of inspection, precision, accuracy, sensitivity, stability, hysteresis, threshold, dead band, readability, calibration, errors and sources of errors		
	1.2	Abbe's Principle of alignment, selection of instruments, Precautions while using an instrument		
2.	**COMMON MEASURING INSTRUMENTS & COMPARATORS**		10	08
	2.1	Classification of instruments, Construction and methods of use of Vernier Calliper, Vernier Height Gauge, Vernier Depth Gauge, Micrometers, Dial Indicators, surface plates, angle plates, magnetic stands, V – blocks, Optical Flats, precision square block, precision cylinder, precision spirit level blocks, slip gauges, angle gauges, length bars, measuring microscopes, CMM, etc.		
	2.2	Comparators such as – mechanical, optical, mechanical – optical, electrical and electronic, pneumatic & fluid – displacement comparator, their advantages, disadvantages and limitations		
3.	**STANDARDS OF MEASUREMENT**		14	08
	3.1	Line standard, End standard and Wavelength standard and their examples		
4.	**LIMITS, FITS & GAUGES**		05	05
	4.1	Concept of limits, fits and tolerances and their symbolic representation		
	4.2	Selective assembly, Interchangeability, Hole Basis System & Shaft Basis System, Taylor's Principle of Gauge Design		
5.	**MEASUREMENT OF SURFACE FINISH**		05	05
	5.1	Primary and Secondary texture, Sampling Length, lay, Terminology as per IS 3073 – 1967, Direction of lay, Sources of lay and it's significance		
	5.2	CLA, Ra, RMS, Rz, Rp – values and their interpretation, Symbol for designating surface finish on drawing, Working principle of MECRIN – gauge, Taylor Hofson Talysurf		
6.	**MEASUREMENT OF VARIOUS DIMENSIONAL AND NON-DIMENSIONAL PARAMETERS**		20	12
	6.1	**Angular Measurement**-Classification of angle measuring instruments, Angular measurement by using Vernier Bevel Protractor, Universal Bevel Protractor, Clinometer, Angle Dekkor / Auto-collimator used in conjunction with Angle Gauges, Sine Bar / Sine Table used in conjunction with Slip Gauges		
	6.2	**Gear Measurement -** Gear Terminology, Gear tooth thickness measurement, Gear tooth profile testing and Composite gear testing		
	6.3	**Screw thread Measurement -** Screw thread terminology, measurement of various parameters by Screw Thread Micrometer, Floating carriage diameter measuring machine, Introduction to the measurement of Internal Threads		
	6.4	**Geometrical Features Measurement -** Measurement of Straightness, Flatness, Parallelism, Roundness, Squareness,		

		Alignment & Coaxiality		
7.	**STATISTICAL QUALITY CONTROL**		**20**	**21**
	7.1	**Various basic terms of SQC -** Mean, Median, Mode, Standard Deviation, range, Specification Limits, Control Limits, Normal Distribution curve, Frequency Distribution curve, Significance of three – sigma limits.		
	7.2	**Quality control charts -** Classification and selection of proper Q. C. Charts for variables such as X – bar & R – chart, 6 & R – chart, Control charts for Attributes such as p – chart, np – chart, %p - chart, C – chart, U – chart, Process Capability and it's determination.		
	7.3	**Sampling techniques -** Need of acceptance sampling, Sampling Techniques v/s 100 % Inspection, Determination of sample size, various sampling plans such as – Single Sampling Plan, Double Sampling Plan and Multiple Sampling Plan.		
	7.4	**ISO 9000 Standards and QS 14000 Standards :-** Concept of ISO 9000 Standards, ISO 9000 series, QS 14000 Standards, their evaluation and implications, Necessity of ISO Certification,ISO 9000-2008 standards, BIS standards		
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS
(Term work shall consist of following lab work/assignments/visit report etc. Oral is based on TW)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Use of Vernier Calliper.	**2**
2	Trial on Internal & External Micrometers.	**2**
3	Trial on Vernier Height Gauge.	**2**
4	Trial on Dial Indicator.	**2**
5	Trial on Vernier Bevel Protractor & Optical Bevel Protractor.	**4**
6	Trial on Sine Bar & Slip Gauges.	**4**
7	Demonstration on Optical Profile Projector & Tool Maker's Microscope.	**4**
8	Demonstration and use of Angle Deccor & Angle Gauges.	**4**
9	To Draw and interpret the control limits for X-bar & R – chart.	**4**
10	To Draw and interpret the control limits for P-chart & C – chart.	**4**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration**
v. **Case study**
vi. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

i. **PRINT:** Text books/Reference books/Manuals/Journals.
ii. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models.

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Metrology fundamentals	09	03	03	03	09
2	Common measuring instruments & Comparators	15	05	05	05	15
3	Standards of measurement	21	07	07	07	21
4	Limits, fits & gauges	06	03	03	--	06
5	Measurement of surface finish	09	03	03	03	09
6	Measurement of various dimensional and non-dimensional parameters	30	10	10	10	30
7	Statistical quality control	30	10	10	10	30
Total		**120**	**41**	**41**	**38**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Engineering Metrology	I. C. Gupta Dhanpat Rai & Sons , Delhi	10 : 8189928457
2.	Engineering Metrology	R. K. Jain, Khanna Publications, Delhi.	8172747633
3.	Engineering Metrology & Instrumentation	R.K. Rajput, Paperback Publishers, New York.	8185749825

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. Y.K.Gaiky	Lecturer Mech. Engg	Govt. Polytechnic Nagpur
2.	Prof. S. V. Joshi	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1409($)

COURSE TITLE : REFRIGERATION AND AIR CONDITIONING

PREREQUISITE : ME 1401

TEACHING SCHEME : TH : 04; TU : 00 ; PR : 02 ; TOTAL CREDITS: 06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	---	25@	25#	150
MIN.	32	---	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST: 01 HRS.

❖ RATIONALE :

With the increase in standard of living of people & society in general, the use of refrigeration & air-conditioning systems has become very common. Hence the mechanical technicians are required to know about the systems. The knowledge of various refrigeration systems, their thermodynamic analysis & different refrigerants from one of the basic requirements. It is also expected that they are conversant with various refrigerating equipments & controls, basics of cryogenics and psychrometry.

❖ OBJECTIVES :

On completion of this course the students shall be able to

1 Know about various refrigeration systems and their thermodynamic analysis.
2 Understand the working principles of various refrigerating equipments and controls.
3 Know about cryogenics.
4 Know about psychrometry & load calculations.
5 Layout of air distribution systems.

❖ SKILLS :

On completion of this course the students shall be able

1. To develop ability to use measuring instruments.
2. To develop ability to operate test rigs.
3. To develop ability to diagnose faults and suggest remedial measures.
4. To develop ability to analyse the performance of different refrigeration systems
5. To develop ability to analyse and select the proper refrigeration and air Conditioning system.
6. To appraise of modern trends in the field of refrigeration and air conditioning.

CONTENTS :
A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**BASICS OF REFRIGERATION**		10	06
	1.1	Definition of refrigeration		
	1.2	Necessity of refrigeration		
	1.3	Concept of heat engine, heat pump and refrigerator		
	1.4	Unit of refrigeration, C.O.P. and refrigerating effect. Reversed Carnot Cycle and its representation on PV and TS diagram. (Simple numericals)		
	1.5	Air Refrigeration Cycles		
	1.6	Bell Coleman air refrigerator, it's representation on PV and TS Diagram		
2.	**REFRIGERATION SYSTEM**		10	08
	2.1	**Vapour Compression Refrigeration Cycle (V.C.R.C):** principle, components, Representation on P-H and T-S diagram, effects of wet compression, dry compression, calculation of COP, Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V.C.R.C, (simple numericals), Introduction to multistage V.C.R.C, its necessity, advantages		
	2.2	**Vapour Absorption Refrigeration system :** Principle, components and working of aqua- ammonia system (simple & practical) Li-Br Absorption System Electrolux Refrigeration System, Desirable properties of Refrigerant and absorbent used in Vapour Absorption System		
	2.3	Comparison of above Refrigeration Cycles.		
3.	**REFRIGERANTS**		06	06
	3.1	Classification of refrigerants		
	3.2	Desirable properties of refrigerants		
	3.3	Nomenclature of refrigerants		
	3.4	Selection of refrigerant for specific applications		
	3.5	Concept of Green House Effect, Ozone depletion, Global warming		
	3.6	Eco-friendly refrigerants like , R-134a alternate refrigerants etc.		
	3.7	Retrofitting for switchover from conventional refrigerant to ecofriendly refrigerant,& problems associated with retrofitting.		
4.	**COMPONENTS OF VAPOUR COMPRESSION REFRIGERATION SYSTEM.**		15	10
	4.1	**Compressors -** Classification, Construction and working of open type, hermetic, centrifugal, root blower,vane type, axial, screw compressor and their applications.		
	4.2	**Condensers -** Classification, description of air cooled and water cooled condensers, comparison and applications. Evaporative condensers		
	4.3	**Expansion devices -** Types - Capillary tube, automatic expansion valve, thermostatic expansion valve and their applications		
	4.4	**Controls** – High pressure & low pressure cut-outs, high voltage & low voltage control, thermostat & overload protecter relay. Accumulator, strainer, drier, oil separator, their functions & locations		
	4.5	**Evaporators and chillers -**		

