

GOVERNMENT POLYTECHNIC, NAGPUR
DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
FIRST SEMESTER MECHANICAL ENGINEERING

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH,TU,PR Hrs/Week)*			Credit	Examination Scheme (Max. Marks)				
								Theory Marks		Practical Marks		Total Marks
				TH	TU	PR		TE E	CA	TEE	CA	
1	MH101G	Basic Mathematics	Basic Science	3	1		4	60	40			100
2	ME101G	Engineering Graphics	Engineering Science	1		4	3	60	40		50	150
3	CH101G	Chemistry	Engineering Science	3		2	4	60	40	25@	25	150
4	EN101G	English	Engineering Science	2		2	3	30	20	25@	25	100
5	IT151G	Introduction to IT Systems (online Course)	Engineering Science				2			25@	25	50
6	LS151G	Life Skills	Humanities and Social Science			2	1				25	25
7	EV151G	Environmental Science	Audit	2					Grades (A,B,C)			
8	IC151G	Indian Constitution	Audit	1					Grades (A,B,C)			
Total				12	1	10	17	210	140	75	150	575

Abbreviations:

• TH – Theory ; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment

*Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

Student Centered Activity – Library -1 Hour, Sports- 2 Hours,

Student Creative Activity-2 Hours Self Learning Mode Through MOOCS/NPTEL/ SWAYAM

Audit courses are to be evaluated with Grades(A, B, C)

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GOVERNMENT POLYTECHNIC, NAGPUR
DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
SECOND SEMESTER MECHANICAL ENGINEERING

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH,TU,PR Hrs/Week)*			Credit	Examination Scheme (Max.Marks)				
								Theory Marks		Practical Marks		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
1	MH102G	Applied Mathematics	Basic Science	3	1		4	60	40			100
2	EX101G	Fundamentals of Electrical & Electronics	Engineering Science	4		2	5	60	40	25@	25	150
3	PH101G	Physics	Basic Science	3		2	4	60	40	25@	25	150
4	AM101G	Engineering Mechanics	Engineering Science	3		2	4	60	40	25@	25	150
5	ME203G	Engineering Drawing	Core Course	2		4	4	60	40		50	150
6	EN151G	Business Communication	Basic Science	1		2	2			25@	25	50
7	WS151G	Engineering Workshop Practice	Engineering Science			4	2			25#	25	50
			Total	16	1	16	25	300	200	125	175	800

Abbreviations:

- TH – Theory; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment
- Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

Student Centered Activity - Library -1 Hour, Sports- 2 Hours,

Student Creative Activity-2 Hours Self Learning Mode Through MOOCS/NPTEL/ SWAYAM

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DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
THIRD SEMESTER MECHANICAL ENGINEERING

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH,TU,PR Hrs/Week)*			Credit	Examination Scheme (Max. Marks)				
								Theory Marks		Practical Marks		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
1	ME201G	Thermal Engineering	Core Course	3		2	4	60	40	50@	25	175
2	AM201G	Strength of Material	Core Course	3		2	4	60	40	50@	25	175
3	ME202G	Machine Drawing	Core Course	2		4	4	60	40		50	150
4	ME204G	Measurement and Metrology ^s	Core Course	4		2	5	60	40	50#	50	200
5	WS201G	Manufacturing Processes ^s	Core Course	3		2	4	60	40	50#	25	175
6	OE201G TO OE222G	Open Elective	Open Elective	2			2	30**	20			50
7	ME251G	Computer Aided Drafting	Core Course	1		4	3			50@	25	75
			Total	18		16	26	330	220	250	200	1000

Abbreviations:

- TH – Theory; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment

*Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

Student Centered Activity - Library -1 Hour, Sports- 2 Hours,

Student Creative Activity-2 Hours Self Learning Mode Through MOOCS/NPTEL/ SWAYAM

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DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
FOURTH SEMESTER MECHANICAL ENGINEERING

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH,TU,PR Hrs/Week)*			Credi t	Examination Scheme (Max.Marks)				
				TH	TU	PR		Theory Marks		Practical Marks		Total Marks
								TEE	CA	TEE	CA	
1	ME205G	Fluid Power	Core Course	3		2	4	60	40	50@	25	175
2	ME206G	Energy Conversion ^s	Core Course	3		2	4	60	40	50#	25	175
Elective –I (Any One)												
3	ME207G	Heat Transfer ^s	Programme Elective	3		2	4	60	40	50#	25	175
	ME208G	Renewable Energy Sources ^s										
	ME209G	Automation ^s										
4	ME210G	Theory of Machines ^s	Core Course	3		2	4	60	40	50#	25	175
5	ME211G	Production Technology & Quality Control	Core Course	3		0	3	60**	40			100
6	MT115G	Engineering Materials	Core Course	3		2	4	30	20		25	75
7	ME252G	CNC Technology and Robotics	Core Course	1		2	2			50@	25	75
			Total	19		12	25	330	220	250	150	950

Abbreviations:

• TH – Theory ; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment

*Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

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DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
FIFTH SEMESTER MECHANICAL ENGINEERING

FIFTH SEMESTER MECHANICAL ENGINEERING												
Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH,TU,PR Hrs/Week)*			Credit	Examination Scheme (Max.Marks)				
								Theory Marks		Practical Marks		Total Marks
				TH	TU	PR		TEE	CA	TEE	CA	
				3		2	4	60	40	50#	25	175
1	ME301G	Machine Design ^s	Core Course	3		2	4	60	40	50#	25	175
2	ME308G	Automobile Engineering ^s	Core Course	3		2	3	30	20	50@	50	150
3	WS301G	Machining Processes	Core Course	2								
4	AE213G	Industrial Management	Humanities and Social Science	3			3	60**	40			100
Elective –II (Any One)												
5	ME302G	Industrial Fluid Power ^s	Programme Elective	3	-	2	4	60	40	50#	25	175
	ME303G	Power Plant Engineering ^s										
	ME304G	Tool Engineering. ^s										
Elective –III (Any One)												
6	ME305G	Refrigeration & Air-Conditioning ^s	Programme Elective	3	-	2	4	60	40	50#	25	175
	ME306G	Computer Integrated Manufacturing ^s										
	ME307G	Product Development ^s										
7	ES351G	Entrepreneurship and Start up	Humanities and Social Science	2	-	2	3				25	25
8	ME351G	Project ^s	Project and Internship	-	-	4	2	-	-	100#	100	200
			Total	19	-	16	27	330	220	350	275	1175

Abbreviations:

• TH – Theory; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment

*Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

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DIPLOMA IN MECHANICAL ENGINEERING
TEACHING AND EXAMINATION SCHEME (CURRICULUM 2021)
SIXTH SEMESTER MECHANICAL ENGINEERING

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme (TH, TU, PR Hrs /Week)*			Credit	Examination Scheme (Max.Marks)				
								Theory Marks		Practical Marks		Total Marks
								TEE	CA	TEE	CA	
1	IN351G	Internship ^{\$}	Project and Internship			30	15			100#	100	200
			Total			30	15			100#	100	200

Abbreviations:

- TH – Theory ; PR- Practical; TU- Tutorial; TEE- Term End Examination; CA-Continuous Assessment
- *Credit Formula: 1 TH Hr. = 1 Credit; 1 TU Hr. = 1 Credit; 2 PR Hrs. = 1 Credit

Symbolic Representation

** Online Examination, @ Internal Practical Examination, # External Practical Examination, \$ Award of Class Course.

Teaching load = 6 x 3 = 18

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/AE/PK/MT/EE/EC/IT/CM/TX/
MC/AI

COURSE CATEGORY: BASIC SCIENCE COURSE

COURSE CODE : MH101G

COURSE TITLE : BASIC MATHEMATICS

TEACHING SCHEME: TH:03; TU: 01(1TH/TU CREDIT=1CLOCK HRS.)

TOTAL CREDITS : 04

TH. TEE : 03 HRs

PR. TEE : --

PT. : 01 HR

❖ RATIONALE:

The course is classified under basic sciences and intends to teach students basic facts, concepts and principles of Mathematics as a tool to analyze Engineering problems. Mathematics lay- down the foundation for understanding core Technology courses.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply laws of logarithm to solve engineering problems.
2. Resolve Proper real fractions into partial fractions.
3. Apply matrix method to solve simultaneous equations in two and three variables.
4. Use concept of allied angle, compound angle, multiple, and sub multiple angle to solve engineering problems.
5. Find principle value of inverse trigonometric functions, use properties to solve the examples of inverse trigonometric functions.
6. Use measures of central tendency and measures of dispersion in decision making.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Logarithm	1a. Evaluate the value of given logarithm without using calculator. 1b. Solve the given logarithm by using Laws of logarithm. 1c. Identify natural and common logarithm.	1.1 Logarithm:-Concept of Logarithm 1.2 Rules and Laws of Logarithm; Addition, Subtraction, Multiplication, Division and Change of Base Formula. 1.3 Concept of natural & common logarithm	03
2. Partial Fractions	2a. Identify rational function, proper and improper fraction. 2b. Resolve the given proper fraction into partial fraction. 2c. Resolve the given improper fraction into partial fraction.	2.1 Concept of rational function , proper ,improper fraction and partial fraction 2.2 Resolving proper fraction into partial fraction. Denominator containing non repeated linear factors, Denominator containing repeated linear factors, Denominator containing irreducible non repeated quadratic factors 2.3 Resolving improper fraction into partial fraction.	05
3. Determinant and Matrix	3a. Find the value of given determinant of order 2 and 3. 3b. Solve the given matrix by using Algebra of matrix, transpose of matrix , ad-joint of matrix, singularity of matrix and find inverse of matrix. 3c. Solve the given simultaneous equation in two and three variables.	3.1 Concept of determinant ,order of determinant, Expansion & Evaluation of determinant of order 2 and 3 3.2 Concept of matrix, Types of matrices, Algebra of matrices Transpose of matrix , ad-joint, singularity of matrix and inverse of matrix 3.3 Solution of system of linear equations two and three variables by inverse matrix method	12
4. Trigonometry	4a. Use fundamental identities to solve the given Trigonometric relation. 4b. Apply the concept of allied angle , compound angle, multiple angle (2θ and 3θ) sub-multiple angle ($\frac{\theta}{2}$), to solve the given trigonometric relation. 4c. Apply Factorisation, De-	4.1 Fundamental identities, Trigonometric ratios of any angle. 4.2 Trigonometric ratios of allied angles, compound angles , multiple and sub-multiple angles (without proof) 4.3 Factorization and de-factorization formulae(without proof).	14

	Factorisation formulae to solve the given trigonometric relations.		
5. Inverse Trigonometric Functions	5a. Find the principle value the given Inverse trigonometric functions. 5b. Solve the given inverse trigonometric functions. 5c. Evaluate the value of given inverse trigonometric functions.	5.1 Concept of inverse trigonometric functions, Principle values of inverse trigonometric functions. 5.2 Properties of inverse trigonometric functions. 5.3 Relation between inverse trigonometric functions	05
6. Statistics	6a. Find mean or Combined Mean of given Statistical data. 6b. Find the Range, Co-efficient of Range, Mean Deviation, Standard Deviation of given Statistical data. 6c. Find variances, coefficient of variation of given Statistical data. 6d. Compare the given Two sets and Check the Consistency & Reliability OR Interpret the result by co-efficient of variations.	6.1 Measures of central tendency Mean (only), & Combined mean 6.2 Measures of dispersion:- Range, mean deviation, standard deviation of Discrete, Grouped & Ungrouped Data. 6.3 Variance and coefficient of variation, of Discrete, Grouped & Ungrouped Data. 6.4 Comparison of two sets of observations, Consistency & Reliability	09
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assignments	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Solve examples using laws of logarithm.	Logarithm	01
2	Find partial fraction of proper fraction.	Partial fraction	01
3	Find partial fraction of improper fraction.		01
4	Expand determinant of order 2 and 3.	Determinant and Matrix	01
5	Perform all algebraic operations on matrices.		01
6	Find transpose, ad-joint and inverse of matrix.		01
7	Solve simultaneous equations in two and three variables.		01
8	Verify trigonometric identities.	Trigonometry	01
9	Use allied angle and compound formulae.		01
10	Use multiple and sub-multiple angle formulae.		01
11	Apply factorization formula to solve examples.		01
12	Apply de-factorization formula to solve examples.		01
13	Find principle values of inverse trigonometric functions and verify formulae.	Inverse trigonometric functions	01

14	Find mean of any data and combined mean of two sets of data.	Statistics	01
15	Find the range, mean deviation, standard deviation and variance.		01
16	Find coefficient of variation and compare the consistency.		01
Total Hrs.			16

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Logarithm	04(00)	00(00)	00(03)	04(03)
2	Partial Fraction	00(04)	03(00)	03(00)	06(04)
3	Determinant and Matrix	02(02)	06(03)	06(03)	14(08)
4	Trigonometry	02(00)	12(06)	06(06)	20(12)
5	Inverse Trigonometric Functions	02(00)	00(03)	03(00)	05(03)
6	Statistics	02(00)	03(03)	06(03)	11(06)
	Total	12(06)	24(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	1	R	2	2	R	2	2	R	2	3	R	2	3	R	2	6/9
	4	R	2	5	R	2	6	R	2										
2	2	U	3	3	U	3	3	U	3	1	A	3	2	A	3				3/5
3	3	U	3	4	U	3	4	U	3	4	U	3	3	A	3				3/5
4	4	U	3	4	U	3	4	U	3	4	A	3	4	A	3				3/5
5	5	U	3	6	U	3	6	U	3	5	A	3	6	A	3				3/5
6	3	A	6	4	A	6	6	A	6										2/3

T- Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcome s
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Class Room Assignment s		Tutorial Assignments	15	--	Assignme nt Book	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Stude nts	End of the Course	60	24	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	--	--	--	--
		Journal Writing		Assignments	--	--	--	--
				Total	--	--		
	TEE (Term End Examination)	End Exam	Stude nts	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Stude nts	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
	Nil	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	-	-	-	-			
2	3	-	-	-	-	-	-			
3	3	-	-	-	-	-	3			
4	3	-	-	-	-	-	-			
5	3	-	-	-	-	-	-			
6	3	-	-	-	-	1	3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Higher Algebra	Hall & Knight, Publisher: Arihant, 6 th Edition 2021	9789351762539
2	Plane Trigonometry	S.L.Loney, Publisher: Arihant, 5 th Edition 2015	9352030540
3	Basic Statistics	B.L.Agarwal, Publisher: Anshan	1848290675
4	Basic Mathematics	G.V.Kumbhojkar, P. Jamnadas LLP., 21 st Edition 2017	978-81-934573-5-1
5	Fundamental of Statistics	S.C.Gupta, Himalaya Publishing House, 7 th Edition 2015	9789350517697

❖ **E-REFERENCES:**

- https://econtent.msbte.ac.in/econtent/econtent_home.php
- <https://www.khanacademy.org>
- https://www.youtube.com/watch?v=5_TuK1yCPD4

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr.S.M.Sayyed	I/C Mathematics Dept.	Govt. Polytechnic Nagpur
2	Mr.P.T.Khobragade	Lecturer	Govt. Polytechnic Nagpur
3	Mr.G.R.Dewalkar	Lecturer	Govt. Polytechnic Sakoli
4	Dr.P.B.Bahatkar	Professor	Y. C. C. E. Nagpur
5	Mr.W.T.Gaidhane	Lecturer	Nagar Parishad Junior College, Arvi

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/CE/PK/MC
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: ME101G
COURSE TITLE	: ENGINEERING GRAPHICS
TEACHING SCHEME	: TH:01; TU: 00;PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 03 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 04 HRs
PR. TE EXAM	: --
PT. EXAM	: 02 HR

❖ **RATIONALE:**

Engineering graphics is a non-verbal and graphical language to communicate ideas, instructions and facts with each other clearly and without ambiguity while carrying out engineering jobs on the sites, shop floor etc. It describes the fundamentals, facts, concepts, principles and techniques of Engineering Graphics. The course illustrates techniques of drawing in an engineering field. It helps to develop the idea of visualizing the actual object or part on the basis of drawings and blue prints. This course is useful in developing drafting and sketching skills of the student. This preliminary course aims at building a foundation for the further course in drawing and other allied courses.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to –

1. Select and construct appropriate drawing scales and use drawing instruments & Apply IS SP-46 2011 for engineering drawing.
2. Draw various engineering curves.
3. Covert isometric projections into orthographic projections.
4. Visualize three dimensional objects and draw isometric projections.
5. Apply knowledge of projections of points and solve the problems on projection of straight lines.
6. Draw freehand sketches of a given engineering element.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Principles of Drawing	1a. Draw the scale as per IS SP-46 from given data. 1b. Redraw the given geometrical figure as per IS SP -46.	1.1 Use of different drawing instruments and equipment, Types of letters and numbers (single stroke vertical) and Conventions of lines, Dimensioning technique as per IS SP-46 1.2 Scales (reduced, enlarged and full size)-Plain scale, diagonal scale, 1.3 Redrawing of geometrical figures.	02
2. Engineering Curves.	2a. Draw conic sections by specified method from given data. 2b. Draw involute, and know their applications. 2c. Draw cycloidal curve, spiral and helix from given data and know their applications.	2.1 Drawing of Conic Sections • Draw an ellipse by: i) Arcs of circles method ii) Rectangle method iii) Concentric circles method • Draw parabola by i) Directrix-focus method ii) Rectangle method • Draw hyperbola by i) Directrix–focus method ii) Passing through a given point with reference to given asymptotes 2.2 Draw involute of circle and polygon of maximum six sides 2.3 Draw cycloid, epi-cycloid and hypo-cycloid 2.4 Draw Archimedean spiral & Helix	04
3. Orthographic Projections	3a. Draw Orthographic projection methods. 3b. Visualize, interpret and draw orthographic views from given pictorial views.	3.1 Introduction to orthographic projections 3.2 First angle and Third angle method of projections 3.3 Conversion of simple pictorial view (object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces.) into orthographic views by First angle and third angle projection method.	03
4. Isometric Projections	4a. Draw isometric scale. 4b. Visualize, interpret and draw Isometric views/ projections from given orthographic view.	4.1 Isometric scales 4.2 Isometric views/ projections of simple & cylindrical object (plane surfaces, slanting surfaces, and Rectangular, V, Trapezoidal slots)	03

5. Projection of Straight Lines	5a. Draw projection of Lines from the given data.	5.1 Projections of straight lines inclined to one reference plane and parallel to the other—limited to both ends in first quadrant.	02
6. Free Hand Sketches	6a. Sketch proportionate free hand sketches of given screw and threads. 6b. Sketch proportionate free hand sketches of given bolts and nuts and locking arrangement. 6c. Sketch proportionate free hand sketches of given riveted joints.	6.1 Types of screws & threads —Vee and square threads, left hand and right hand threads 6.2 Bolts —square and hexagonal bolts, Eyebolt Types of nuts —square, hexagonal, wing, capstan, cap, flanged, ring and dome nut 6.3 Locking arrangement —lock or check nut, split pin, slotted nut, castle nut, swan nut and grooved nut Foundation bolts —Eye foundation bolt, Rag foundation bolt and Lewis foundation bolt Riveted joints —Types of rivets, Single/ double riveted Lap and Butt joints.	02
Total Hrs.			16

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw types of lines, lettering, numbers on sketch book and two problem of scales, & two problems of redraw. (01Sheet)	1. Principles of drawing	08
2	Draw four Engineering Curves, two from topic 2.1, one from topic 2.2, 2.3, one from topic 2.4 (01Sheet)	2. Engineering Curves	12
3	Draw one problem using first angle method of projection and another using third angle method of projection (01Sheet)	3. Orthographic Projections	12
4	Draw one problem with plane surfaces & other with cylindrical, slot, slanting surfaces (using natural Scale and isometric scale) (01Sheet)	4. Isometric Projections	12
5	Draw four problems by using first angle method of projection (01Sheet)	5. Projections of Straight Lines	08
6	Draw Free Hand Sketches—any ten sketches covering all the topics under chapter 6 (01Sheet)	6. Free Hand Sketches	12
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Principles of drawing	8(04)	00(00)	00(00)	08(04)
2	Engineering Curves	00(00)	12(06)	00(00)	12(06)
3	Orthographic Projections	00(00)	00(00)	12(12)	12(12)
4	Isometric Projections	00(00)	00(00)	12(12)	12(12)
5	Projections of Straight Lines	00(00)	08(04)	00(00)	08(04)
6	Free Hand Sketches	08(04)	00(00)	00(00)	08(05)
	Total	16(08)	20(10)	24(24)	60(42)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	4	1	R	4	1	R	4										2/3
2	5	U	4	5	U	4	5	U	4	-	-	-	-	-	-	-	-	-	2/3
3	2	U	6	2	U	6	2	U	6										2/3
4	3	A	12	3	A	12	-	-	-	-	-	-	-	-	-	-	-	-	1/2
5	4	A	12	4	A	12	-	-	-	-	-	-	-	-	-	-	-	-	1/2
6	6	R	4	6	R	4	6	R	4										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Drawing Answer Sheets	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Sketch Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Drawing Answer Sheets	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	40	--	Drawing Sheets	1, 2, 3,4,5,6
		Journal Writing		Assignments	10	--	Drawing Portfolio	1, 2, 3,4,5,6
				Total	50	20		
	TEE (Term End Examination)	End Exam	Students	End of the Course	-	-	-	-
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Neatness , cleanliness and line work on drawing sheet	10
2	Creation of given drawing with proper dimensioning	20
3	In time submission	10
4	Viva Voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	2	-	-	-	2	-	-
2	3	3	3	-	-	-	2	-	-
3	3	3	3	-	-	-	3	-	-
4	3	3	3	-	-	-	3	3	-
5	3	3	3	-	-	-	2	3	-
6	3	3	3	-	-	-	2	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Drawing Practice for Schools and Colleges IS:SP-46	Bureau of Indian Standards, Reprint in, 2003	8170610192
2	Engineering Drawing	N.D. Bhatt, Charotar Publishing house 53 rd Edition 2019	9789380358963
3	Geometrical and Machine Drawing	N.D. Bhatt & V.M Panchal, Charotar Publishing house, 20 th Edition 2014	9789380358895
4	Engineering Drawing	D.A.Jolhe, Tata McGraw Hill Edu.2010	978-0-07-064837-1
5	Engineering Drawing	R.K.Dhawan , Published by S.Chand&co. 2012	9788121914314
6	Engineering Drawing	P.JShaha,S.Chand&co.2013	8121941822

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=ANEvQyt3PnU> accessed on 30 June 2021
- <https://www.youtube.com/watch?v=-W7tH49dBLw> accessed on 30 June 2021.
- <https://www.youtube.com/watch?v=FXP3tKedM5g> accessed on 30 June 2021.
- <https://www.youtube.com/watch?v=j5nwOJwVv4&list=PLDN15nk5uLiBpnIOK5r3KXdfFOVzGHJSt> accessed on 30 June 2021.
- [https://www.youtube.com/watch?v=77ufJXvXUk4&list=PLIhUrsYr8yHxVky7bfrnbRcdXcHjT_K83&index=2\(Iso\)](https://www.youtube.com/watch?v=77ufJXvXUk4&list=PLIhUrsYr8yHxVky7bfrnbRcdXcHjT_K83&index=2(Iso)) accessed on 30 June 2021.
- <https://www.youtube.com/watch?v=Jzr5PTbvkVI&list=PL1xA-ZWMKpOMt3ew5vcn3keBxlqHKtlg> accessed on 30 June 2021.

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

- Drawing Board with drawing instruments
- Mini-drafter

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rehadde	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	K. S. Thekedar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic,
4	Y. K. Gaiki	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE Representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/AE/CE/EE / ET/PK/ MT/TX/IT/CM / MC / AI
COURSE CATEGORY	: BASIC SCIENCE COURSE
COURSE CODE	: CH101G
COURSE TITLE	: CHEMISTRY
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

Chemistry is the basic science which is essential to all engineering courses. For an engineer, the usage of equipment's and instruments would require knowledge of chemical substances, their composition and properties. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to all engineering fields. Chemistry subject knowledge also aims to bridge the theoretical concepts and their practical engineering applications, thus highlighting the role of chemistry in the field of engineering. This will be gateway for development of reasoning capacity of students and understanding new technology as well.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Predict the valency and application of catalyst in industry.
2. Select metal and nonmetallic materials for industrial application.
3. Select Engineering materials on the basis of properties and application.
4. Apply knowledge related with Electrochemistry, and fuel Cells.
5. Apply the knowledge of preventive measures in Industry.
6. Analyze different type of energy sources for sustainable development.