		Classification of evaporators Construction and working of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator, Capacity of evaporator and their applications. Classification of chillers, Construction and working of dry expansion Chillers and flooded chillers and their applications.		
5.	**PSYCHROMETRY**		**09**	**10**
	5.1	Definition and necessity of air conditioning		
	5.2	Properties of Air, Dalton's law of partial pressure		
	5.3	Psychrometric chart		
	5.4	Psychrometric processes, Bypass Factor, ADP, concept of SHF, RSHF, ERSHF, GSHF		
	5.5	Adiabatic mixing of Air streams		
	5.6	Simple numericals using Psychrometric chart.		
	5.7	Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils		
6.	**COMFORT CONDITIONS AND COOLING LOAD CALCULATIONS**		**10**	**08**
	6.1	Thermal exchange of body with environment		
	6.2	Factors affecting human comfort		
	6.3	Effective temp. and comfort chart		
	6.4	Components of cooling load- sensible heat gain and latent heat gain sources		
7	**AIR- CONDITIONING SYSTEMS**		**10**	**08**
	7.1	Classification of A.C. systems		
	7.2	Industrial and commercial A.C. systems		
	7.3	Summer, winter and year round A.C. systems		
	7.4	Central and unitary A.C. systems		
	7.5	Application areas of A.C. systems		
8	**AIR DISTRIBUTION SYSTEMS**		**10**	**08**
	8.1	Duct systems -Closed perimeter system, extended plenum system, radial duct system, duct materials, requirement of duct materials, losses in ducts		
	8.2	Fans and Blowers -Types, working of fans and blowers		
	8.3	Air distribution outlets: - Supply outlets, return outlets, grills, diffusers		
	8.4	Insulation - Purpose, properties of insulating material, types of insulating materials, methods of applying insulation.		
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :
(Term work shall consist of following lab work/assignments/visit report etc. Oral is based on TW)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Trial on water cooler test rig.	**02**
2	Trial on ice plant test rig.	**02**
3	Visit to cold storage	**06**
4	Demonstration of domestic refrigerator in View of construction, operation and controls used	**02**
5	Demonstration of various controls like L.P./H.P. cut outs, thermostat, overload protector, solenoid valve used in RAC	**02**
6	Identification of components of 'hermetically sealed compressor.	**02**
7	Visit to repair and maintenance workshop in view of use of various tools and charging procedure	**06**

8	Trial on A.C. test rig.	**02**
9	Visit to central A.C. plant in view of ducting system, insulation system and Air distribution system (e.g. frozen food industry/ice-cream industry/mushroom plants/textile industries).Trouble shooting of domestic refrigerator/window air- Conditioner	**06**
10	Case study of heat load calculations of room air-conditioning	**02**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**
7. **Industrial visit.**

❖ **SUGGESTED LEARNING RESOURCES :**

1) PRINT: Text books/Reference books/Manuals/Journals.

2) NON PRINT : CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	**Title of Chapter**	**Marks** (1.5 x Marks allotted to chapter)	**Distribution of Marks**			
			Knowledge	**Comprehension**	**Application**	**Total**
1	Basics of refrigeration	15	05	05	05	15
2	Refrigeration system	15	05	05	05	15
3	Refrigerants.	09	03	03	03	09
4	Components of vapour compression refrigeration system.	22	08	07	07	22
5	Psychrometry	14	05	05	04	14
6	Comfort conditions and cooling load calculations	15	05	05	05	15
7	Air- conditioning systems	15	05	05	05	15
8	Air distribution systems	15	05	05	05	15
Total		**120**	**41**	**40**	**39**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	**Title**	**Author, Publisher, Edition and Year Of publication**	**ISBN Number**
1.	Refrigeration and Air Conditioning	R.S.Khurmi; S.Chand and Co.	81-219-1687-9

2.	Refrigeration and Air Conditioning	C.P.Arrora, Tata Mc-Graw Hill.	0-07-451515-2
3.	Refrigeration and Air Conditioning	Manohar Prasad, New Age Publications.	13: 9788122414295
4.	Refrigeration and Air Conditioning	P.N.Ananthanarayanan; "Tata McGraw Hill.	0074620088

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. M.M.Dangre	Lecturer Mech. Engg	Govt. Polytechnic Nagpur.
2	Prof. M.P. Daniel	Lecturer Mech. Engg	Govt. Polytechnic Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1410 ($)

COURSE TITLE : FLUID POWER ENGINEERING

PREREQUISITE : NIL

TEACHING SCHEME : TH : 04; TU : 00 ; PR : 02 ; TOTAL CREDITS: 06 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	---	25@	25#	150
MIN.	32	---	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

❖ RATIONALE :

Hydraulic Engineers play a vital role in present age. Different types of turbines are used in hydroelectric power plant. The pumps in general find their place in almost all types of industries in process plants, in irrigation, city water supply systems & indivisiual uses. Therefore the knowledge of turbines & pumps becomes inevitable. Selection of pump is very much essential to handle the fluidic mixture. The hydraulic machines such as lifts, presses, cranes etc. are largely used in industries. The hydraulic circuits and CNC machines.are incorporated in many automation industries, Pneumatic tools are largely used in machine and assembly shops. Hence their study is necessary.

❖ OBJECTIVES :

After completing this course students will be able to

1. Know the basic fluid properties, laws pertaining to their behavior & resistances offered during the flow due to various obstructions.
2. Measure various quantities using piezometer tube, tube, pilot tube, differential manometer, pressure gauges, venturi meter & triangular notch.
3. Understand the classification, construction & working principles of centrifugal pumps & reciprocating pumps along with their performance characteristics & selection.
4. Understand the construction & working principles of hydraulic presses, jack, lift, cranes, intensifiers & accumulators.
5. Know the elements of hydraulic & pneumatic circuits, symbolic representations. Simple circuits for operation of grinder, shaper & milling machines.
6. Understand the operation of pneumatic tools.
7. Understand the construction & working principles Reaction and Impulse Turbine

❖ SKILLS :

After completing this course students will be able to

1. To develop ability to use measuring instruments.
2. To develop ability to operate machine.
3. To develop ability to diagnose faults and suggest remedial measures.

4. To develop ability to analyse the performance of hydraulic turbine.
5. To develop ability to analyse the performance of hydraulic and pneumatic circuit.

CONTENTS :
A: THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**FLUID MECHANICS**		20	15
	1.1	Properties of Fluids, pressure and its measurement, (Simple Numericals)		
	1.2	Hydrostatic forces on surfaces (Simple Numericals)		
	1.3	Kinematics of flow (Simple Numericals)		
	1.4	Dynamics of fluid flow (Simple Numericals)		
	1.5	Orifices and mouthpieces (Simple Numericals)		
	1.6	Flow through the pipes ,Total energy line, hydraulic gradient line, (Simple Numericals)		
2.	**CENTRIFUGAL PUMP**		10	08
	2.1	Introduction, main components ,working ,application		
	2.2	Heads, Losses, work done & efficiency of centrifugal pump		
	2.3	Priming, Cavitation, NPSH ,specific speed of C.P		
	2.4	Performance characteristic, multistage pump, pump selection		
	2.5	Simple Numerical on C.P		
3.	**RECIPROCATING PUMP**		10	08
	3.1	Construction, main components and principle of Reciprocating pump		
	3.2	Single acting and double acting pumps, Coefficient of discharge and concept of slips		
	3.3	Indicator diagram with acceleration head and friction head		
	3.4	Cavitations, separation, Air vessels and performance characteristic		
	3.5	Simple Numerical on R.P		
4.	**HYDRAULIC TURBINES**		20	12
	4.1	Impact of jet on flat and curved vanes for stationary and moving plate work done by the jet. (Simple Numericals)		
	4.2	Impulse Turbine, classification, working, construction, Heads, work done and efficiencies, (Simple Numericals)		
	4.3	Applications, governing of turbines, velocity diagrams, specific speed, work done		
	4.4	Classification, working, construction of Reaction Turbine, Draft Tube, Its type, specific speed, main (Simple Numericals)		
	4.5	Characteristic curve of Hydraulic Turbine, governing of Reaction turbines, selection of Turbine		
5.	**HYDRAULIC SYSTEM**		10	09
	5.1	Hydraulic ram its construction details, working principle and its efficiency (Simple Numericals)		
	5.2	Construction, working and applications of following hydraulic system Accumulator, Intensifier, Hydraulic jack, Press, Crane, Lift, coupling, Torque converter, Air lift pump etc.		
6.	**HYDRAULIC CIRCUITS**		05	06
	6.1	Pressure control valves, Flow control valves, Direction control valves		
	6.2	Hydraulic symbols for pumps, motor, valves & controls		
	6.3	Speed control circuits of hydraulic ckt.		
7.	**PNEUMATIC CIRCUITS**		05	06

	7.1	FRL unit (air filters, pressure regulator & lubricator), pneumatic cylinders, single and double acting, air motor such as piston, vane type		
	7.2	Pneumatic tools such as drill, hammer, grinder & riveter		
	7.3	General pneumatic circuit, its comparison with hydraulic circuit		
	7.4	Symbols for pneumatic circuit		
		Total	**80**	**64**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :
(Term work shall consist of following lab work/assignments/visit report etc. Oral is based on TW)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Determination of coefficient of discharge for triangular notch	**04**
2	Determination of coefficient of discharge for circular orifice.	**03**
3	Determination of Darcy's Coefficient of friction for flow through pipes.	**04**
4	Trial on centrifugal pump to draw performance characteristic curves	**03**
5	Trial on reciprocating pump to draw performance characteristic curves	**03**
6	Trial on hydraulic ram to find its efficiency.	**03**
7	Trial on Pelton wheel turbine to draw performance characteristics curves.	**03**
8	Trial on Francis turbine to draw performance characteristics curves	**03**
9	Demonstration of hydraulic circuit	**02**
10	Demonstration of pneumatic circuit	**02**
11	Demonstration of hydraulic circuit for shaper machine.	**02**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**
7. **Industrial Visits.**

❖ **SUGGESTED LEARNING RESOURCES :**

1) PRINT: Text books/Reference books/Manuals/Journals.

2) NON PRINT : CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Fluid mechanics	30	10	10	10	30

2	Centrifugal pump	15	05	05	05	15
3	Reciprocating pump	15	05	05	05	15
4	Hydraulic turbines	30	10	10	10	30
5	Hydraulic system	15	05	05	05	15
6	Hydraulic circuits	08	03	03	02	08
7	Pneumatic circuits	07	03	02	02	07
	Total	**120**	**41**	**40**	**39**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Fluid mechanics and Hydraulic machines	Dr. R.K.Bansal Firewall Media Publication.	8170083117
2.	Fluid mechanics and Hydraulic machines	Dr.R.K.Rajput S.Chand & Company Limited, New Delhi,	8121916666
3.	Fluid mechanics and Hydraulic machines	S. Ramamrutham, R. Narayan Dhanpat Rai Publishing Company (P) Ltd., 2006	8187433841
4	Fluid mechanics and Hydraulic machines	Jagdishlal, MPP Publication.	9788120002722

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. N.S.Pawar	Lecturer Mechanical engg.	Govt. Polytechnic Nagpur
2.	Prof. M.P Daniel	Lecturer Mechanical engg.	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME 1411 ($)

COURSE TITLE : COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING (CAD/CAM)

PREREQUISITE : WS1402

TEACHING SCHEME: TH :02; TU : 00; PR :02; TOTAL CREDITS: 04 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	---	---	---	25#	50@	---	75
MIN.	---	---	---	10	20	---	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

❖ RATIONALE :

CAD/CAM technology is moving in the direction of greater integration of design activities & manufacturing activities. CAD covers the use of computer to assist creation, modification and analysis of design CAM include the use of computer to plan manage & control the operation in manufacturing.

❖ OBJECTIVES :

Student will be able

1. To understand the fundamentals of CAD.
2. To known transformation of drawing.
3. To understand fundamentals of CAM
4. To understand CNC, DNC system.
5. To understand Group Technology.

❖ SKILLS :

Student will be able

1. To develop ability to handle CAD / CAM software
2. To develop ability to prepare models in CAD
3. To develop ability to identify the requirement and generate program by using appropriate software.
4. To appraise the concept of CNC/DNC.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		HOURS
1.	**FUNDAMENTAL OF CAD**		06
	1.1	Introduction, scope of CAD	
	1.2	Benefits of CAD hardware of CAD	
	1.3	Input/output devices	

	1.4	CRT and their types	
	1.5	Storages devices	
	1.6	Product cycle.	
2.	**GEOMETRIC MODELING**		**06**
	2.1	Introduction to Geometric Modeling, types of geometric modeling	
	2.2	Wire frame Modeling- Linear edges, Curve linear edges	
	2.3	Surface Modeling	
	2.4	Solid Modeling	
	2.5	Pure primitive instancing, General sweep , Partial occupancy enumeration, Cell decomposition, Constructive solid geometry, Boundary Representation	
	2.6	Animation Engineering	
	2.7	Introduction to sheet metal modeling.	
3.	**TRANSFORMATION AND DATABASE MANAGEMENT**		**08**
	3.1	TWO DIMENSIONAL TRANSFORMATION translation, rotation, scaling (Only Matrix Representation)	
	3.2	THREE DIMENSIONAL TRANSFORMATION translation, rotation, scaling (Only Matrix Representation)	
	3.3	DATABASE MANAGEMENT Database model, hirachical, Network database-Design Database.	
4.	**DESIGN PROCESS**		**06**
	4.1	General design procedure, Application of computer for design, Geometric Modeling Engg., Analysis, Design review & Evaluation	
	4.2	Automated Drafting .Automated Modeling database used for different application of CAD/CAM for e.g. tool & fixture design , NC Programming	
	4.3	CAPP, Computerized production planning & scheduling. Computer aided Process plan – Retrieval types, CAPP (variant system) , Generative CAPP, benefits of CAPP	
	4.4	Material Resource Planning , inventory management , manufacture & Resource planning	
5.	**CAM**		**06**
	5.1	DNC – Component of DNC, its type , functions ,and advantages	
	5.2	Group Technology – Introduction, part families, part classification & coding	
	5.3	GT machine cell, types of GT machine cell , benefits of GT as compared to other system	
		Total	**32**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

(Enlisted experiments should be conducted on any CAD/CAM software (IDEAS, Pro-e, CATIA, Uni-graphics , Solid edge etc.).

S.No.	Title of Practical/Lab.Work/Assignments	HRS
1.	2-D Drafting (Any Two sketches)	**08**
2.	3-D Model (Any two components)	**08**
3.	One Assembly model. (Min 5-components)	**08**
4.	Generation of CNC programme using post processor (any two component) Demonstration of CNC program generated by post processor on any CNC machine	**04**
5.	Industrial visit/Report.	**04**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term End Practical examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars,**
7. **Industrial visits.**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	CAD/CAM	M. Groover, E. Zimmers, Pearson Education	8177584162
2.	CAD/CAM	Suresh Dalela and P.K. Jain, S Chand & Company	8121917840
3.	CAD/CAM: Principles and Applications	P.N.Rao Tata McGraw-Hill Education	0070583730

D. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1	Prof. A.R.Shaikh	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2	Prof. M.G.Thote.	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1412

COURSE TITLE : ENGINEERING MATERIALS

PREREQUISITE : NIL

TEACHING SCHEME : TH : 03; TU : 01 ; PR : 00 ; TOTAL CREDITS: 04 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	----	25@	----	125
MIN.	32	---	40	----	10	----	----

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST: 01 HRS.

❖ RATIONALE :

In mechanical engineering, the selection and application of various materials, metals and non-metals is of prime importance for the designing & manufacturing of parts. To maintain the desired quality, better selection of metals and materials is required. So, for achieving adequate knowledge about various metals and materials, there is a need of this subject. The contents of this course are designed to cater to above requirements by covering all relevant basic requirements. This course covers information about various ferrous metals, non-ferrous metals, non-metals and their specific properties for the selection and application in the various areas of designing and manufacturing. The practical use of this course in the field of designing and manufacturing play a vital role in the mechanical engineering field, hence this subject is introduced.

❖ OBJECTIVES :

After completing this course students will be able to

1. To select and apply the proper metals and material for the various applications.
2. To know the properties of various metals and materials.
3. To select a proper metal or alloy for the reactor, container or vessel.
4. To use correctly the Heat Treatment Process for the machine parts.
5. To know the necessity and application of Powder Metallurgical Parts.
6. To select and use a proper Non-destructive Testing Method.

❖ SKILLS :

After completing this course students will be able

1. To develop ability to select proper metal or material for the various machine parts.
2. To develop skill in selection and application of metals and materials for the reactors, containers, vessels, etc.
3. To develop knowledge towards proper selection and application of a specific heat Treatment Process for the metals and alloys.
4. To understand the application of Powder Metallurgy Process.
5. To develop ability to apply Non-destructive technique.

CONTENTS :

A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**ENGINEERING MATERIALS AND THEIR PROPERTIES**		**10**	**08**
	1.1	Introduction, classification and applications of Engineering materials, I.S. Specifications of metals, composition of Mild Steel, Stainless Steels, Alloyed Steels, Cast Steel, Cast Iron, Alloyed Cast Iron, S.G.Iron, Grey Cast Iron, Ductile Iron and Bearing Materials, Corrosion Resistant Metals and materials, etc		
	1.2	Properties of metals – "Physical Properties" such as – Structure, Density, Melting Point, etc.		
2.	**FERROUS METALS AND ALLOYS**		**12**	**08**
	2.1	Characteristics and applications of Ferrous Metals and Alloys, Iron-Iron Carbide Equilibrium diagram, Flow diagram for production of Iron and Steel, Classification, composition and uses of Cast Irons		
	2.2	Chemical composition, properties and applications of Low Carbon Steel, Medium carbon steel, High Carbon Steel. Alloy Steels – Low Alloy Steel, High Alloy Steel, Tool Steel & Stainless Steel and the effects of various alloying elements such as – Nickel, Chromium, Tungsten, Molybdenum, Cobalt, Vanadium, Manganese, Silicon, etc.		
3.	**NON-FERROUS METALS AND ALLOYS**		**12**	**08**
	3.1	Chemical composition, properties and applications of Copper Alloys such as – Brass, Bronze, Muntz metal, Gun metal, Monel metal, etc.		
	3.2	Chemical composition, properties and applications of Aluminium Alloys such as – Duraluminium, Alnico, magnox, Silumin, Titanul, Y – alloy, etc.		
4.	**NON-METALLIC MATERIALS**		**12**	**06**
	4.1	Properties and applications of polymeric Materials such as – Thermoplastics (Acrylic, Nylon, Teflon), Thermosetting Plastics (Polyesters, Expoxies, Melamines & backelite), Rubbers (Neoprene rubber, Butadiene Rubber, Silicon Rubber)		
	4.2	Properties and applications of Engineering Materials such as – Ceramics, Adhesives,Cork, Asbestos, Thermocol, glass wool,etc.		
5.	**HEAT TREATMENT OF STEELS**		**12**	**06**
	5.1	Introduction to Heat Treatment Processes such as – Hardening, Annealing, Normalizing, Tempering (Austempering, Martempering), Principles and Applications, S – curves		
	5.2	Surface Hardening methods such as – Case Hardening, Flame Hardening, Induction Hardening, Nitriding & Carburising		
6.	**POWDER METALLURGY**		**10**	**06**
	6.1	Advantages, limitations and applications of Powder Metallurgy for the engineering products		
	6.2	Powder Metallurgical process – Powder making, Blending, Compacting, Sintering, Infiltration and Impregnation		
	6.3	Applications of Powder metallurgy for Tungsten Carbide tip tools & Porous Bearings		
7.	**NON-DESTRUCTIVE TESTING**		**12**	**06**
	7.1	Importance of Non-destructive testing, Difference between Destructive and Non-destructive testing		
	7.2	Non-destructive testing methods such as – Radiography (X – Ray &		