❖ **COURSE DETAILS:****A. THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Chemical Bonding & Catalysis	1a. Predict valence electrons and type valence of elements. 1b. Formulate given molecule on the basis of given type. 1c. Differentiate between electrovalent and covalent compound on basis of given properties. 1d. Describe given type of catalysts, catalysis. 1e. Select the relevant catalyst for given application.	1.1 Valency: Definition & types of valence (Electrovalence & Covalence). Octet Rule, Duplet Rule. 1.2 Formation of Electrovalent e.g., NaCl, CaCl ₂ , MgO. and Formation of Covalent Compounds CO ₂ , NH ₃ , N ₂ . 1.3 Distinction between electrovalent & covalent compounds (formation, M.P. B.P., Type of bond, Solubility, strength of bond) Catalysis: 1.4 Definitions of catalyst Types of Catalyst, Positive Catalyst, Negative Catalyst, Auto - catalyst.: Definitions of catalysis, Types of catalysis. 1.5 Industrial Application of Catalyst.	06
2. Metallurgy, Alloy & Polymer	2a. Describe given terms in metallurgy. 2b. Describe given process of metal extraction. 2c. Select proper alloy for given application or vice versa. 2d. Distinguish between thermo softening and thermosetting plastics on given points. 2e. Select the given Plastic Polymer for Industry application. 2f. Apply given Thermal insulators in industry on their Characteristics.	2.1 Metallurgy: Definitions of terms used in metallurgy like Minerals, Ore, gangue, Flux, slag. Definition of metallurgy. 2.2 Flow chart of extraction process (Crushing, Concentration (physical and chemical), reduction, refining. 2.3 Definition of alloy, purposes of alloy formation, Types of alloys (ferrous alloy and nonferrous alloy) Composition properties and application of High-speed steel, Magnetic steel, Duralumin, Woods metal. 2.4 Polymer (plastic): Definition of polymer, types of polymers and difference of thermo softening and thermosetting plastics. 2.5 Formation of Plastic by Addition polymerization of Polyethylene, polystyrene. Formation of Plastic by Condensation process Bakelite plastic, nylon 6, 6. 2.6 Insulating material: Characteristics	08

		of Thermal insulators. Preparation, Properties & Applications of Thermocol & glass wool.	
3. Engineering Materials	3a. Describe functions & characteristics of given Lubricants. 3b. Select given lubricant on the basis of different types of machines. 3c. Detect the adverse effects of hard water as per given industry. 3d. Describe given type of water treatment process. 3e. Describe the given properties and applications of given construction material.	Lubricant: 3.1 Definition, Types of Lubricants, Functions of Lubricants. Characteristics of Lubricants- Viscosity, Volatility, viscosity Index, oiliness, cloud and pour point, Flash and fire point, Neutralization number. 3.2 Selection of Lubricant for various types of machines such as I.C engine, Gear system, cutting tools delicate and simple machines, tractors and rollers. Water: 3.3 Types of impurities in natural water. Definitions of hard and soft water, types of hardness. Adverse effects of hard water in: Industries- paper industry, textile industry, dyeing industry, sugar industry. 3.4 Potable water treatment: Sedimentation, Coagulation, filtration, sterilization (Chlorination method). Cement & Lime 3.4 Portland cement: Definition, chemical composition. Special Cements: Properties and application of water proofing cement, super sulphate cement. lime: Composition, properties and uses of fat lime, lean lime.	10
4. Electrochemistry	4a. Describe given terms involved in electrochemistry. 4b. Interpret degree of ionization on the basis of given factors. 4c. Describe the electroplating of given metal. 4d. Calculate the pH/POH of solutions with given concentration. 4e. Differentiate Primary and Secondary cells on given points. 4f. Use of Hydrogen-	Basic concepts of electrolysis: 4.1 Atoms, Ions, Electrolyte, conductivity of electrolytes, type of electrolyte- strong and weak electrolyte. 4.2 Ionization and electrolytic dissociation, Arrhenius theory of electrolytic dissociation, degree of ionization, factors affecting degree of ionization. Electrolysis 4.3 Faraday's laws of electrolysis: Faraday's First and Second law (Statement and mathematical expression) Application of electrolysis: Electro Plating of	09

	oxygen fuel cell in Engineering field.	copper and silver. pH and pOH: 4.4 Definition of pH, pOH, pH scale, numerical. Electrochemical cells/ batteries: 4.5 Basic concepts: cell, battery, distinction between Primary and secondary cells. 4.6 Fuel cell: Definition, construction, working, advantages, limitations and applications of Hydrogen-oxygen fuel cell.	
5. Corrosion	5a. Identify the given types of oxide film & its effect on corrosion. 5b. Describe mechanism of given type of corrosion. 5c. Choose different corrosion protection methods of metal and its use in given situation.	5.1 Definition of corrosion, Types of corrosion, mechanism of Atmospheric or chemical corrosion. Effect of oxide film on atmospheric corrosion. Factor effecting atmospheric corrosion. 5.2 Immersed Corrosion or Electrochemical Corrosion, definition, types and mechanism (Hydrogen evolution and oxygen absorption) 5.3 Application of Protective Coatings like metal coating by - Galvanizing, Tinning, Sherardizing, Metal Spraying, Metal Cladding	07
6. Energy & Pollution Control	6a. Compare given types of Fuel on given points. 6b. Analyse components of fuel by proximate analysis. 6c. Describe the properties and uses of given solid, liquid and gaseous fuel. 6d. Select proper pollution control methods for given type of pollution. 6e. Describe the significance of given E- waste Management methods for implementation of sustainable development.	Energy 6.1 Definitions of a fuel, Classification of fuels with suitable examples Characteristics of a good fuel, calorific value and ignition temperature, comparison between solid, liquid, gaseous fuels based on their properties. Classifications of fuel: 6.2 Solid fuels: analysis of solid fuels- Proximate analysis for determination of moisture, volatile matter, ash and fixed carbon, significance of Proximate analysis. 6.3 Liquid fuels: Bio diesel - properties, applications. Gaseous fuels: Composition, properties, applications of LPG, CNG Pollution control 6.4 Definition of pollution – Types of pollution (Air, water pollution) 6.5 3R Concept, recycling of plastic. E -waste management, sustainable development – significance of Wind	08

		Energy, Solar Energy.	
		Total Hrs.	48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Pra cti- cals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Explore the chemistry laboratory.	Chemical Bonding & Catalysis	02
2	Analyse basic and Acidic Radicals of known salt solution-1 (Confirmatory Test) using qualitative analysis method.	Chemical Bonding & Catalysis	02
3	Analyse basic and Acidic Radicals of known salt solution-2 (Confirmatory Test) using qualitative analysis method.		02
4	Analyse basic and Acidic Radicals of known salt solution-3 (Confirmatory Test) using qualitative analysis method.		02
5	Determine the percentage of Iron in given steel sample by redox titration. (OR) Determine the percentage of copper in given alloy sample.	Metallurgy Alloys & Polymer	02
6	Prepare Phenol formaldehyde resin used in manufacturing of Bakelite Plastic.	Metallurgy Alloys & Polymer	02
7	Determine total hardness (permanent and temporary) of given sample of water by EDTA method.	Engineering Materials	04
8	Determine the percentage of calcium content in cement	Engineering Materials	02
9	Determine acid value of lubricant by KOH OR Determine coefficient of viscosity using Ostwald's Viscometer.	Engineering Materials	02
10	Determination of PH value of given solution by using PH meter.	Electrochemistry	02
11	Find the Electrochemical equivalent (ECE) of copper.	Electrochemistry	02
12	Find the relation between loss in weight of aluminium strip in acidic and alkaline medium and rate of corrosion	Corrosion	02
13	Determine the strength of given hydrochloric acid solution by titrating it against sodium hydroxide solution.		02

14	Determine the percentage of moisture and ash content in the given coal sample. by proximate analysis.	Energy & pollution control	04
		Total	32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Chemical Bonding & Catalysis	02(02)	03(03)	03(00)	08(05)
2	Metallurgy, Alloy & Polymer	04(00)	06(00)	00(06)	10(06)
3	Engineering Materials	00(02)	06(06)	06(00)	12(08)
4	Electrochemistry	02(00)	03(06)	06(00)	11(06)
5	Corrosion	02(02)	03(00)	03(03)	08(05)
6	Energy and Pollution control	02(00)	03(06)	06(00)	11(06)
	Total	12(06)	24(21)	24(09)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

T-Unit/Topic Number

L- Level of Question

M-Marks

R-Remember

U-Understand

A-Analyze/ Apply

1R2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	2	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	3	R	2	5	R	2										
2	1	U	3	1	A	3	2	U	3	1	U	3	5	A	3				3/5
3	2	U	3	3	U	3	3	U	3	3	U	3	3	U	3				3/5
4	4	U	3	5	U	3	5	A	3	4	U	3	4	U	3				3/5
5	6	U	3	6	A	3	6	A	3	6	U	3	6	U	3				3/5
6	3	A	6	4	A	6	2	A	6										2/3

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Cours e Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3, 4, 5, 6
		Class Room Assignments		Assignments	15	--	Assignment book	1, 2, 3, 4, 5, 6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4, 5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous assessment of practical	Students	End of every practical	20	--	Journal	1, 2, 3, 4, 5, 6
		Journal Writing		Assignment	05	--	Journal	1, 2, 3, 4, 5, 6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1, 2, 3, 4, 5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4, 5, 6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Writing chemical reactions, handling the equipment, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs (if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3									
2	3			3						
3	3			3	3		3			
4	3			3			3			
5	3				3		3			
6	3			3	3		3			

- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Chemistry Jain and Jain	Engineering Chemistry Jain and Jain, Dhanpat Rai publishing company(P) ltd.15 edition	10092
2	Engineering Chemistry	Engineering Chemistry S. S. Dara, S. Chand Publication	15 th Edition
3	Engineering Chemistry	R. Sivakumar N. Sivakumar and Tata McGrawHill, edition10.	9780745-328896
4	Polytechnic Chemistry	Vedprakash Mehta, Jain brothers, 6 th Edition	13-9788183600134
5	Industrial Chemistry	Goel Publication, 8 th Edition	81877224002

❖ **E-REFERENCES:**

- http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_polymer_s- , accessed on 10 June 2021
- http://www.substech.com/dokuwiki/doku.php?id=full_index_of_articles_on_fluids-, accessed on 10 June 2021
- <http://www.asetute.com.au/corrosion.html>, accessed on 10 June 2021
- http://www.sherardizing.com/resources/files/9_Sherardizing_Corrosion.pdf , accessed on 10 June 2021
- <http://www.galvanizeit.org/aga/animation> , accessed on 10 June 2021
- http://www.ehow.com/list_6725219_different-types-metal-cladding.html , accessed on 10 June 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Electronic balance (measure up to 0.001 mg)
2. Battery 12 volt
3. Digital multi-meter
4. Rheostat assorted sizes
5. Voltmeter MI 0-150-300 V
6. Ammeter MI 0-5-10 A
7. Electrolytic cell set up
8. Digital PH meter

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM : (786)**

Sr.No.	Name	Designation	Institute / Industry
1	Dr.M.I.Ahmed	Coordinator Sr. Lecturer in Chemistry	Government Polytechnic, Nagpur
2	Dr.S.A.Petkar	Lecturer Chemistry.	Government Polytechnic, Nagpur.
3	Dr.K.A.Nandekar	Lecturer Chemistry	G.H.Raisoni college of Engineering Nagpur
4	Dr.Prashant Zade	Lecturer Chemistry	Dharampeth Polytechnic, Nagpur
5	Prashant B.Chouke	Lecturer Chemistry	Government Polytechnic, Brahmpuri
6	Dr.D.K.Borikar	Lecturer Chemistry	Government Polytechnic, Nagpur
7	Dr.S.L.Sayre	Lecturer Chemistry	Government Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	:DIPLOMA IN AI,CE,ME,EE,EC,PK,MC,MT,IT,AU, CM, TX,TR
COURSE CATEGORY	: HUMANITIES & SOCIAL SCIENCE COURSE
COURSE CODE	: EN101G
COURSE TITLE	: ENGLISH
TEACHING SCHEME	: TH: 02 TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 03(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 02 HRs
PR. TEE	: 02 HRs
PT.	: 01 HR

❖ **RATIONALE:**

English as a means of communication and interaction is imperative in the holistic development of an individual. While giving a practical view of the world around him it also helps define well their role in the world. While teaching this course, emphasis will be laid on enhancing expression of ideas in English by the students. Excellence in this language enables a professional to develop his career as well as builds a strong standing in society.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Incorporate Grammatically correct structures in usage.
2. Acquire comprehension ability.
3. Assess the idea and information given.
4. Demonstrate usage of language effectively.
5. Formulate language into meaningful structures.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Application of Grammar	1a. Incorporate correct sentence pattern in writing and speaking. 1b. Identify & use tenses in various situation. 1c. Formulate direct and indirect speeches according to the situations. 1d. Draft multiple and meaningful sentences.	1.1 Articles & Prepositions 1.2 Tenses: Appropriate uses of tenses in given situations. 1.3 Voice: use of active and passive voice. 1.4 Narration: direct & indirect speech	06
2. Text	2a. Interpret oral summary of topics read or heard. 2b. Adjust speed of reading. 2c. Follow oral instructions and explain them to others. 2d. Comprehend the lecture and make notes while listening. 2e. Inculcate ethical and inspirational values.	2.1 Text: Learning to read fluently and to develop insight through. Selected prose prescribed in the text. 1. Dale Carnegie's : Six ways to make people like you 2. When Life gave me Lemons- Rashmi Raj 3. Two Gentlemen of Verona- A.J. Cronin 4. To be a Somebody, Remain a Nobody by K S Ram 5. Brief answers to questions: AI	09
3. Comprehension of Passage	3a. Articulate single or multiple sentences. 3b. Comprehend main ideas and demonstrate them. 3c. Analyze and assess the information and ideas gathered from the given articles.	Articles for reading 3.1 Be Remarkable 3.2 Our Muddled Generation 3.3 Employers look for potential Employees	06
4. Speaking Skills	4a. Apply correct Pronunciations. 4b. Compose sentences with correct intentions and sense. 4c. Associate correct accent/stress to the given words.	Sample situations for conversational practice 4.1 Introducing yourself and others. 4.2 Meeting and parting. 4.3 Requesting information 4.4 Inquiries and information. 4.5 Asking, Giving and Refusing Permission. 4.6 Apologizing to an individual/ office.	06

5. Writing Skills	5a. Develop and expand ideas into paragraphs. 5b. Exercise speeches as per given situations.	5.1 Paragraph writing: Elaborate and expand ideas, Types of paragraphs 5.2 Speech writing: Introducing the Guests and vote of thanks.	05
Total Hrs.			32

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform Tense Busters -All levels (To be performed in language lab).	Application of Grammar	06
2	Transform given sentences into active and passive Voice.	Application of Grammar	02
3	Practice narration(Direct & Indirect Speech).	Application of Grammar	02
4	Outline an introduction- for self & others.	Speaking Skills	02
5	Build Vocabulary for different situations.	Text	04
6	Read and make notes on given topic.	Text	02
7	Write a paragraph on given topic.	Writing Skills	06
8	Conduct a Book Review.	Writing Skills	02
9	Practice Dialogue Writing & presentation.	Writing Skills	02
10	Conduct Comprehension of Passage.	Comprehension Passage	02
11	Prepare Speech and Present: 1) Introduction of guests 2) Vote of thanks	Speaking Skills	02
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Application of Grammar	02(02)	02(01)	02(02)	06(05)
2	Text	04(02)	04(02)	00(00)	08(04)
3	Short stories	02(02)	04(02)	00(00)	06(04)
4	Conversational Practice	00(00)	03(00)	02(01)	05(01)
5	Writing Techniques	00(00)	03(00)	02(02)	05(02)
	Total	08(12)	16(20)	06(09)	30(16)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

T- Unit/Topic Number

L-Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	3	R	2	2	R	2	2	R	2	3	R	2	2	R	2	4/7
	1	R	2																
2	2	U	3	3	U	3	4	A	3	1	U	3							3/4
3	3	U	3	5	U	3	2	U	3	4	U	3							3/4
4	5	A	4	1	A	4													1/2

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Cours e Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3, 4, 5, 6
		Class Room Assignments		Assignments	15	--	Assignment book	1, 2, 3, 4, 5, 6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4, 5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous assessment of practical	Students	End of every practical	20	--	Journal	1, 2, 3, 4, 5, 6
		Journal Writing		Assignment	05	--	Journal	1, 2, 3, 4, 5, 6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1, 2, 3, 4, 5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4, 5, 6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Performance	10
2	Overall presentation of given assignment	10
3	Viva voce	20
4	Activity	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	-	-	-	3			
2	3	-	-	-	3	-	3			
3	-	2	-	-	3	-	-			
4	-	-	-	-	3	-	3			
5	3	2	-	-	-	-	-			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	How to Win Friends and Influence people: Six ways to make people like you	Dale Carnegie, Rupa; First edition (20 May 2016)	978-8129140173
2	When life gave me lemons	https://storymirror.com/read/english/story/when-life-gave-me-lemons/krd7xe09 ,	
3	Two gentleman of Verona	A.J.Cronin, Oxford University Press 2013	
4	To be a somebody remain a nobody	K.S.Ram[Author] Times of India [Publisher] 20edition December 2004	
5	Brief answers to questions: Artificial Intelligence	Stephen Hawking Hodder & Stoughton, 16 October 2018	9781529345421

6	Our muddled generation.	Dinesh Kumar, Manish Sabharwal, Golden Harvest,	9788125059523
7	High School English Grammar and Composition	Wren and Martin Revised by Dr.N.D.V.PrasadaRao,	High School English Grammar and Composition
8	Contemporary English Grammar-structure and composition	David Green Revised Edition,2004 Himalaya Publication	033392183-6
9	Interactive English	S.K.Gangal, Revised Edition 1997 Allied Publishers	81-7023-678-9
10	Applied English Grammar and composition.	Dr. P.C. Das, 2013, New Central Book Agency.	978-81-7381- 542-3
11	English for Practical Purposes	Z. N. Patil, B.S. Valke	033935098

❖ **E-REFERENCES:**

- <https://storymirror.com/read/english/story/when-life-gave-me-lemons/krd7xe09>, accessed on 25th July, 2021
- www.talkenglish.com-grammar , Accessed on 12th July, 2021
- www.perfect-english-grammar.com , Accessed on 18th March, 2021

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.Rupali Londhe	Lecturer in English & Coordinator	Government Polytechnic, Nagpur.
2	Prof. Nitin Pote	Expert, Lecturer in English	Government Polytechnic, Bramhapuri
3	Prof. Ravindra Suryawanshi	Expert, Lecturer in English	NIT Polytechnic, Nagpur
4	Prof. Nitin Pathak	Expert, Lecturer in English	Kamptee Polytechnic, Nagpur
5	Dr.M.M.Machale	Lecturer in English	Government Polytechnic, Nagpur.
6	Mrs.Kamala Grace	Visiting Lecturer in English	Government Polytechnic, Nagpur.
7	Mrs.Swati Mahatme	Visiting Lecturer in English	Government Polytechnic, Nagpur.
8	Ms.Rasika Joshi	Visiting Lecturer in English	Government Polytechnic, Nagpur.
9	Mrs.Barnali Roy	Visiting Lecturer in English	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN AI,CE,ME,EE,EC,PK,MC,MT,IT,AU,CM,
TX,TR

COURSE CATEGORY : HUMANITIES & SOCIAL SCIENCE COURSE

COURSE CODE : EN101G

COURSE TITLE : ENGLISH

TEACHING SCHEME : TH: 02 TU: 00; PR: 02 (CLOCK HRs.)

TOTAL CREDITS : 03(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE : 02 HRs

PR. TEE : 02 HRs

PT. : 01 HR

❖ RATIONALE:

English as a means of communication and interaction is imperative in the holistic development of an individual. While giving a practical view of the world around him it also helps define well their role in the world. While teaching this course, emphasis will be laid on enhancing expression of ideas in English by the students. Excellence in this language enables a professional to develop his career as well as builds a strong standing in society.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Incorporate Grammatically correct structures in usage.
2. Acquire comprehension ability.
3. Assess the idea and information given.
4. Demonstrate usage of language effectively.
5. Formulate language into meaningful structures.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Application of Grammar	1a. Incorporate correct sentence pattern in writing and speaking. 1b. Identify & use tenses in various situation. 1c. Formulate direct and indirect speeches according to the situations. 1d. Draft multiple and meaningful sentences	1.1 Articles & Prepositions 1.2 Tenses: Appropriate uses of tenses in given situations. 1.3 Voice: use of active and passive voice. 1.4 Narration: direct & indirect speech	06
2. Text	2a. Interpret oral summary of topics read or heard. 2b. Adjust speed of reading. 2c. Follow oral instructions and explain them to others. 2d. Comprehend the lecture and make notes while listening. 2e. Inculcate ethical and inspirational values	2.1 Text: Learning to read fluently and to develop insight through. Selected prose prescribed in the text. 1. Dale Carnegie's : Six ways to make people like you 2. When Life gave me Lemons- Rashmi Raj 3. Two Gentlemen of Verona- A.J. Cronin 4. To be a Somebody, Remain a Nobody by K S Ram 5. Brief answers to questions: AI	09
3. Comprehension of Passage	3a. Articulate single or multiple sentences. 3b. Comprehend main ideas and demonstrate them. 3c. Analyze and assess the information and ideas gathered from the given articles.	Articles for reading 3.1 Be Remarkable 3.2 Our Muddled Generation 3.3 Employers look for potential Employees	06
4. Speaking Skills	4a. Apply correct pronunciations. 4b. Compose sentences with correct intentions and sense. 4c. Associate correct accent/stress to the	Sample situations for conversational practice 4.1 Introducing yourself and others. 4.2 Meeting and parting. 4.3 Requesting information 4.4 Inquiries and information. 4.5 Asking, Giving and Refusing	06

	given words.	4.6 Permission. Apologizing to an individual/ office.	
5. Writing Skills	5a. Develop and expand ideas into paragraphs. 5b. Exercise speeches as per given situation.	5.1 Paragraph writing: Elaborate and expand ideas, Types of paragraphs 5.2 Speech writing: Introducing the guests and vote of thanks.	05
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform Tense Busters -All levels(To be performed in language lab)	Application of Grammar	06
2	Transform given sentences into active and passiveVoice	Application of Grammar	02
3	Practice narration(Direct & Indirect Speech)	Application of Grammar	02
4	outline an introduction- for self & others	Speaking Skills	02
5	Build Vocabulary for different situations	Text	04
6	Read and make notes on given topic	Text	02
7	Write a paragraph on given topic	Writing Skills	06
8	Conduct a Book Review	Writing Skills	02
9	Practice Dialogue Writing & presentation	Writing Skills	02
10	Conduct Comprehension of Passage	Comprehension passage	02
11	Prepare Speech and Present: 1) Introduction of guests 2) Vote of thanks	Speaking Skills	02
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Application of Grammar	02(00)	03(00)	00(02)	05(02)
2	Text	04(02)	06(03)	00(00)	10(05)
3	Comprehension of Passage.	02(00)	06(00)	00(00)	08(00)
4	Speaking Skills	00(00)	00(00)	03(04)	03(04)
5	Writing Skills	00(00)	00(00)	04(03)	04(03)
	Total	08(02)	15(03)	07(09)	30(14)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

T- Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	2	R	2	3	R	2	1	A	2	2	R	2	4/6
2	2	U	3	3	U	3	1	U	3	2	U	3							3/4
3	4	A	3	2	U	3	3	U	3	5	A	3							3/4
4	5	A	4	4	A	4													1/2

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	15	--	Test Answer Scripts	1, 2, 3,4,5
		Class Room Assignments		Assignments	05	--	Assignment Book	1, 2, 3,4,5
	TEE (Term End Examination)	End Exam	Students	End of the Course	30	12	Theory Answer Scripts	1,2,3,4,5
				Total	50	20		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End Of the Course	25	10	Practical Answer Scripts	1,2,3,4,5
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5
	End of Course Survey			End Of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Performance	05
2	Overall presentation of given assignment	05
3	Viva voce	10
4	Activity	05
	TOTAL	25

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	-	-	-	3			
2	3	-	-	-	3	-	3			
3	-	2	-	-	3	-	-			
4	-	-	-	-	3	-	3			
5	3	2	-	-	-	-	-			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	How to Win Friends and Influence people: Six ways to make people like you	Dale Carnegie, Rupa; First edition (20 May 2016)	978-8129140173
2	When life gave me lemons	https://storymirror.com/read/english/story/when-life-gave-me-lemons/krd7xe09 ,	
3	Two gentleman of Verona	A.J.Cronin, Oxford University Press 2013	
4.	To be a somebody remain a nobody	K.S.Ram[Author] Times of India [Publisher] 20edition December 2004	
5	Brief answers to questions: Artificial Intelligence	Stephen HawkingHodder&Stoughton, 16 October 2018	9781529345421
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10	Applied English Grammar and composition.	Dr. P.C. Das, 2013, New Central Book Agency.	978-81-7381-542-3
11	English for Practical Purposes	Z. N. Patil, B.S. Valke	033935098

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- www.talkenglish.com-grammar , Assessed on 12th July, 2021
- www.perfect-english-grammar.com , Assessed on 18th March, 2021

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3	Prof Ravindra Suryawanshi	Expert, Lecturer in English	NIT Polytechnic, Nagpur
4	Prof NitinPathak	Expert, Lecturer in English	Kamptee Polytechnic, Nagpur
5	Dr.M.M.Machale	Lecturer in English	Government Polytechnic, Nagpur.
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8	Ms.Rasika Joshi	Visiting Lecturer in English	Government Polytechnic, Nagpur.
9	Mrs.Barnali Roy	Visiting Lecturer in English	Government Polytechnic, Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/CM/IT/PK/MT/TX/ TR/MC/AI
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: IT151G
COURSE TITLE	: INTRODUCTION TO IT SYSTEMS
TEACHING SCHEME	: ONLINE COURSE FOR CREDIT TRANSFER
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: --
PR. TEE EXAM	: --
PT. EXAM	: --

❖ **RATIONALE:**

Information Technology (IT) is an essential tool that we cannot avoid as it plays an important role in our day to day life, especially in the present scenario. Introduction to IT Systems course starts with the basic computer skills, learning basic application software tools, Understanding Computer Hardware, Basic Internet awareness.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply the basics of computer fundamentals.
2. Identify Basic Internet skills.
3. Demonstrate the use of different Office Tools.
4. Recognize various computer hardware components.
5. Install, configure and maintain the operating system.
6. Identify and illustrate the use of Digital India portals (state and national portals).

❖ COURSE DETAILS:

Students Can select any ONE from Online Course from A), B) , C) given below. A student must obtain a certificate for passing the examination of selected course.

A) Spoken Tutorial (IIT Mumbai) :-

Module I –Introduction to Computer -- Duration 5 Hrs

Module II - Any two course modules from following

- a) LibreOffice –Writer--10 hours
- b) LibreOffice –Calc -- 12 hours
- c) LibreOffice-Impress --08 hours

Students can register for the above online course modules on Spoken Tutorial Portal in first semester. However institute registration shall be done as per program structure. Program department shall appoint one faculty as mentor to this on line activity.

B) Swayam :-Course Module:- Course in Information Technology—08 Weeks duration

C) Any equivalent course as compared to above from MOOCs available .