		Gamma Ray), Ultrasonic Flaw detection, Dye Penetrant test, Magnaflux test.		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS: -
(Term work shall consist of following Lab.work/assignments/ visit report etc.)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Assignment /Demonstration of the classification and applications of Engineering materials, such as – Metallic / Non-metallic materials.	1
2	Assignment on the characteristics and applications of Ferrous Metals and Alloys, such as – MS, CS, SS, CI, DI, GI, S.G. Iron, etc.	1
3	Assignment on the characteristics and applications of Non-ferrous Metals and Alloys, such as – Copper Alloys, Aluminium Alloys, etc.	1
4	Assignment on the characteristics and applications of various Corrosion Resistant Metals.	1
5	Assignment/Demonstration of the details of Heat Treatment Processes, such as - Hardening, Annealing, Normalizing, Tempering (Austempering, Martempering)	2
6	Assignment on the details of Powder Metallurgical process and the Applications of Powder Metallurgy for the engineering products.	2
7	Assignment/Demonstration of the details of Non-destructive testing methods such as – Radiography (X – Ray & Gamma Ray).	2
8	Assignment/Demonstration of the details of Non-destructive testing methods such as – Ultrasonic Flaw detection.	2
9	Assignment /Demonstration of the details of Non-destructive testing methods such as –Dye penetrant test	2
10	Assignment/Demonstration of the details of Non-destructive testing methods such as –Magnaflux test.	2
	Total	**16**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

i. **PRINT:** Text books/Reference books/Manuals/Journals.
ii. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total

1	Engineering materials and their properties	15	05	05	05	15
2	Ferrous metals and alloys	18	06	06	06	18
3	Non-ferrous metals and alloys	18	06	06	06	18
4	Non-metallic materials	18	06	06	06	18
5	Heat treatment of steels	18	06	06	06	18
6	Powder metallurgy	15	05	05	05	15
7	Non-destructive testing	18	06	06	06	18
	Total	**120**	**40**	**40**	**40**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Material Science and Metallurgy	O.P. Khanna ,Dhanpat Rai and Sons	13978013
2.	Material Science and Metallurgy	Dr. D.V. Kodgire ,Everest Publishing House	8186314008
3.	Engg. Materials and Metallurgy	R.K. Rajput ,S. Chand & Co.	8121927099
4.	Engg.Materials & Metallurgy	R. Srinivasan ,Tata Mc- Graw Hil Publications ; New Delhi.	13: 980070672819
5.	Engg. Materials & Metallurgy	Dr. J.T. Winowlin Japper ; Laxmi Publications Pvt. Ltd.; New Delhi.	8170089573

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. Y.K.Gaiky	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur
2.	Prof. S.V.Joshi	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1413

COURSE TITLE : MECHANICAL MEASUREMENT

PREREQUISITE : NIL

TEACHING SCHEME: TH : 03 ; TU : 00 ; PR : 02; TOTAL CREDITS: 05 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	--	25@	25#	150
MIN.	32	--	40	--	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

- **RATIONALE :**

The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of non electrical parameters like temperature, pressure, flow, velocity, force and stress.

- **OBJECTIVES :**

The students will be able to

1. Understand the selection and application of various transducers.
2. Understand the selection and use of various instruments.
3. Apply the concept of measuring techniques.

- **SKILLS :**

1. To develop ability to understand the concept of measurement.
2. To develop ability to know working and applications of various transducers.
3. To develop ability to understand and develop the measuring techniques.
4. To carry out the selection and application of various instruments. .

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**FUNDAMENTAL OF MEASUREMENTS**		**10**	**05**
	1.1	Significance of measurement, classification of instruments.		
	1.2	Static terms and characteristics, range and span, accuracy and precision, calibration, hysteresis and dead zone, threshold and resolution, drift, sensitivity, stability, linearity, non-linearity, traceability.		
	1.3	Dynamic characteristics- speed of response, fidelity and dynamic		

		errors, overshoot.		
	1.4	Measurement of error- classification of errors, environmental errors, signal transmission errors, observation errors, operational errors, random errors.		
2.	**CONTROL SYSTEMS**			
	2.1	Block diagram of automatic control system, ,	**10**	**07**
	2.2	Closed loop system, open loop system, feed back control system, feed forward control system.		
	2.3	Proportional integration and derivative (PID) – controller.		
	2.4	Applications of measurements and control setup for boilers, air conditioners, and motor speed control.		
3.	**PRESSURE MEASUREMENTS**			
	3.1	Selection criteria for various pressure gauges.	**08**	**06**
	3.2	Specification of pressure gauges.		
	3.3	Methods of measuring pressure, vaccum.		
	3.4	Types of pressure gauges, Bourdon tube pressure gauge, Bourdon tube vacuum gauge, Diaphragm type pressure gauge, Bellow type pressure gauge, manometers, Mc-leod gauge, piezo-electric load cell.		
4.	**TEMPERATURE MEASUREMENTS**			
	4.1	Definition and temperature scales, bimetallic thermometer, liquid in glass thermometer, mercury in steel tube thermometer, platinum resistance thermometer, thermistor.	**10**	**06**
	4.2	Thermocouple- elements of thermocouple, law of intermediate temperature, law of intermediate metals.		
	4.3	Pyrometers- Total Radiation Pyrometer and Optical Pyrometer.		
5.	**FLOW MEASUREMENTS**			
	5.1	Head type flow meters - Orificemeter, Venturimeter, Nozzlemeter.	**08**	**06**
	5.2	Rota meter		
	5.3	Anemometer- hot wire and hot film		
	5.4	Turbine flowmeter, Nutating Disc type flowmeter.		
	5.5	Ultrasonic flow meter, Electromagnetic flowmeter.		
	5.6	Mass flow meter (Coriolis principle).		
6.	**STRAIN MEASUREMENT**			
	6.1	Stress-strain relation.	**10**	**06**
	6.2	Types of strain gauges.		
	6.3	Strain gauge materials.		
	6.4	Mounting of gauges.		
	6.5	Resistance strain gauge- bonded and unbounded type, foil type gauge , semiconductor type gauge, wire wound gauges.		
	6.6	Strain gauge Load cells, Strain Rossets.		
7.	**DISPLACEMENT MEASUREMENT**			
	7.1	Potentiometers, LVDT, RVDT, Inductive transducer, Capacitive transducer.	**08**	**04**
	7.2	Ultrasonic displacement sensor.		
8.	**LEVEL MEASUREMENT**			
	8.1	Mechanical type - float & shaft gauge, Dip Stick, Sight Glass. level measurement of solid substance, Differential pressure principle.	**08**	**04**
	8.2	Ultrasonic techniques for - Liquid level measurement & Solid substance level measurement.		
9.	**FORCE , TORQUE & SHAFT POWER MEASUREMENT**			
	9.1	Force measurement by Elastic force meters, Spring balance, Beam Balance, Pendulum Scale.	**08**	**04**

	9.2	Torque Measurement by Torsion meters,Torque Wrench.		
	9.3	Shaft power measurement by mechanical dynamometer, electric dynamometer, and transmission dynamometer.		
			80	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	Know Your Measurement Lab.	**02**
2.	Temperature control by using Thermal Reed Switch & Bimetal Switch.	**02**
3.	Measurement of pressure and vacuum by using Bourdon tube type Gauges.	**02**
4.	Determination of Negative Temperature Coefficient and calibration of a thermistor.	**02**
5.	Measurement of flow rate by using Rotameter.	**04**
6.	Verify characteristics of a Strain Gauge.	**04**
7.	Displacement measurement by using LVDT.	**04**
8.	Liquid Level measurement by using Capacitive Gauge.	**04**
9.	Liquid Level measurement by using Float and Shaft Gauge.	**04**
10.	Measurement of force, Torque and Shaft Power.	**04**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term End Oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Fundamental Of Measurements	15	6	6	3	15
2	Control Systems	15	6	6	3	15
3	Pressure Measurements	12	3	6	3	12
4	Temperature Measurements	15	6	6	3	15
5	Flow Measurements	12	3	6	3	12
6	Strain Measurement	15	6	6	3	15
7	Displacement	12	3	6	3	12