❖ SPECIFICATION TABLE FOR THEORY PAPER:Nil**❖ QUESTION PAPER PROFILE FOR THEORY PAPER:Nil**

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Class Room Assignments		Assignments	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:** Online Examination❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:IT Dept.**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	--	--	--	--	3	3	--
2	3	3		--	--	--	3	3	--
3	3	3	3	3	--	--	3	3	--
4	3	3	--	3	--	--	3	3	--
5	3	3	--	3	--	--	3	3	--
6	3	3	--	--	--	--	3	3	--

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Computer Fundamentals	R.S. Salaria Khanna Publishing House	ISBN: 9789381068533
2	Computer Course Made Easy	Ramesh Bangia Edition: 1	ISBN 13: 9789382609377
3	Internet Applications	Ikvinderpal Singh	ISBN 10: 9381068399

❖ **E-REFERENCES:**

- <https://www.latex-tutorial.com/tutorials/> accessed on 22/6/2021
- <http://www1.maths.leeds.ac.uk/LaTeX/TableHelp1.pdf> accessed on 22/6/2021
- <https://www.wikihow.com/Create-a-Website-Using-Google-Sites> accessed on 22/6/2021
- <http://www.tutorialsforopenoffice.org/> accessed on 22/6/2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Computer System (with latest specifications)
2. MS Office 2007 Professional or latest version
3. PC tools
4. Windows 7

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.A.R.Mahajan	HoD, Information Technology	Government Polytechnic, Nagpur.
2	Mr. Dipak Dhote	Operations Manager, IT- Network Infosystems Pvt LTD	Industry Expert
3	Dr. Rakesh Kadu	Assistant Professor, I.T., Ramdeobaba College of Engg, and Management, Nagpur.	Member from Academics(External)
4	Mrs.V.A.Raje	Lecturer in C.O., G.P.Arvi	MSBTE Nominee
5	Mr. M.N.Gawande	Lecturer in Electrical Engg.	CDC In Charge
6	Mrs.D.P.Chanmanwar	Lecturer in IT	Member (Internal)
7	Mr.L.D.Vilhekar	Lecturer in IT	Member (Internal), Course Expert
8	Mr. S.J.Pukale	Lecturer in IT	Course Expert

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/CM/IT/MT/PK/AE/TR/
TX/MK

COURSE CATEGORY : HUMANITIES & SCIENCE COURSE

COURSE CODE : LS151G

COURSE TITLE : LIFE SKILLS

TEACHING SCHEME : TH:00; TU:00;PR: 02 (CLOCK Hrs.)

TOTAL CREDITS : 01(TH/TU CREDIT = 0 , 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE EXAM : --

PR. TEE EXAM : --

PT. EXAM : --

❖ RATIONALE:

According to NASSCOM and other agency surveys conducted, suggests that today's Diploma engineers are technically solid, can do linear programming problems, solve issues quickly but lack in Interpersonal and Communication skills. The list of required life skills include communication, leadership, team work, public speaking, attitude, ethics, professional etiquettes etc. This 'disconnect' between the desired skills and the qualifications and skills obtained needs to be addressed. Bridging the gap between Formal technical education and Industry's requirements, an interface between Industry and Institute is very essential. A pre-employment training in these life skills therefore becomes the essential part of the curriculum of Diploma programmes. to prepare job ready students for industries. This will enhance the employability and the industry connect for the students and will reduce the gestation period of students in Corporate world.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Acquire knowledge of Self discovery.
2. Build essential soft skills.
3. Enhance professional competencies

4. Adapt ethics and values.
5. Develop interpersonal skills.
6. Maintain physical and mental fitness.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes(Cognitive Domain)	Topics and subtopics	Hrs
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

S.No.	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	1. Prepare a draft of personal information. 2. Practice and perform self introduction. 3. Demonstrate appropriate body language during self intro and introducing others.	A. Soft Skills Understanding self & Others a. Self Introduction b. Introducing others	2 hrs
2	1. Practice Yoga Asanas recommended in AYUSH Common Yoga Protocol (Tadasana, Vrikshasana, Pada-hastasana, Trikonasana, Ardha-Chakrasana etc) for good health and fitness. 2. Prepare a diet chart for - Teenagers/Old age people/Diseased person etc. 3. Prepare a table of Do's and Don'ts of Habit formation.	B. Life Skills Mental & Physical Health a. Warm up b. Yoga c. Habit formation- Do's & Don'ts d. Diet Pyramid	4 hrs
3	1. Practice Pranayamas recommended in AYUSH Protocol (Anulom vilom, Kapalbhati, Bhramari Pranayama, Bhastrika, Surya Bhedan etc) for good health and fitness. 2. Practice different types of meditation -Mindfulness meditation, Loving Kindness Meditation, Yoga Meditation.	B. Life Skills Mental & Physical Health a. Pranayam b. Meditation	4 hrs
4	1. Practice and perform Group Discussions on topics/ issues of	A. Soft Skills Personality	2 hrs

	relevance. 2. Demonstrate appropriate dress and appearance for formal conversation. 3. Exhibit suitable non verbal codes of communication.	Development a. Group Discussion b. Personal grooming c. Verbal-Non Verbal communication	
5	1. Draft pros and cons on given topic of Debate. 2. Practice sessions on Debate on current affairs.	C. Employability Skills Interpersonal Skills a. Public Speaking b. Analytical thinking	2 hrs
6	1. Prepare draft for seeking permission to organize academic activity/event/visit etc. 2. Prepare checklist of things to do and schedule for organizing academic activity/event/visit etc. 3. Exercise activities (2 to 3) based on confidence building- such as Interviewing of field experts, organizing industrial visits and submitting reports etc.	C. Employability Skills Effective Management a. Planning b. Motivating self & others	4hrs
7	1. Jot down the qualities and skills of successful entrepreneur to prepare presentation on his/her achievements and contribution. 2. Prepare and present presentation on Learning lessons from Biographies of industrialists (like Rusy Modi, Dhirubhai Ambani, Ratan Tata, Narayana Murthy etc.	D. Presentation Skills - Corporate Culture a. Attitude b. Creativity & Innovation	4hrs
8	1. Investigate and examine industry related issues and prepare a case study on it. 2. Present case studies based on industry related issues like-indefinite labour strike, accidents , customer complaints, employees' career requirements.	D. Presentation Skills - Problem Solving a. Critical Thinking b. Problem Analysis	2 hrs
9	1. Jot down the lacunas of the entrepreneur which caused fall in business. 2. Prepare and present presentations on Learning lessons from failure business stories.	D. Presentation Skills - Learning Attitude a. Adaptability b. Persistence	2 hrs

10	1. Participate and practice in basket exercises / Games related to Team Working & Leadership. 2. Exhibit leadership qualities in group task.	A. Soft Skills Interpersonal Skills a. Working in a team b. Leadership	2hrs
11	1. Demonstrate exercises on Problem solving in Assertive communication (Role Play). 2. Incorporate assertive communication in given situation.	A. Soft Skills Interpersonal Skills a. Positive Thinking b. Assertiveness	2 hrs
12	1. Set short term and long term career goals. 2. Practice sessions on Time management (Prepare schedule to achieve short term and long term goals).	A. Soft Skills Effective Time Management a. Goal Setting b. Time Management	2 hrs
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Nil

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Nil



❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Who m	Frequency	Max Mark s	Min Mark s	Evidence Collected	Course Outcome s
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)		--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments		--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course			Theory Answer Scripts	1,2,3,4,5, 6
				Total				
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course			Practical Answer Scripts	1,2,3,4,5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Presentation Skills	10
2	Communication	10
3	Motivation	10
4	Confidence/Enthusiasm	05
5	Interpersonal Skills	10
6	Viva voce	05
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	-	-	-	-	-	2	3	-	-	-
2	-	-	-	-	-	2	3	-	-	-
3	-	-	-	-	-	3	3	-	-	-
4	-	-	-	1	1	3	3	-	-	-
5	-	-	-	-	-	3	3	-	-	-
6	-	-	-	-	-	2	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Yoga Therapy	Angarai, G. M. and Indra Mohan, Shambhala Publications, 2 nd Edition, January 1, 2014.	ISBN-13 9781590301319
2	The ACE of Soft Skills: Attitude, Communication and Etiquette for Success	Gopalaswamy R. and Mahadevan Pearson Publication, 1 st Edition, 13 May 2010.	ISBN-13 978-8131732854
3	Simple Art of Business Etiquette: How to Rise to the Top by Playing Nice	Jeffrey L Seglin, Tycho Pr Publication, 12 January 2016	ISBN-13 978-1623156886
4	The Big Book of Team-Motivating Games	Edward Scannell and Mary Scannell, McGraw-Hill Education, 7 October 2009	-----

5	Team Building: Proven Strategies for Improving Team Performance	W. Gibb Dyer , Jeffrey H. Dyer , and William G. Dyer, 5th Edition, Jossey-Bass, 3 January 2013	ISBN-13 978-1118105139
6	How to Win Friends & Influence People	Dale Carnegie, Pocket Books October 1, 1998	ISBN-10 0671027034
7	Famous Industrialists: Famous Biographies for Young People	Sigmund A. Lavine, Literary Licensing, LLC, 13 October 2012	ISBN-13 978-1258497026
8	Why Entrepreneurs Really Fail	Buchia Nozer, Bloomsbury, October 1, 1998	ISBN-13 9789382951605

❖ **E-REFERENCES:**

- <http://ihmshimla.org/wp-content/uploads/2013/05/Industrial-Training-Rule-Book.pdf>, accessed on 25th July, 2021
- <https://www.oliveboard.in/blog/from-rags-to-riches-indias-most-inspiring-success-stories>, accessed on 23rd May, 2021
- <https://coach.basketball.net.au/10-simple-team-building-activities-for-your-under-14s>, accessed on 14th June, 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Prof. Deepak Kulkarni	Soft Skills Trainer & Councilor	Consultant, Nagpur
2	Dr. Shabbir Zukerya	Director	Learner's Academy for Skill Development, Nagpur
3	Mr. Anand Toal	Director	International Placements, Nagpur
4	Dr. Megha Machale (Bhelande)	Lecturer in English	Government Polytechnic, Nagpur.
5	Prof. Yogesh Chandarana	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.
6	Mr. Manish Gawande	In-Charge, Curriculum Development Cell	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : **DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/PK/MT/TX/**
TR/MC/AI

COURSE CATEGORY: **AUDIT COURSE**

COURSE CODE : **EV151G**

COURSE TITLE : **ENVIRONMENTAL SCIENCE**

TEACHING SCHEME: **TH: 02; TU: 00; PR: 00 (CLOCK HRs.)**

TOTAL CREDITS : **02 (1 TH CREDIT = 1 CLOCK HR.)**

TH. TEE : --

PR. TEE : --

PT : --

❖ **RATIONALE:**

The world today is facing the biggest challenge of survival. Degradation of ecosystem, depletion of natural resources, increasing levels of pollution, poses major threat to the survival of mankind. The need of the hour, therefore, is to concentrate on the area of environmental science, which shall provide an insight into various environment related issues.

Environmental science is an interdisciplinary academic field that integrates physical and biological sciences, with the study of the environment. It provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems & gives an insight into solutions of Environmental problems.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Acquire the knowledge of terms related to Environmental Studies.
2. Identify natural resources and resolve problems associated with them.
3. Identify alternate energy resources and use them efficiently during their engineering practices.
4. Develop habits which will reduce various types of pollution.

5. Analyze key issues about environment and create public awareness about those environmental issues.
6. Acquire formal & non formal environmental education.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Earth System and Resources	1a. Prepare list of historical events of earthquakes, volcanoes, Tsunami, cyclone & landslides in the world. 1b. Identify problems associated with soil, water. 1c. Differentiate weather and climate. 1d. Analyze the global water problems.	1.1 Earth Science: Concepts of Geologic time scale; earthquakes, volcanoes, Tsunami, cyclone & landslides 1.2 The Atmosphere: Weather and climate; the Coriolis Effect 1.3 Global Water Resources and Use: Present scenario, surface and groundwater issues; global problems; and its conservation. 1.4 Soil : soil erosion and other soil problems; methods of soil conservation	04
2. Concept of Biodiversity	2a. Describe Biodiversity. 2b. Identify Levels of Biodiversity. 2c. Prepare a list of biodiversity hotspots 2d. List the endangered species. 2e. Prepare a report on value of Biodiversity. 2f. Suggest methods / steps for Biodiversity conservation .	2.1 Definition of Biodiversity 2.2 Levels of biodiversity 2.3 Value of biodiversity 2.4 Threats to biodiversity, loss of biodiversity (biodiversity hotspots) 2.5 Conservation of biodiversity (modern methods of biodiversity conservation)	04
3. Energy Resources and Consumption	3a. Match the energy forms projects. 3b. Describe various forms of energy. 3c. Describe advantages and disadvantages of forms of energy. 3d. Select appropriate solutions of Efficient use of energy. 3e. Utilize techniques for energy consumption to reduce impact on environment.	3.1 Energy Consumption history 3.2 Present global energy use, Future energy needs 3.3 Energy forms:(conventional and non conventional) 3.4 Energy Conservation 3.5 Renewable Energy: Solar energy; solar electricity; biomass; wind energy; ocean waves and tidal energy; geothermal	06