	Measurement					
8	Level Measurement	12	3	6	3	12
9	Force , Torque & Shaft Power Measurement	12	3	6	3	12
Total		**120**	**39**	**54**	**27**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Mech. Measurements & Instrumentation	A.K.Sawhney, Dhanpat Rai & Sons, New Delhi.	0071775076
2.	Mechanical Measurement & Control.	R.V. Jalgaonkar, Everest Publishing House, Pune.	0-915299-41-0. 2
3.	Mechanical & Industrial Measurements.	R.K.Jain Khanna Publications, New Delhi.	9788174091918
4.	Instrumentation Devices & Systems'	C.S.Narang, Instrumentation Devices & Systems' Tata McGraw Hill Publications, New Delhi.	9780074633502
5.	Mechanical Measurements & Control.	D.S.Kumar , Metropolitan Public., New Delhi	9788120002728

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. Y.K.Gaiky	Lecturer	Govt. Polytechnic Nagpur
2.	Prof. A.R. Shiekh	Lecturer	Govt. Polytechnic Nagpur
3.	Prof. K.S. Thekedar	Lecturer	Govt. Polytechnic nagpur

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1414

COURSE TITLE : SUPPLY CHAIN MANAGEMENT

PREREQUISITE : NIL

TEACHING SCHEME : TH : 03; TU : 02 ; PR : 00 ; TOTAL CREDITS: 05 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	----	25@	----	125
MIN.	32	---	40	----	10	----	----

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.

❖ RATIONALE :

A Supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm.

In the present market scenario, there are many challenges that are forcing the existing supply chains for revamp. However, increasing global competition necessitates identifying right avenues for investing efforts and resources for such improvements. For this reason, it is important to thoroughly understand various aspects of Supply Chain Management (SCM), the purposes for which it has been used in the past, the benefits of its applications and the obstacles that have been faced in its use. Keeping this in view, the students are required to know about the supply chain management. What a supply chain is, why it is important, and what types of challenges are implicit in managing supply chain. It is also expected that they are conversant with various concepts, drivers of supply chain.

❖ OBJECTIVES :

After completing this course students will be able to

1. Understand the strategic importance of good supply chain design, planning and operation for every firm.
2. Describe the cycle and push/pull views of supply chain.
3. Identify the three key supply chain decision phases.
4. Understand how good supply chain management can be competitive.
   advantage while weaknesses in the supply chain hurt the performance of a firm.
5. Identify facilities, inventory, transportation and information as the key drivers of supply chain performance.
6. Understand how these drivers may be used on a conceptual level during supply chain design, planning and operation to improve performance.

❖ SKILLS :

After completing this course students will be able to

1. To develop ability to understand the basic concept of supply chain management.
2. To develop ability to understand strategic role of supply chain.
3. To develop ability to identify key strategic drivers of supply chain performance.
4. To develop ability to understand the role of supply chain management in industrial process.
5. To develop ability to understand the role of information technology in supply chain management.

CONTENTS :
A: THEORY

SR. NO.	CHAPTER		MARKS	HOURS
1.	**INTRODUCTION TO SUPPLY CHAIN MANAGEMENT**		**16**	**08**
	1.1	Definition of supply chain		
	1.2	Objective of supply chain		
	1.3	Decision phases in a supply chain		
	1.4	Process view of supply chain: Cycle view of supply chain processes, Customer order cycle, Replenishment cycle, Manufacturing cycle, Procurement cycle. Push/Pull view of supply chain processes		
	1.5	Importance of supply chain flows		
	1.6	Examples of supply chains		
2.	**SUPPLY CHAIN STRATEGIES**		**12**	**08**
	2.1	Competitive and supply chain strategies		
	2.2	Achieving strategic fit		
	2.3	Expanding strategic scope		
3.	**SUPPLY CHAIN DRIVERS AND OBSTACLES**		**20**	**12**
	3.1	Drivers of supply chain performance		
	3.2	Framework for structuring drivers		
	3.3	Facilities- Role in the supply chain, Role in the competitive strategy, Components of facility decisions		
	3.4	Inventory-Role in the supply chain, Role in the competitive strategy, Components of Inventory decisions		
	3.5	Transportation: Role in the supply chain, Role in the competitive strategy, Components of Transportation decisions		
	3.6	Information- Role in the supply chain, Role in the competitive strategy, Components of Information decisions		
	3.7	Obstacles to achieving strategic fit		
4.	**LOGISTICS MANAGEMENT**		**12**	**08**
	4.1	Introduction to logistics, Concept & Components Of logistics		
	4.2	Operational Objectives of logistics, Functions of logistics		
	4.3	Documentation in logistics		
5.	**INFORMATION TECHNOLOGY AND THE SUPPLY CHAIN**		**20**	**12**
	5.1	Role of IT in supply chain.		
	5.2	Supply chain IT framework		
	5.3	Customer relationship management		
	5.4	Internal supply chain management		
	5.5	Supplier relationship management		

	5.6	Future of IT in supply chain		
	5.7	Supply chain IT in practice		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :
(Term work shall consist of following Lab work/assignment/visit report etc.)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Consider the purchase of cold drink at convenience store .Describe the various stages in the supply chain and the different flow involved, prepare the case report	**04**
2	Consider the supply chain involved when a customer purchases a book at a bookstore. Identify the cycles in the supply chain and the location of the push/pull boundary, prepare the report	**04**
3	Prepare a report on Dell Supply Chain.	**04**
4	Prepare a report on any one retail supply chain related with fabricatic products	**04**
5	How should replenishment of inventory be managed at the various stocking locations at Big Bazaar? Prepare a case report	**04**
6	Visit to different ware house / storage to see supply chain practices followed (at least two), and prepare the report for the same	**04**
7	Prepare a report (any one) on Automobile Supply Chain (Tata / Maruti / Hyundai)	**04**
8	What type of distribution networks is typically best suited for perishable items? Prepare a case report for any one item	**04**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of Term Work and Term end oral/ practical examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration**
v. **Case study**
vi. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

i. **PRINT:** Text books/Reference books/Manuals/Journals.
ii. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Introduction to Supply Chain Management	22	08	08	06	22
2	Supply Chain Strategies	18	06	08	04	18
3	Supply Chain Drivers and Obstacles	30	10	14	06	30

4	Supply Chain Network Design	20	04	12	04	20
5	Information Technology and the Supply Chain	30	10	14	06	30
	Total	**120**	**38**	**56**	**26**	**120**

D. R FERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Supply chain management	Sunil Chopra and Peter Meindl, Pearson Education., Eighth Edition, 2009	81-297-1072-3
2.	An introduction to management science	Anderson, D.,Sweeney D. and Williams T. Thomson south western,2010.	13:978-0-324-39979-0
3.	Introduction to supply chain management	Robert B.Handfield and Ernest L. Nichols,Jr. Pearson Education, 2005.	81-297-0953-8

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Dr. S.W.Rajurkar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Shri. S. V. Joshi	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Dr. V. M. Athavale	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1415

COURSE TITLE : POWER PLANT ENGINEERING

PREREQUISITE : NIL

TEACHING SCHEME : TH : 03; TU : 02 ; PR : 00 ; TOTAL CREDITS: 05 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	---	25@	---	125
MIN.	32	---	40	---	10	---	----

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

- **RATIONALE :**

The consumption of electrical energy per capita is universally accepted as a scale for measuring the living standard of a country. The demand for energy is increasing day by day and existing power generation capacity is inadequate to meet this increasing demand. Industries are expected to generate their own power and supply the excess power to national grid. Alternate energy sources are also harnessed to meet the increasing demand. Diploma engineers should know the layout, components of different power plants and economic aspects of power plants.

- **OBJECTIVES :**

After completing this course students will be able to

1. Get familiar with present and future power scenario of India.
2. Calculate efficiency of power generation cycles.
3. Understand working of power plants, and its safety parameters.
4. Draw layout, understand the working and compare different power plants.
5. Appreciate economical and operational aspects of power plants.

- **SKILLS :**

After completing this course students will be able

1. To develop ability to write a report.
2. To develop ability to collect and tabulate the data.
3. To develop ability to communicate.
4. To develop ability to gather requisite information.