4. Pollution	4a. Define pollution and pollutants. 4b. Classify various types of pollutants. 4c. Identify the Pollutants and their sources. 4d. Develop habits to reduce pollution. 4e. State the standard / limiting/ controlling values of various type of pollution.	4.1 Definition of pollution. 4.2 Air pollution: Definition, Classification, sources, effects, Prevention and ambient air quality standards. 4.3 Water Pollution: Definition, Classification, sources effects, Prevention And WHO and BIS water quality standards. 4.4 Soil Pollution/land pollution: Definition, sources, effects prevention 4.5 Noise Pollution: Definition, sources, effects, prevention. 4.6 Biomedical Waste and E-Waste – Origin, Effects and control Measures. 4.7 CPCB and MPCB norms and roles and responsibilities.	08
5. Social issues and Environment	5a. Describe sustainable development. 5b. Evaluate sources of Green house effect, acid rains, Global warming. 5c. Describe the incidences of Nuclear accidents.	5.1 Concept of development, sustainable development 5.2 Watershed management , rain water harvesting 5.3 Global Warming, greenhouse effect; ozone depletion, relevant laws and treaties 5.4 Nuclear Accidents and Holocaust: Basic concepts and their effect on climate, , relevant laws and treaties	05
6. Environmental Education	6a. Differentiate formal and non formal education. 6b. Describe various acts and their provisions. 6c. Develop awareness about environment.	6.1 Formal and non-formal education 6.2 Role of Govt. and Non-Govt. Organization 6.3 Indian constitutional provisions regarding the environment. Brief description of the following acts and their provisions: Environmental Protection Act and Prevention of Water, air and noise Pollution Act. 6.4 Concepts EIA and environmental Ethics	05
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assignments	Specific Learning Outcomes (Psychomotor Domain)	Units
1	Prepare report on Loss of biodiversity, its conservation and also describe biodiversity hotspots.	Concept Of Biodiversity
2	Prepare report on use of various renewable energy sources.	Energy Resources And Consumption
3	Assignment on article collection from news papers, magazines and internet on local environmental pollution.	Pollution
4	Prepare report on case study of Industrial /Nuclear / any other Disaster in India.	Social Issues And Environment

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Nil

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Nil



❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Class Room Assignments		Assignments	--	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Theory Answer Scripts	1,2,3,4,5,6
				Total	--	--		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	--	--	--	--
		Journal Writing		Assignments	--	--	--	--
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

Nil

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	
	1	2	3	4	5	6	7	9	10
1	3	-	-	-	2	-	-	-	-
2	3	-	-	-	2	-	2	-	-
3	3	-	-	-	2	-	2	-	-
4	2	-	-	-	2	-	-	-	-
5	3	-	-	-	2	-	2	-	-
6	2	-	-	-	2	-	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Environmental studies	Oxford University Press, New Delhi. 2011	0-19-807228-2
2	Environmental Science	Y.K. Singh, New Age International, New Delhi	8122418481, 9788122418484
3.	A Text Book Of Environmental Science	Arvind Kumar, APH Publishing, New Delhi	817648590X, 9788176485906
4	Environmental Engg	A Kamla & D.L.Kanth Rao, Tata Mc Graw-Hill, New Delhi	0-07-451708-2
5	A Textbook of Environmental Studies	Shashi Chawla, Tata Mc Graw-Hill, New Delhi	9781259006388
6	Environmental studies	Erach Bharucha	UGC , New Delhi

❖ **E-REFERENCES:**

1. https://en.wikipedia.org/wiki/Lists_of_nuclear_disasters_and_radioactive_incidents, accessed on 20 January 2021
2. www.legalserviceindia.com/articles/noip.htm accessed on 18 March 2021
3. <https://prezi.com/8mnz--ldkybc/apes-unit-1-earth-systems-resources/> accessed on 23 March 2021
4. <http://www.conserve-energy-future.com/AlternativeEnergySources.php>, 18 March 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.N.V Raut	Head of Civil Engineering, (I)	Government Polytechnic, Nagpur.
2	Dr.S.R.Kukdapwar	Head of Civil Engineering, (II)	Government Polytechnic, Nagpur.
3	Dr.Mrs.R.A.Wankhade	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
4	Mr. A.J.Fulzele	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.
5	Mr.V.B. Dhait	Lecturer in Civil Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

**PROGRAMME : DIPLOMA IN EC/IT/MC/EE/CM/CE/ME/AE/PK/
TR/TX/MT/AI**

COURSE CATEGORY: AUDIT COURSE

COURSE CODE : IC151G

COURSE TITLE : INDIAN CONSTITUTION

TEACHING SCHEME: TH:01; TU: 00; PR: 00 (CLOCK HRs.)

TOTAL CREDITS : -

TH. TEE EXAM : -

PR. TEE EXAM :-

PT. EXAM : -

❖ **RATIONALE:**

The Constitution of India is the supreme law of India. The document lays down the framework that demarcates fundamental political code, structure, procedures, powers, and duties of government institutions and sets out fundamental rights, directive principles, and the duties of citizens. Engineer has to perform different works related to project planning, constructing project work, lead a group of workers etc. Engineer must also know about different bodies of administration, fundamental rights of citizen, different levels of Indian Union. Hence every Diploma Holder should have knowledge about Indian Constitution.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Interpret policies of government.
2. Outline structure of Indian Union.
3. Describe functions of State Secretariat and different Ministries .
4. Describe structure of District Administration.
5. Describe role and functions of Chief Election Commissioner.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Topics and Subtopics	Hrs.
1. The Constitution - Introduction	1.1 The History of the Making of the Indian Constitution 1.2 Preamble and the Basic Structure, and its interpretation 1.3 Fundamental Rights and Duties and their interpretation 1.4 State Policy Principles	04
2. Union Government	2.1 Structure of the Indian Union 2.2 President – Role and Power 2.3 Prime Minister and Council of Ministers 2.4 Formation of Lok Sabha and Rajya Sabha and its functions	04
3. State Government	3.1 Role and Power of Governor 3.2 Role and Functions of Chief Minister and Council of Ministers 3.3 Functions and Powers of State Secretariat	03
4. Local Administration	4.1 Structure of District Administration 4.2 Functions of Municipal Corporation 4.3 Functions of Zila Parishad	03
5. Election Commission	5.1 Role and Functions of Chief Election Commissioner 5.2 Role and Functions of State Election Commission	02
	Total	16

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assignment on each topic (Total 5 Assignments)

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Class Room Assignments		Assignments	--	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Theory Answer Scripts	1,2,3,4,5,6
				Total	--	--		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	--	--	--	--
		Journal Writing		Assignments	--	--	--	--
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	-	-	-	-	3	-	3	-	-	-
2	-	-	-	-	3	-	3	-	-	-
3	-	-	-	-	3	-	3	-	-	-
4	-	-	-	-	3	-	3	-	-	-
5	-	-	-	-	3	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Ethics and Politics of the Indian Constitution	Rajeev Bhargava, Oxford University Press, New Delhi, 2008	
2	The Constitution of India	B.L. Fadia, Sahitya Bhawan; New edition (2017)	
3	Introduction to the Constitution of India	DD Basu, Lexis Nexis; Twenty-Third 2018 edition	

❖ **E-REFERENCES:**

- <https://www.constitution.org/cons/india/const.html>
- <http://www.legislative.gov.in/constitution-of-india>
- <https://www.sci.gov.in/constitution>
- <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.D.D.Lulekar	HoD, Electrical Engg. Deptt.	Government Polytechnic, Nashik.
2	Prof.A.M.Arekar	Lecturer In Electrical Engg.	Government Polytechnic, Nagpur
3	Mr.M.N.Gawande	Lecturer In Electrical Engg.	Government Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/ CM / IT/AE/PK/MT/AI
COURSE CATEGORY	: BASIC SCIENCE COURSE
COURSE CODE	: MH102G
COURSE TITLE	: APPLIED MATHEMATICS
TEACHING SCHEME	: TH:03; TU: 01(1TH/TU CREDIT=1CLOCK Hrs.)
TOTAL CREDITS	: 04
TH. TEE EXAM.	: 03 Hrs.
PR. TEE EXAM	: --
PT. EXAM	: 01 Hrs.

❖ RATIONALE:

Mathematics is the backbone of Technical courses, Understanding of engineering concepts require logical approach and thinking. The course is extension of Basic Mathematics of first semester and stepping into the prerequisites to learn Calculus and Numerical method. Applied Mathematics lay down the foundation to understand and express principles and laws involved in other Technological courses.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply the concept of functions to Identify and find the value, Range, Domain ,Co Domain of the given function.
2. Apply methods of evaluation of limit to solve the given examples of limits .
3. Apply the concept of limit, define the first principal of derivatives, notation, understood the Rules to solve the examples of derivatives.
4. Using integral of standard function, rules, and methods to solve indefinite and definite integral problems .
5. Apply the concept of differential equation which helps to solve engineering problems.
6. Apply various numerical method to solve algebraic and simultaneous equations.

❖ COURSE DETAILS:

A.THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Functions	1a. Find the Range , Domain and Co-Domain of the given function. 1b. Find the value of given function. 1c. Identify the type of given functions. 1d. Check whether the given function is odd or even function	1.1 Concept of function, Domain, Co-Domain, and Range of the Functions. 1.2 Value of a function. 1.3 Types of functions:- Logarithmic, Inverse, Algebraic, Trigonometric, & Inverse(LIATE) 1.4 Even and odd Function , Parametric, Composite Implicit, Explicit Functions.	04
2. Limits	2a. Evaluate given limits by using Algebra of limits . 2b. Solve the limit of given trigonometric function. 2c. Evaluate limits of the given exponential functions. 2d. Evaluate the given logarithmic limit and Exponential limit.	2.1 Concept of limit. 2.2 Algebra of limits.(Addition Subtraction, Multiplication & Division) 2.3 Limits of algebraic functions (By Direct Method, Factorisation, & Rationalisation Method).Limits of Trigonometric function. Limit based on x tends to infinity, 2.4 Exponential Limits & Logarithmic Limits, Use of Logarithmic Limits for Exponential Limits.	08
3. Derivatives and Higher Order Derivatives	3a. Find the derivatives of given function using standard function formulae. 3b. Find the derivatives of given function using Rules of Derivatives. 3c. Find the derivatives of given composite inverse and inverse trigonometric, implicit, explicit, parametric, and exponential functions. 3d. Differentiate the given function w.r.t. x by using logarithmic differentiation.	3.1 First principle of derivatives and Notations(without proof), Derivatives of standard function.(LIATE) 3.2 Rules for differentiation (without proof) 3.3 Derivative of composite, inverse and inverse trigonometric , implicit, explicit, parametric, and exponential functions. 3.4 Logarithmic differentiation. 3.5 Derivatives of one function with respect to another function 3.6 Second order differentiation.	12

	3e. Differentiate the given function w.r.t. another function. 3f. Find the second order derivatives of the given function.		
4. Indefinite and Definite Integration	4a. Integrate the given function w.r.t. x 4b. Evaluate the given integral by substitution method. 4c. Evaluate the integral of given composite or rational function. 4d. Integrate the given Trigonometric function. 4e. Integrate the given 4f. function by, Integration by Parts or Partial Fraction. 4g. Evaluate the given definite integral by using properties.	4.1 Concept of Integration as a anti derivatives, Integral of standard function (LIATE), Rules of integration. 4.2 Integration by substitution method. 4.3 Integration of Algebraic Rational function and composite function. 4.4 Integration of trigonometric function. 4.5 Integration by partial fraction and by parts. 4.6 Definite integral and their properties.	10
5. Differential Equations	5a. Find the order and degree of the given D.E. 5b. Form the differential equation by eliminating arbitrary constant. 5c. Solve given differential equations of first order and first degree by variable separable method. 5d. Reduce the given differential equation to variable separable form and solve it. 5e. Identify the given D.E(Homogeneous, Linear, or Bernoulli's) and find its solution.	5.1 Concept of differential equation, Order and degree of differential equation, Formation of differential Equation. 5.2 Methods of solving Differential equation of first order and first Degree. (a) Variable separable Method. (b) Equation reducible to variable separable form. (c) Exact Differential Equation. 5.3 Linear differential equation 5.4 Homogenous differential equation, 5.5 Bernoulli differential equations.	06

6. Numerical Methods	6a. Identify the interval of root of algebraic equation and Find the approximate root of algebraic equation by using given method. 6b. Solve the system of simultaneous equations containing 3 unknowns by using given method.	6.1 Solution of algebraic equation by, - Bisection method. - Regula-Falsi method. - Newton-Raphson method. 6.2 Solution of Simultaneous Equations containing 3 unknowns by, - Gauss elimination method. - Iterative methods: Gauss-Seidal & Jacobi's method.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assignments	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Find value of any given function.	1. Functions	01
2	Find limits algebraic functions.	2. Limits	01
3	Find limits trigonometric, exponential functions.		01
4	Solve examples on derivative using algebraic operations.	3. Derivatives and Higher order Derivatives	01
5	To find dy/dx of implicit functions.		01
6	To find dy/dx of parametric functions and inverse trigonometric functions.		01
7	To find the higher order derivatives of the given function.		01
8	Solve examples using rules of integration and substitution method.	4. Integration, Definite integration	01
9	Solve examples using integration by parts and partial method.		01
10	Solve examples using integration by parts and partial fraction method.		01
11	Solve the examples of Definite integral.(Simple)		01
12	Evaluate definite integral using properties.		01
13	Solve D.E. using variable separable method and reducible to variable separable.	5. Differential Equations	01
14	Solve homogenous, linear and Bernoulli D.E.		01
15	Find the approximate root of algebraic equation.	6. Numerical Methods	01
16	Solve the system of simultaneous equations.		01