CONTENTS :

A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**INTRODUCTION TO POWER PLANTS**		12	08
	1.1	Power scenario in india, primary energy sources in india and there availability, principle types of power plant, principle power plant in		

		india		
	1.2	Factors influencing their selection, Cost Structure		
	1.3	**Analysis of steam cycles**- Carnot cycle, Rankine cycle, Reheat cycle, Regenerative cycle, Methods of reheating, Advantages and disadvantages of reheat cycle, Gas turbine cycle.		
2.	**THERMAL POWER PLANT**		**15**	**12**
	2.1	Site selection of steam power plant, General layout of steam power station		
	2.3	**Coal and ash handling system-**Equipments for in plant handling of coal such as belt conveyor, bucket elevator, Coal crushing, Pulverized fuel handling system, Ball mill, Bowl mill Pulverized fuel burner, Hydraulic and pneumatic ,Dry and wet ash handling and disposal of ash, effect of ash, Electrostatic precipitator. Back filters, flue gas conditioning		
	2.4	**Fuels**-Types of fuels, weathering of coal, moisture, sulphur & oxygen in coals, unit and central system		
	2.5	Condensers and cooling water system. Ponds, Spray Tanks, Cooling Towers (For Thermal Power Plant)		
3.	**GAS TURBINES POWER PLANT**		**10**	**06**
	3.1	Introduction and application of Gas Turbine power plant		
	3.2	Type of gas Turbine Power Plant General Layout, selection of site		
	3.3	Gas turbine power plants in India		
	3.4	Cogeneration Gas power plant in India		
4.	**HYDROELECTRIC POWER PLANT**		**08**	**06**
	4.1	Introduction and classification of hydroelectric power plant, site selection		
	4.2	Selection of Hydraulic Turbine.		
	4.3	Hydroelectric power plant Auxiliary, safety measures in Hydro station		
5.	**NUCLEAR POWER PLANT**		**10**	**05**
	5.1	Types of nuclear reactors. Nuclear fuels, coolant & Moderators		
	5.2	Working of PWR, BWR, CANDU, BREEDER type reactor. Safety , Precautions and waste disposals		
6.	**NON CONVENTIONAL ENERGY POWER PLANTS**		**15**	**06**
	6.1	Geothermal power plant- Types, economical justification, geothermal resources		
	6.2	**Tidal power plant-** Factors affecting suitability of site, working of different tidal power plants, advantages and disadvantages		
	6.3	Wind power plant- Different types of wind power plant, Basic principle of wind energy conversion		
	6.4	Solar power plant, Magneto Hydro dynamics power plant		
7.	**ECONOMICS OF POWER PLANT**		**10**	**05**
	7.1	Estimation and Prediction of load, Load duration curves,		
	7.2	Cost analysis, different terms like maximum demand, average load, load factor, plant capacity factor, plant use factor		
	7.3	Factor affecting Economics of generation and Distribution of power plant, Tariffs, coal factor, Heat rate		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :
(Term work shall consist of following Lab work/assignment/visit report etc.)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Visit and Study of thermal power plants and study the different cycles in power plants.	06
2	Collect information & Technical details of nuclear power plants.	06
3	Collect information & Technical details of Steam power plants.	06
4	Collect information & Technical details of Solar & Wind power plants.	06
5	Study of economic and operational aspects of power plants.	04
6	Study of Gas power plant (Ref. To Dabhol power Plant.)	04
	Total	32

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of Term Work and Term end oral/ practical examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration**
v. **Case study**
vi. **Seminars**
vii. **Industrial visits.**

❖ **SUGGESTED LEARNING RESOURCES :**

1) PRINT: Text books/Reference books/Manuals/Journals.

2) NON PRINT : CDs / PPT / Transperencies / Charts / Models.

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Introduction to power plants	18	06	06	06	18
2	Thermal power plant	22.5	07	07	08	22
3	Gas turbine power plant	15	05	05	05	15
4	Hydroelectric power plant	12	04	04	04	12
5	Nuclear power plant	15	05	05	05	15
6	Non conventional energy power plant	22.5	07	07	08	22
7	Economics of power plant	15	05	05	05	15
Total		**120**	**39**	**39**	**41**	**119**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Power Plant Engineering	Arora and Domkundwar. Dhanpat Rai & co.	0-07-084175-6
2.	Power Plant Engineering	M. M. El-Wakil TATA McGraw-Hill.	9780070702448
3.	Power Plant Engineering	Fredrick T. Morse East-West Press Pvt Ltd.	9788176710619
4	Power Plant Engineering	P K Nag. Tata McGraw-Hill.	0070435995
5	An Introduction to Power plant engineering,	G.D.Rai, Khanna Publishers, IIIrd edition, 2001	978-0-07-727604-3

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. N.S.Pawar	Lecturer Mech. Engg	Govt. Polytechnic Nagpur
2.	Prof. M.P.Daniel	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1416

COURSE TITLE : MATERIAL HANDLING

PREREQUISITE : NIL

TEACHING SCHEME : TH : 03; TU : 02 ; PR : 00 ; TOTAL CREDITS: 05 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	----	25@	----	125
MIN.	32	---	40	----	10	----	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST: 01 HRS.

❖ RATIONALE :

Material handling equipment is an integral part of modern industrial enterprise. The flow of material in industry depends on a rational choice of the material handling equipment, correct determination of its main parameters and efficient operation. Every diploma technician must know the operational features of the equipment & its practical application.

Carrying parts & products in a shop from one work station to another, transferring them from shop to shop or taking care of stockpiling and reclaiming operations, material handling equipment/systems enable the process to go on without interruptions & at a predetermined pace.

❖ OBJECTIVES :

After completing this course students will be able to

1. Understand constructional & operational features of various materials handling systems.
2. Identify, compare & select proper material handling equipment for specified applications.
3. Know the controls & safety measures incorporated on material handling equipment.
4. Understand different material handling processes used in industries.
5. Appreciate the role of material handling devices in mechanization & automation of industrial process.

❖ SKILLS :

After completing this course students will be able

1. To develop ability to understand the working principle of Material Handling equipment/devices.
2. To develop ability to Identify & name major component of material handling device.
3. To develop ability to understand role of material handling equipment in the industrial Process.
4. To develop ability to understand & appreciate safety instructions for equipment.
5. To develop ability to identify & select the material handling devices for a given application.
6. To develop ability to operate the working model of material handling equipment.

7. To develop ability to implement preventive maintenance schedule of material handling devices.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**INTRODUCTION TO MATERIAL HANDLING SYSTEM**		10	06
	1.1	Definition and scope of Material handling system		
	1.2	Main types of material handling equipments & their applications		
	1.3	Types of load to be handled, concept of unit load and bulk load		
	1.4	Types/ nature of movements, loading & unloading systems		
	1.5	Principles and objective of material handling systems		
	1.6	Limitations of material handling system		
2.	**HOISTING MACHINERY & EQUIPMENTS**		16	10
	2.1	Construction, working & maintenance of different types of hoists such as lever operated hoist, portable hand chain hoist, differential hoists, worm geared and spur geared hoists, electric & pneumatic hoists, winch & turfor		
	2.2	Construction, working & maintenance of different types of cranes such as rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes & EOT		
	2.3	Construction, working & maintenance of elevating equipments such as forklift, stackers, industrial lifts, freight elevators, passenger lifts, and mast type elevators, vertical skip hoist elevators		
3.	**CONVEYING MACHINERY**		14	08
	3.1	Construction, working & maintenance of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators, and slate conveyors, roller conveyors		
	3.2	Construction, working & maintenance of traction less type conveyors such as gravity type conveyors, vibrating & oscillating conveyors, screw conveyors, pneumatic & hydraulic conveyors		
4.	**SURFACE TRANSPORTATION EQUIPMENT**		14	08
	4.1	Construction, function, working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV- Automatic Guided vehicle, features, types and safety considerations, industrial Trailers		
	4.2	Construction, function, working of cross handling equipment such as winches, reach truck, capstans, Turntables, Transfer tables, monorail conveyors		
5.	**COMPONENTS OF MATERIAL HANDLING SYSTEMS**		16	08
	5.1	Flexible hoisting appliances such as welded load chains, roller chains, hemp ropes, steel wire ropes, fastening methods of wire & chains, eye bolts, lifting tackles		
	5.2	Load handling attachments- Various types of hooks-forged, triangular eye hooks, appliances for suspending hooks, b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter d) Grabbing attachment for loose materials e) Crane attachment for handling liquids / molten metals		
6.	**SELECTION OF MATERIAL HANDLING EQUIPMENT**		10	08
	6.1	Factors affecting choice of material handling equipments		

	6.2	Economics of material handling system- material handling cost and economical aspects, safety cost and consideration.		
	6.3	Benefits of good material handling system.		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :
(Term work shall consist of following Lab work/assignment/visit report)

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Study & demonstration of any one type of conveyor – belt, Screw, pneumatic, hydraulic.	**06**
2	Study and demonstration of any one type of crane (working model or actual).	**04**
3	Study and demonstration of fork lift truck (using electric drive or diesel engine) Or hoisting equipment.	**06**
4	Study of preventive maintenance schedule of any one major material handling equipment using operation manual.	**04**
5	Visit to coal handling plant of thermal power plant or cement industry to observe working of different types of bulk material handling devices (at least three equipments). Write report of the visit. OR Visit to steel industry or automobile manufacturing unit or sugar industry to observe different types of roller conveyors, Bucket elevators, overhead cranes load handling attachments, electric lifting magnet (at least 3 equipments). Write report of the visit	**12**
	Total	**32**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**
Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration**
v. **Case study**
vi. **Seminars**

❖ **SUGGESTED LEARNING RESOURCES :**

1) PRINT: Text books/Reference books/Manuals/Journals.

2) NON PRINT : CDs / PPT / Transperencies / Charts / Models.