❖ SPECIFICATION TABLE FOR THEORY PAPER:

R – Remember

U – Understand

A – Analyze / Apply

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Functions	02(00)	00(03)	03(00)	05(03)
2	Limits	02(00)	06(00)	00(03)	08(03)
3	Derivatives and Higher Order Derivative	02(02)	03(03)	06(03)	11(08)
4	Integration, Definite integration and Applications	02(02)	09(00)	03(06)	14(08)
5	Differential Equations	04(00)	06(03)	00(03)	10(06)
6	Numerical Methods	00(02)	00(06)	12(00)	12(08)
	Total	12(06)	24(15)	24(15)	60(36)

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

T- Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	2	R	2	3	R	2	3	R	2	4	R	2	4	R	2	6/9
	5	R	2	5	R	2	6	R	2										
2	1	U	3	2	U	3	2	U	3	1	A	3	2	A	3				3/5
3	3	U	3	3	U	3	4	U	3	4	U	3	3	A	3				3/5
4	4	U	3	4	A	3	5	U	3	4	A	3	4	A	3				3/5
5	5	U	3	5	U	3	6	U	3	6	U	3	5	A	3				3/5
6	3	A	6	6	A	6	6	A	6										2/3

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequency	Max Mark s	Min Mar ks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3, 4,5,6
		Class Room Assign ments		Tutorial Assignments	15	--	Assignment Book	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Stud ents	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Contin uous Assess ment of Practic al	Students	End of Every Practical	--	--	--	--
		Journa l Writin g		Assignments	--	--	--	--
				Total	--	--		
	TEE (Term End Examination)	End Exam	Stud ents	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Stud ents	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	-	-	-	-	-	-	-
2	3	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-
4	3	-	-	-	-	-	-	-	-	-
5	3	-	-	-	-	-	-	-	-	-
6	3	-	-	-	-	-	-	-	--	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Mathematics	P N Wartikar, Pune Vidyarthi Griha Prakashan	4567155742
2	Calculus of One Variable	IA Maron, Publisher: Arihant, 5 th Edition 2015	9352030559
3	Engineering Mathematics	S.S .Shastry, Prentice Hall Of India, 4 th edition 2008	9788120336162
4	Engineering Mathematics	D.T.Gaikwad, S Chand Publication, 1 st edition 2010	8121933560
5	Higher Engineering Mathematics	B S Grewal, Publisher: S Chand, 43 rd edition 2014	9788174091955

❖ **E-REFERENCES:**

- <https://msbte.org.in/msbtelectures.html>

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. S.M.Sayyed	I/C HOD, Mathematics Deptt.	Govt. Polytechnic, Nagpur
2	Mr.P.T.Khobaragade	Lecturer	Govt. Polytechnic, Nagpur
3	Mr.G R.Dewalkar	Lecturer	Govt. Polytechnic, Nagpur
4	Mr.W.T.Gaidhane	Lecturer	Nagar Parishad Jr. College ,Arvi
5	Dr. P.B.Bahatkar	Professor	Y. C. C. E. Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME, TX, PK, MT, MC
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: EX101G
COURSE TITLE	: FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH/TU CREDIT = 1 CLOCK HR.,1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

All diploma engineering students should know the facts, concepts, principles and procedures in electrical & electronic engineering. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to electrical area. It is very useful course for understanding the higher level knowledge in the field of electrical & electronic engineering.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different Electrical equipment and follow electrical safety rules.
2. Measure electrical quantities in AC/DC circuit.
3. Select suitable machine for particular application.
4. Illustrate the working of Electronics components.
5. Use semiconductor devices in Electronic circuits.
6. Use different Equipment / meters for measurement and testing of Electronic Circuits.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
SECTION 1 – ELECTRICAL ENGINEERING			
1. Fundamentals of Electric, Magnetic Circuit and Electrical Safety	1a. Determine given parameters and quantities used in electric circuit. 1b. Describe the given effects of electric current 1c. Calculate work, power and energy for given circuits / data. 1d. Determine given parameters of magnetic circuits. 1e. Select given electrical safety equipment for the given situation.	1.1 Electric Current, Voltage , Current Source, Voltage Source: Electric Potential, Potential Difference (PD) Electro-Motive-Force (EMF), Resistance, Resistivity, Conductivity, Effect of Temperature on Resistance. Ohm's law, Concept of cell and battery, types of batteries and their applications. 1.2 Heating Effect, Magnetic Effect and Chemical Effect of Electric current. 1.3 Definition and numerical based on Electrical Work, Power and Energy 1.4 Concepts of magnetic circuits and Faraday's laws of electromagnetic Induction. 1.5 Importance of Electrical Safety • Causes of electrical accidents • Concept of Electrical Shock (ac and dc). • General Safety rules, • Safety Signs and Symbols. • First Aid • Artificial Respiration and Method of Removing electrocuted person. • Types of Firefighting equipment.. • Earthing - Necessity of earthing, types of earthing. • Purpose of fuse , relay and circuit breaker in electric Circuit	10
2. DC and AC	2a. Compare the points of the given	2.1 Concept of DC and AC voltage & Current.	10

Circuits	supply. 2b. Describe generation of alternating given type of supply 2c. Describe current and voltage relationship for given connection of three phase connections. 2d. Calculate the given parameter from given data. 2e. Describe a circuit diagram of a given electrical circuit	• Comparison between AC and DC Supply 2.2 Generation of alternating voltage – Single phase and three-phase. 2.3 Voltage and Current relationship In Star and delta connection. 2.4 Equation of sinusoidal alternating voltage and current • Definition of waveform, instantaneous value, cycle, time period, frequency, amplitude, Maximum, average and R.M.S value • Relation between time, period and frequency, angular velocity and Frequency, Frequency and speed. 2.5 Concept of A.C. voltage applied to pure resistor, pure inductor, and pure capacitor, Concept of reactance, Impedance and Power factor, power in single - phase circuits.	
3. Transformer and Motors	3a. Describe the construction and working principle of given Transformer. 3b. Describe the types and uses of transformers. 3c. Describe construction and working of given type of Motor. 3d. Identify drives electrical power systems employed for motionControl 3e. Compare the salient features of the given motors on given points.	3.1 Transformer:-Definition, principle of operation, EMF equation, transformation ratio, KVA rating of transformer, voltage regulation and efficiency 3.2 Types of transformer :- • Core Type • Shell Type • Auto-transformer –Special features, Schematic diagram and its applications 3.3 Broad classification of A.C & D.C Motor • DC Motor- Working principle of D. C. motor. selection for Different applications, reversal of Rotation. Types:-Shunt, Series and Compound d.c Motor • AC Motor-Single-phase induction:- Working principle of A.C. motor. selection for different applications, reversal of rotation Types:- Split-phase motor, Capacitor-start motor, and Capacitor-start capacitor-run motor	12

		Three phase induction motors, application and selection for different applications, reversal of rotation. Types :-Squirrel Cage Induction Motor, and Slip Ring Induction Motor 3.4 Draw the block diagram of Electrical Drives ,Concept and its application 3.5 Stepper motor and Servo-motor-working principle, construction, and its application	
SECTION 2 – ELECTRONICS ENGINEERING			
4. Semiconductor or Theory, P-N Junction Diode & Zener Diode	4a. State the importance of Electronics. 4b. Define terms related to Semiconductor. 4c. Describe the Formation of PN junction. 4d. Draw & describe the forward and reverse V-I characteristic of different diodes. 4e. Give specification of diode and Draw the symbols of different types of diodes. 4f. State the Principle of Operation of Zener diode 4g. Explain application of Zener Diode as voltage regulator. 4h. Describe operation of LED and Photo diode.	4.1 Definition& importance of Electronics. 4.2 Commonly used semiconductor – - Germanium, Silicon. - Intrinsic semiconductor, - Extrinsic semiconductors. - P-type and N-type semiconductors 4.3 PN junction, Formation of PN junction 4.4 Forward and reverse biasing. V-I Characteristics of PN junction diode. 4.5 Specification of diode. 4.6 Principle of operation, characteristics symbol of zener diode. 4.7 Application of Zener diode as a voltage regulator. 4.8 Photo Devices Principle of operation of - - LED - Photo diode	12

5. Rectifiers and Filter Circuits	5a. Define the terms related to Rectifier & filter. 5b. Describe circuit diagrams and operation of Rectifiers & Filters. 5c. Describe working of Full wave rectifiers. 5d. Define of peak inverse voltage (PIV), Ripple factor, Rectification efficiency 5e. Compare the difference between half and full Wave Rectifier. 5f. State the necessity of filters. 5g. Describe Circuit diagram, operating principle and output waveforms of shunt capacitor CLC (PI) filter. 5h. Describe the block diagram of DC regulated power supply . 5i. Describe the block diagram of SMPS.	5.1 Definition and types of rectifier. 5.2 Circuit details, Operating principle, advantages and disadvantages of half wave Rectifier. 5.3 Circuit details, operating principle, advantages and disadvantages of Full wave rectifiers. Centre Tap Full Wave Rectifier Bridge Full Wave Rectifier 5.4 Definition of peak inverse voltage (PIV), Ripple factor, Rectification efficiency 5.5 Comparison of half and full wave rectifier 5.6 Necessity of filters and types of Filter. 5.7 Circuit diagram, operating principle and output waveforms of shunt capacitor CLC (PI) filter. 5.8 Block diagram of DC regulated power supply 5.9 Block diagram of SMPS. (Only block diagram no circuit details)	10
6 . Bipolar Junction Transistor	6a. Define the terms related to Transistor. And Identify PNP & NPN Transistor. 6b. Describe the CB ,CE and CC transistor configuration. 6c. Describe the operating regions of transistor. 6d. Define Input and Output resistance of transistor along with current gain alpha and beta.	6.1 Construction, operating principle and Symbol of PNP and NPN transistor. 6.2 CB ,CE and CC transistor configuration.(only circuit diagram) 6.3 Input and output characteristics of transistor in CE configuration 6.4 Definition of transistor parameter- • Input resistance, • Output resistance, • Current gains Alpha and Beta. 6.5 Applications of transistors. • Switch • Amplifier	10

	6e. List the application of transistor as switch and amplifier		
Total Hrs.			64

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
SECTION 1 –Electrical Engineering			
1	a. Identify electrical measuring instruments, sources. b. Illustrate the different method to remove the electrocuted person from live conductor .	1.Fundamentals of Electric, magnetic circuit and Electrical Safety	02
2	Connect voltmeter, ammeter and wattmeter in electrical circuit.		02
3	Measure the current, voltage and resistance with the help of multi-meter or tong tester.	2. DC and AC Circuits	02
4	Find unknown resistance using ohms law.		02
5	Find temperature coefficient of materials.		02
6	Determine the voltage and current ratio of single phase transformer	3.Transformer and Motors	02
7	Reverse the directions of rotation of DC shunt motor		02
8	Start Three phase Induction motor and reverse the direction of rotation		02
		Total Hours	16
SECTION 2 –Electronics Engineering			
1	i) Use the different front panel controls of CRO for Measurement. ii) Measure Vpp & Frequency for different waveforms generated from function generator on CRO.	1.Semiconduct or Theory, P-N Junction Diode & Zener Diode	04
2	Find the relation between voltage and current of PN junction Diode .Plot V-I characteristics of P-N junction diode.		02
3	i) Set the proper voltage& current limits with Controls in regulated power supply. ii) Measure voltage & currents using multimeter	2.Rectifiers & Filter Circuits	04
4	Connect Half-wave rectifier with filter and observe waveform with and without filter on CRO and draw the input and output waveforms. Find the average DC voltage for each.		02

5	Connect Full wave rectifier with filter and observe waveform with and without filter on CRO and draw the input and output waveforms. Find the average DC voltage for each.		02
6	Connect CE configuration of transistor as amplifier and observe the waveform. Calculate gain.	3.Bipolar Junction Transistor	02
Total Hours			16

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
SECTION 1 –Electrical Engineering					
1	Fundamentals of Electric, magnetic circuit and Electrical Safety	04(00)	00(03)	06(00)	10(03)
2	DC and AC Circuits	00(02)	03(03)	06(00)	09(05)
3	Transformer and Motors	02(02)	03(05)	06(03)	11(10)
SECTION 2 –Electronics Engineering					
4	Semiconductor Theory, P-N Junction Diode & Zener Diode	00(02)	06(03)	06(03)	12(08)
5	Rectifiers and Filter Circuits	02(02)	03(00)	03(03)	08(05)
6	Bipolar Junction Transistor	02(02)	05(00)	03(03)	10(05)
	Total	10(10)	20(14)	30(12)	60(36)

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
SECTION 1 –Electrical Engineering																			
1	1	R	2	1	R	2	3	R	2	1	A	2	1	A	2	1	A	2	6/9
	2	R	2	3	R	2	1	U	3										
2	2	U	3	3	U	3	2	A	3	2	U	3	3	U	2				3/5
3	2	A	3	3	A	3	3	A	3	3	U	3	3	A	3				3/5
SECTION 2 –Electronics Engineering																			
4	5	R	2	6	R	2	4	A	2	4	A	2	4	A	2	6	U	2	6/9
	4	R	2	5	R	2	6	R	2										
5	4	U	3	4	U	3	5	U	3	4	U	3	4	A	3				3/5
6	6	U	3	5	A	3	6	A	3	5	A	3	6	A	3				3/5