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Introduction to Material Handling System.	15	4	8	3	15

2	Hoisting Machinery & Equipments.	24	4	12	8	24
3	Conveying Machinery.	21	4	12	5	21
4	Surface Transportation Equipment.	21	4	12	5	21
5	Components of Material Handling System.	24	4	12	8	24
6	Selection of material handling equipment.	15	4	8	3	15
	Total	**120**	**24**	**64**	**32**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Plant Layout and Material handling equipment	R. B. Chowdary & G. R. N. Tagore, Khanna Publisher, Delhi.	10:81740915x8
2.	Material handling (Principles & Practice)	Allegri T. H., CBS Publisher, Delhi	0442209851
3.	Plant layout & materials handling	Apple J. M, John Wiley Publishers.	0471071714
4	Plant layout & materials handling.	G.K. Agarwal Jain Brother Publication, New Delhi.	8186321780
6	Material handling	Immer J. R., Mc Graw Hill, New York.	0070316775
7	Plant Layout & material handling.	S.C. Sharma (Khanna Publication Delhi)	8174090983

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. V.S.Ikhar.	Lecturer Mech. Engg	Govt. Polytechnic Nagpur
2.	Dr.V.M. Athawale.	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur

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COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : ME1418 ($)

COURSE TITLE : PROJECT

PREREQUISITE : MIN.100 CREDITS & ME1407

TEACHING SCHEME : TH : 00; TU : 00 ; PR : 04 ; TOTAL CREDITS: 04 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY		TUTORIAL/PRACTICAL				TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	---	---	---	---	50@	50#	100
MIN.	---	---	---	---	20	20	---

(# - External & Internal Assessment ; @ - Internal Assessment only; $-Award Of Class Courses.)

TIME ALLOTTED FOR TERM EXAM : --

TIME ALLOTTED FOR PROGRESSIVE TEST : --

❖ RATIONALE :

The attitude entrepreneurship can be developed in a student easily if he is properly motivated. This inspiration can be achieved through case studies & field visits. An inspired entrepreneur requires to know the process of starting a business & steps to be taken therefore. He also requires to know how to run the business & the legality involved. Further the student of a particular discipline is expected to utilize the knowledge & skills gathered during earlier levels i.e. right from foundation engineering science courses to basic technology course for problem solving at practical or field level. As a technician it is required that a student should be able to identify shop floor & industrial problems in the purview, which may be from different areas of the concerned branch of engineering. The technician should be able to think on his own & apply the knowledge & skills acquired earlier to take decision, for analyzing & problem solving.

❖ OBJECTIVES :

The Students will be able to

1. Appreciate the concept of entrepreneurship.
2. Appreciate the factors affecting entrepreneurship development.
3. Know the procedures of preparing a project report.
4. Know the sources of raising finance.
5. Appreciate the principles of running a business.
6. Appreciate the laws & regulations involved in starting and running a business.
7. Independently identify and analyze problems in field of manufacturing, planning, control, inspection, maintenance etc.
8. Compile the information, analyze and draw conclusions.
9. Prepare feasible projects.
10. Interact with concerned people for collecting information or data.

❖ SKILLS :

After completing this course students will be able to

1. Develop ability to communicate verbally & in written form.
2. Develop ability to gather and analyze the gathered information/data.
3. To develop the decision-making ability
4. To develop the risk-taking attitude.

5. To develop managerial skills to handle resources in general & Human resources in particular.
6. To develop ability to identify and analyze problems in the field of manufacturing, planning, control, inspection, maintenance etc.

B. CONTENTS :

A batch of maximum 4 to 6 student will select a problem and then plan, organize & execute the project work of solving the problem in a specified duration. Student is expected to apply the knowledge & skills acquired. Batch may select any one-problem/project work from following categories.

a) Fabrication of small machine / devices/ test rigs/ material handling devices/ jig & Fixtures/ demonstration models, etc. Report involving aspects of drawing, process sheets, costing, Installation, commissioning & testing should be prepared and submitted.
b) Design & fabrication of mechanisms, machines, Devices, etc. Report involving aspects of designing & fabricating should be prepared & submitted.
c) Development of computer program for designing and /or drawing of machine components, Simulation of movement & operation, 3D modeling, pick & place robots etc.
d) Industry sponsored projects- project related with solving the problems identified by industry should be selected. One person / engineer from industry is expected to work as co- guide along with guide from institution.
e) Literature survey based projects- Project related with collection tabulation, classification, analysis & Presentation of the information. Topic selected must be related with latest technological developments in mechanical or mechatronics field, and should not be a part of diploma curriculum. Report should be of min 60 pages.
f) Investigative projects- Project related with investigations of causes for change in performance or structure of machine or component under different constraints through experimentation and data analysis.
g) Maintenance based projects- The institute may have some machine/ equipment/ system which are lying idle due to lack of maintenance. Students may select the specific machines/equipment/system. Overhaul it, repair it and bring it to working condition. The systematic procedure for maintenance to be followed and the report of the activity be submitted.
h) Industrial engg. based project: Project based on work study , method study, methods improvement, leading to productivity improvement, data collection, data analysis and data interpretation be undertaken .
i) Automation projects-Project based on hydraulic/pneumatic/mechtronics circuits resulting into low cost automated equipment useful in the identified areas.
j) Innovative/ Creative projects- Projects related with design, develop & implementation of new concept for some identified useful activity using PLC, robotics, non-conventional energy sources, CIM, mechatronics, etc.
k) Environmental management systems projects: Projects related with pollution control, Solid waste management, liquid waste management, Industrial hygiene, etc, Working model or case study should be undertaken.
l) Market research/ survey based projects: Projected related with identification of extent of demand, sales forecasting, Comparative study of marketing strategies, Compararative study of channels of distribution, Impact of variables on sales volume, etc. The project involves extensive survey & market research activities information to be collected through various mechanisms/tools & report be prepared.
m) Project based on use of appropriate technology particularly benefiting rural society or economically weaker section.
n) Project can be selected other than the area specified above.

Project should provide viable and feasible solution to the problem identified.
Report should be of min 50 pages.

B. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. S. V. Joshi	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
2.	Dr. V. M. Athavale	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3.	Shri. S.R.Kaduskar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : WS1401

COURSE TITLE : MANUFACTURING PROCESSES-I

PREREQUISITE : NIL

TEACHINGS SCHEME TH : 03 ; TU : 00 ; PR : 04 ; TOTAL CREDITS: 07 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	25@	25@	150
MIN.	32	--	40	--	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

- **RATIONALE :**

This is core technology course. This course deals with operational features of basic processes such as moulding, casting, welding etc. Construction and principle of operation of workshop machines such as lathe, planning, shaping etc. covered.

- **OBJECTIVES :**

After completing this course students will –

1. Understand the basic manufacturing processes.
2. Select proper production processes, machine tool and equipment.
3. Understand the constructional feature and operation of various machine tools.

- **SKILLS :**

1. To develop the ability of operation of various machines.
2. To develop the ability to handle machine tools and equipment.
3. To develop the ability to select proper tools and machine equipment.
4. To develop the ability to set the tools.
5. To develop the attitude of safety.
6. To develop the ability of inspection.
7. To develop the attitude of housekeeping.

CONTENTS :

A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	**FOUNDRY PRACTICES**		12	07
	1.1	Pattern making principle, types of patterns, materials, various allowances, core prints, core boxes, pattern layout, colour codes, preservation of pattern.		

	1.2	Moulding tools & their uses, moulding sands, composition, properties & preparation, moulding methods, preparation core, cores, core boxes, hand & m/c core making.		
	1.3	Furnaces for steel and cast iron, cupola construction and operation, equipment used in foundry, casting methods such as gravity, pressure die, centrifugal, Investment, Sintering etc, defects in castings, remedies & casting inspection.		
2.	**WELDING**		**12**	**07**
	2.1	Fusion process, Processes of joining, resistance welding, arc welding, gas welding, gas cutting, soldering & brazing.		
	2.2	Tools & equipment used in gas welding.		
	2.3	Types of Welding Rods& its applications		
3.	**COLD WORKING OF SHEET METALS**		**10**	**06**
	3.1	Sheet metal work- Use of hand tools and accessories, Sheet metal machines, Hand and power shears, Circle cutting, folding & bending operations.		
	3.2	Presswork - Types of press tools, press brake, operations performed,		
	3.3	Types of dies.		
4.	**MECHANICS OF METAL CUTTING**		**08**	**05**
	4.1	Basic elements of machining		
	4.2	Principles of metal cutting & forces involved in metal cutting,		
	4.3	Chip formation.		
	4.4	Types of chips		
	4.5	Oblique & orthogonal cutting,		
	4.6	Chip breaker		
	4.7	Cutting tool geometry of single point cutting tool & twist drills.		
	4.8	Resharpening of cutting tools.		
5.	**CUTTING FLUID & CUTTING TOOL MATERIALS:**		**08**	**05**
	5.1	Introduction		
	5.2	classification of cutting fluid, solid & liquid cutting fluid,		
	5.3	chemical coolants		
	5.4	Basic action of cutting fluids and its application during machining operation & selection of cutting fluid.		
	5.5	Introduction, characteristics of tool material, cutting tool material such as plain carbon steel, high carbon steel, high speed steels, carbide tools, ceramics, diamond tools, cemented oxides, abrasives & CBN etc		
	5.6	Machinability, factors affecting machinability.		
	5.7	Tool life & tool wear, types of tool failure.		
6.	**LATHE MACHINES**		**08**	**06**
	6.1	Introduction to metal turning,		
	6.2	Types of lathe machine, centre lathe and its details, classification of lathe machine,		
	6.3	Different lathe operation,		
	6.4	Lathe accessories and attachments		

7.	**DRILLING MACHINE**		**12**	**06**
	7.1	Introduction.		
	7.2	Classification of drilling machine, portable, sensitive, upright, radial, gang, multiple spindle,		
	7.3	Automatic drillers & turret drilling machine,		
	7.4	Cutting speed and feed		
	7.5	Chip breakers		
	7.6	drill wear and sharpening of drill		
	7.7	Operations performed on drilling machines & specifications of drilling machine.		
8.	**SHAPING, SLOTTING & PLANNING MACHINE**		**10**	**06**
	Introduction,			
	Elements of shaping, slotting & planning machine. Working principles, types and classification of them. **,** stroke length and its adjustment. Comparison between them**.**			
		Total	**80**	**48**

Every student shall submit following term work.

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
8.	Pattern making: One job of simple pattern making. One pattern along with simple core.	**16**
9.	Moulding: Preparation of mould & casting of any one of them.	**16**
10.	Machine shop: i) One simple job of plain turning. ii) One composite job comprising turning, facing, thread cutting.	**24**
11.	Visit to Foundry Industry.	**08**
Note: Journal comprises of details of term work done. Journal should be submitted along with jobs.		
	Total	**64**

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term End Practical examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1) Lecture method
2) Improved lecture method.
3) Q & A technique.
4) Demonstration
5) Case study
6) Seminars

❖ **SUGGESTED LEARNING RESOURCES :**

1) PRINT : Text books/Reference books/Manuals/Journals.

2) NON PRINT : CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1	Foundry Practices	18	06	12	-	18

2	Welding	18	06	12	-	18
3	Cold Working of Sheet Metals	15	03	09	03	15
4	Mechanics of Metal Cutting	12	03	06	03	12
5	Cutting Fluid and Cutting Tool Materials.	12	03	06	03	12
6	Lathe Machines	12	03	06	03	12
7	Drilling Machines	18	03	12	03	18
8	Shaping,Slotting & Planning Machines.	15	03	09	03	15
	Total	**120**	**30**	**72**	**18**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Workshop Technology Vol. I & Vol. II	Raghuwanshi.	0071775076
2.	Workshop Technology Vol. I & Vol. II	Haraza & Choudhary	81-85027-04-8
3.	Production Technology	K C Jain	9788120335264
4.	Manufacturing Sciences Vol. I, II & III	Dalela.	EBK0029487
5.	Manufacturing Processes	Amstead.	10: 0471842362
6.	Manufacturing processes	Begeman	9780471047414
7.	Workshop Technology Vol. I & II	H. S. Bawa	0074600273

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. A. W. Wankhede	Work Shop Supdt.	Govt. Polytechnic Nagpur
2.	Prof. S.R. Kaduskar	Lecturer ME	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN MECHANICAL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY COURSES

COURSE CODE : WS 1402

COURSE TITLE : MANUFACTURING PROCESSES-II

PREREQUISITE : WS 1401

TEACHING SCHEME : TH : 03; TU : 00 ; PR : 04; TOTAL CREDITS: 07 (Hrs/Week)

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	---	25@	25#	150
MIN.	32	---	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only;)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HRS.

- **RATIONALE :**

  This is Basic Technology Course. This course deals with the operation, working mechanism, faults, their causes and its remedial measures of production machines. Technicians should know the maintenance procedure of workshop machinery, erection and commissioning of machine tools. It helps to meet above requirements.

- **OBJECTIVES :**

  After completing this course students will be able to

  1. Develop competency in handling of all types of production machines.
  2. Set up machines for different operations.
  3. Select proper production processes, m/c tools and equipments.
  4. Carry out inspection processes for checking the jobs.
  5. Carry out production jobs on machines according to given drawings and specifications.

- **SKILLS :**

  After completing this course students will be able

  1. To develop the ability of operation of various machines.
  2. To develop the ability to handle machine tools and equipment.
  3. To develop the ability to select proper tools and machine equipment.
  4. To develop the ability to set the tools.
  5. To develop the attitude of safety.
  6. To develop the ability of inspection.
  7. To develop the attitude of house keeping.

CONTENTS :

A. THEORY:

SR. NO.	CHAPTER		MARKS	HOURS
1.	**HEAT TREATMENT OF METALS**		08	06
	1.1	Necessity of heat treatment, common heat treatment processes, annealing, normalizing, hardening, tempering & their selection for different metals used for industrial applications		

	1.2	Surface hardening methods-carburizing, induction, flame hardening & their application		
2.	**BORING MACHINES**		**10**	**06**
	2.1	Introduction to boring machines, description & standard parts of boring machines		
	2.2	Types of boring bars, boring heads & boring tools		
3.	**BROACHING AND SAWING MACHINES**		**12**	**06**
	3.1	Introduction, broaching tool, types of broaching machines, broaching operations, Single / Double cut operations, internal & external broaching, advantages & limitations of broaching		
	3.2	Sawing machines - Classification, types, selection of saws		
4.	**GRINDING, FINISHING AND SUPER FINISHING PROCESSES**		**10**	**06**
	4.1	Introduction, theory of grinding, cutting action in grinding machines, types of grinding wheels, types of abrasive, bonding, grade of grinding wheel, selection of wheel for different operations as per B.I.S. specifications. Wheel mounting, dressing & turning. Cylindrical grinders- centre types, chucking types & centreless grinding, internal grinding & surface grinders		
	4.2	Surface finishing & Surface finish values -Microfinishing, honing, lapping, buffing & polishing. Process capability (IS696)		
5.	**CAPSTAN & TURRET LATHE**		**10**	**06**
	5.1	Introduction, principal parts of capstan & turret lathe		
	5.2	Work & tool holding devices		
	5.3	Attachments used on turret lathe, Tooling principal, Tool & tool layout for simple jobs		
6.	**MILLING MACHINES**		**10**	**06**
	6.1	Types of milling machines, principle of working, description, construction of universal milling machines, specifications of milling machines, milling operations, milling cutters, universal dividing head different types of indexing methods, helical milling		
	6.2	Gear tooth elements, types of gear, methods of manufacturing form tooth processes as milling & broaching. Generating processes as gear planning, shaping & hobbing. Working principles of gear shaping, gear shaping cutters, Introduction of gear hobbing, hobbing cutters, Working principles of gear hobbing. Gear finishing processes - gear shaving, grinding & lapping		
7.	**INTRODUCTION TO CNC MACHINING**		**10**	**06**
	7.1	Introduction, Features of NC/ CNC machines		
	7.2	Principle of working of CNC machines, Numerical control system applied to CNC Machines		
	7.3	Nomenclature of machine axes, codes and formats used for NC/CNC machines		
8.	**NON CONVENTIONAL MACHINING PROCESSES**		**10**	**06**
	8.1	Introduction to non-conventional methods of manufacturing,		
	8.2	Principles and working of EDM & Wire cut EDM method of machining		
		Total	**80**	**48**

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS :

S.N.	Title of Practical/Lab.Work/Assignments	HRS
1	Every student shall submit the following term work Composite	**32**

	machining operations including Turning, Shaping, Slotting, Milling & grinding & process sheet of each component - one job	
2	Gear Cutting including boring and key way cutting - one job	**32**
	Total	**64**

Note: Journal comprising of process sheet for each component of composite in detail should be submitted along with job.

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of practical journal / term work.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

i. **Lecture method**
ii. **Improved lecture method.**
iii. **Q & A technique.**
iv. **Demonstration.**
v. **Case study.**
vi. **Seminars.**
vii. **Industrial visits.**

❖ **SUGGESTED LEARNING RESOURCES :**

i. **PRINT:** Text books/Reference books/Manuals/Journals.
ii. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models.

C. SPECIFICATION TABLE :

Chapter No.	**Title of Chapter**	**Marks** (1.5 x Marks allotted to chapter)	**Distribution of Marks**			
			Knowledge	**Comprehension**	**Application**	**Total**
1	Heat treatment of metals	12	06	03	03	12
2	Boring machines	15	06	03	06	15
3	Broaching and sawing machines	18	06	06	06	18
4	Grinding, finishing and super finishing processes	15	06	06	03	15
5	Capstan & turret lathe	15	06	03	06	15
6	Milling machines	15	03	06	06	15
7	Introduction to CNC machining	15	06	06	03	15
8	Non conventional machining processes	15	03	06	06	15
Total		**120**	**42**	**39**	**39**	**120**

D. REFERENCE & TEXT BOOKS:

S.N.	**Title**	**Author, Publisher, Edition and Year Of publication**	**ISBN Number**
1.	Workshop Technology (Vol. – II)	B. S. Raghuwanshi. Tata McGraw-Hill	81 -212-0269-8
2.	Workshop Technology (Vol. - II)	Hazara & Chaudhary. Media Promoters & Publishers.	0-210-98173-3

3.	Production Technology	R.K. Jain & S.C. Gupta. Khanna Publishers.	978-0534934293
4.	Manufacturing Science and Technology (Vol.-I,II & III)	Suresh Dalela. Umesh Publication	81-7611-179-1
6.	Manufacturing Processes	Begeman, Myron L. Amstead, B.H. John Wiley & Sons Inc.	0471062405

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. A.W. Wankhede	Workshop Superindent	Govt. Polytechnic Nagpur
2.	Prof. R. A. Gadekar	Lecturer Mech. Engg.	Govt. Polytechnic Nagpur

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(Member Secretary PBOS) **(Chairman PBOS)**