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
SECTION 1 –Electrical Engineering									
1	3	-	-	2		-	3	-	-
2	3	-	-	-	-	-	3	-	-
3	3	-	-	2		-	3	-	-
SECTION 2 –Electronics Engineering									
4	3	3	-	-	-	-	-	3	-
5	3	3	-	-	-	-	2	3	-
6	3	3	2	2	-	-	-	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
SECTION 1			
1	Principle of Electrical Engineering and Electronics	V.K.Mehta, S.Chand & Company Ltd., Reprint, 1996	81-219-1053-6
2	A Text Book of Electrical Technology Vol-I	B.L.Theraja, A.K.Theraja, S.Chand & Co Ltd., Reprint,2006	81-219-2440-5
3	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 978-0-07-059357-2
4	Experiments in Basic Electrical Engineering	S.K.Bhattacharya and K.M.Rastogi., New Age International Publisher, Reprint, 2009.	978-81-224-1042-6

5	A Text Book on laboratory courses in Electrical Engineering	S.G.Tarnekar and P.K.Kharbanda, S.Chand & Company Ltd., Third, 1990	13: 978-8121901048
SECTION 2			
1	Principles of Electronics	V. K. Mehta, S. Chand & Company Ltd., Reprint, 1996	8121910536
2	Electronic Principles	A.P. Malvino, Tata McGraw Hill, 8th edition	9780073373881
3	Applied Electronics	R. S. Sedha, S. Chand & Co, revised edition, 2013	8121927838, 9788121927833
4	Basic Electronics	Grob, Tata McGraw Hill, 12th edition	0073510859
5	Electronics Devices & Circuits	S Salivahanan, Tata McGraw Hill, 2nd edition 2011	0074633864, 9780074633861

• **E-REFERENCES:**

SECTION 1

- <http://nptel.ac.in/courses/108108076/1> , accessed on 21th June 2021
- <http://www.electrical4u.com> , accessed on 21st June , 2021
- <https://library.automationdirect.com/basic-electrical-theory/> , accessed on 21st June , 2021
- <https://www.di.univr.it/documenti/OccorrenzaIns/matdid/matdid441904.pdf> , accessed on 21st June , 2021

SECTION 2

- www.learnelectronicsonline.com
- www.instructables.com/id/Basic-Electronics

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

SECTION 1

1. Ammeter MI 0-5-10 A
2. Voltmeter MI 0-150-300 V
3. Wattmeter 0-3000 W
4. Digital Multi-meter
5. Rheostat assorted sizes
6. Variable Inductor

SECTION 2

1. Ammeter MI 0-5-10 A
2. Voltmeter MI 0-150-300 V
3. Digital Multi-meter
4. Cathode ray oscilloscope- 0 to 50 MHz
5. Function Generator
6. Regulated Power Supply

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
SECTION 1			
1	Prof .A. M. Arekar	Chairman ,PBOS &, HOD Electrical Engg. Deptt.	Government Polytechnic, Nagpur.
2	Prof. Mrs A. A. Alegaonkar	CDC Coordinator & Lecturer, Electrical Engg. Deptt.	Government Polytechnic, Nagpur
3	Prof. M. C Musale	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
4	Prof. M. N. Gawande	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
5	Prof. Mrs. A. P. Gandhi	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
6	Prof. Mrs .P. M. Sonwane	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
SECTION 2			
7	Dr.R.V.Yenkar	Head of Department (EC)	Government Polytechnic, Nagpur
8	Dr.V.H.Mankar	Head of Department (EC)	Government Polytechnic, Nagpur
9	Prof.V.M.Sakode	Lecturer	Government Polytechnic, Nagpur
10	Prof.P.A.Meshram	Lecturer	Government Polytechnic, Nagpur
11	Prof.J.P.Kelwade	Lecturer	Government Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

**PROGRAMME : DIPLOMA IN CE ,ME, EE,EC, MC,IT, CM, MT,PK,
AE, TX, AI**

COURSE CATEGORY: BASIC SCIENCE COURSE

COURSE CODE : PH101G

COURSE TITLE : PHYSICS

TEACHING SCHEME: TH:03; TU: 00;PR: 02(CLOCK HRs.)

TOTAL CREDITS : 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE EXAM : 03 HRs

PR. TEE EXAM : 02 HRs

PT. EXAM : 01 HR

❖ RATIONALE:

Physics is a fundamental science that endeavors to explain all the natural phenomena that occur in the universe. Studying physics will enable students to become citizens who are better informed about the world around them and who have the critical skills to evaluate and make evidence-based decisions about current scientific issues. The subject will also provide a foundation in physics knowledge, understanding and skills for those students who wish to pursue tertiary study in engineering and technology.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Determine various physical quantities of matter using various measuring instrument.
2. Apply the laws and principles of electricity and magnetism to solve engineering problems.
3. Use the basic principles of heat and optics for engineering applications

4. Apply principles of wave motion, acoustics and radioactivity for engineering problems.
5. Apply the basic physical concepts and terminology used in modern physics.
6. Identify nanotechnology and non-destructive testing for various applications in engineering.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs .
1. General Properties of Matter	1a. Describe the given types of modules of elasticity. 1b. Identify least count and range of given instruments. 1c. Illustrate the phenomenon of Capillarity and angle of contact of for given liquid . 1d. Find given physical quantities using laws of viscosity .	1.1 Elasticity, Plasticity, Rigidity. Stress and Strain with their types, Elastic Limit, Hook's Law, Types of modulus of Elasticity, Stress-Strain curve, Applications of elasticity, calculation of the value of Young's modulus of elasticity of given wire . 1.2 Least count and range of instruments: Vernier caliper, outside micrometer screw gauge, travelling microscope. 1.3 Surface Tension, Factors affecting surface tension, Molecular force, cohesive and adhesive force, Angle of contact with its significance and capillary action (formula only), Application, determination of rise of liquid in capillary tube and surface tension of liquid. 1.4 Viscous force, Definition of viscosity, Newton's law of viscosity, Stoke's law, statement and formula only, Coefficient of viscosity and S.I. unit. Types of flow of liquid, Application, calculation of Reynold's number, terminal velocity and coefficient of viscosity of given fluids.	06
2. Electricity, Magnetism and	2a. Apply Coulomb's inverse square law for determining the force between different	2.1 Concept of charge, Coulomb's inverse square law, Electric field, Electric field intensity, potential and potential difference.	08

Semiconductors	charges on given data. 2b. Describe given concepts of magnetism. 2c. Determine given parameters in electricity using Ohm's law. 2d. Differentiate materials on the basis of given energy band diagram. 2e. Describe the given biasing and its characteristics of PN junction diode.	2.2 Magnetic field and magnetic field intensity and its units, magnetic lines of force, magnetic flux. 2.3 Electric current, Ohm's law, specific resistance, laws of series and parallel combination of resistance, heating effecting of electric current, calculation of resultant resistance of given resistances in series and parallel combination. 2.4 Conductors, Insulators and Semiconductors, Energy bands, intrinsic and extrinsic semiconductors. 2.5 p-n junction diode, I-V characteristics of p-n junction, applications of p-n junction diode.	
3. Heat and Fiber Optics	3a. Select the modes of transmission of heat for given materials. 3b. Illustrate the given laws related to gas and specific heat. 3c. Describe the given phenomenon of light.	3.1 Heat: Three modes of transmission of heat. Good and bad conductor of heat with examples, Law of thermal conductivity and S.I. units. 3.2 Boyles' law, Charles' law, Gay Lussac's law, absolute zero temperature, General gas equation (statement only), two specific heats of gases, adiabatic index. 3.3 Reflection, Refraction, Snell's law, Optical fiber, Structure of optical fiber. Principle of Optical fiber-total internal reflection. Acceptance angle, Numerical aperture. Applications of Optical Fiber.	10
4. Wave Motion and Radioactivity	4a. Classify the given types of wave by their characteristics. 4b. Calculate velocity of sound with end correction on given data. 4c. Find given terms related to Acoustics. 4d. Calculate half-life period of given radioactive substance.	4.1 Definition of wave motion, amplitude, period, frequency & wavelength, relation between velocity, frequency & wavelength. Progressive wave, Stationary waves, longitudinal and transverse wave. Node, Antinode. 4.2 Definition of resonance with example. Formula for velocity of sound with end correction, calculation of velocity of sound with the help of resonance tube. 4.3 Echo, Reverberation, Reverberation Time. Absorption coefficient of	08

		material, Sabine's formula, Factors affecting the Reverberation of time and acoustics of building. Sound absorbing materials, calculation of reverberation time by Sabin's formula. 4.4 Radioactivity, α, β and γ rays and their Properties. Radioactive decay law, half- life period, Advantages and disadvantages of Radioactivity.	
5. Modern Physics (Photoelectricity, LASER, X-Rays)	5a. Calculate given parameters of the photo electricity using given wavelength or frequency. 5b. Apply the basic concepts of LASER in given fields. 5c. Describe the production of X-rays of the given materials with properties and applications.	5.1 Photon, properties of photons, Planck's hypothesis, Threshold frequency, threshold wavelength and Stopping potential. Work function, Photoelectric effect with characteristics properties. Principle, Construction and working of Photoelectric cell with applications. Einstein's photoelectric equation. (Numerical based on above) 5.2 Properties of laser, Types of laser, absorption, spontaneous and stimulated emission. Definition of Pumping and its type, Population inversion, Metastable state. Applications of LASER in Engineering and biomedical field. 5.3 Introduction to X-rays, Properties of X-rays, production of X-ray using Coolidge tube. Applications of X-rays in Engineering, medical and scientific field.	12
6. Nanotechnology and Non Destructive Testing.	6a. Calculate surface area per volume ratio of given objects. 6b. Compare DT and NDT methods on the basis of given points.	6.1 Definition of nanoscale, nanometer, nanoparticle, determination of surface area per volume ratio of objects, application of nanotechnology in Engineering and Technology, medical, cosmetics, environmental, space and defence. 6.2 Non Destructive Testing (NDT), comparison of DT and NDT, Various NDT methods used, Criteria for the selection of NDT method, Merits and Demerits of	04

		NDT.	
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify the various instruments used in Physics laboratory and follow precautionary measures.	General Properties of Matter	02
2	Measure the outer diameter of a cylindrical body by Vernier Caliper.		02
3	Calculate the diameter of a small spherical body by Outside micrometer screw gauge.		02
4	Calculate the value of Young's modulus of elasticity of given wire .		02
5	Find rise of liquid in capillary tube and compute surface tension of liquid.		02
6	Determine the coefficient of viscosity of given fluids by Stoke's method		02
7	Calculate mechanical equivalent of heat, J by electrical method.	Electricity, Magnetism and Semiconductor	02
8	Use magnetic compass to draw the magnetic lines of forces of bar magnet		02
9	Calculate the resultant resistance of given resistances in series and parallel combination.		04
10	Analyze the effect of volume on pressure at constant temperature.	Heat, Gas Laws and Fibre Optics	02
11	Determine inner diameter of resonance tube using Vernier Caliper.	Wave Motion and Radioactivity	02
12	Find the velocity of sound with the help of resonance tube.		04
13	Find the divergence of Laser beam.	Modern Physics	02
14	Calculate the surface area (SA), volume (V) and SA/V of an object and measure dimensions required for it.	Nanotechnology and Non Destructive Testing	02
		Total hours	32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	General Properties of Matter	02(04)	06(00)	00(00)	08(04)
2	Electricity, Magnetism and Semiconductor	02(00)	06(06)	03(00)	11(06)
3	Heat, Gas Laws and Fiber Optics	02(00)	06(00)	03(06)	11(06)
4	Wave Motion and Radioactivity	02(02)	03(06)	06(00)	11(08)
5	Modern Physics	02(00)	06(03)	06(06)	14(09)
6	Nanotechnology and Non Destructive Testing	02(00)	03(03)	00(00)	05(03)
	Total	12(06)	30(18)	18(12)	60(36)

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

M- Marks

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

[illegible]

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequency	Max Mark s	Min Mark s	Evidence Collected	Course Outcome s
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignment s		Assignment s	15	--	Assignmen t Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignment s	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Practical Answer Scripts	1,2,3,4,5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		Questionnaires	1, 2, 3, 4,5,6
	End of Course Survey			End of The Course				

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	3	-	-	3	-	-	-
2	3	-	-	-	2	-	3	-	-	-
3	3	-	-	-	-	-	3	-	-	-
4	3	-	-	3	-	-	3	-	-	-
5	3	-	-	-	2	-	3	-	-	-
6	3	-	-	3	-	-	3	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Modern Physics	B.L.Thereja, S.Chand & Company Ltd 5 th Edition, 2014	13:978-8-12-190163-5
2	Engineering Physics	V.Rajendran, The McGraw Hill Education Pvt. Ltd, 1 st Edition, 2010	13: 978-0-07-107014-0
3	Conceptual Physics	P.G.Hewitt, San Francisco Addison Wesley- 10 th Edition, 2006	13: 9780321909107
4	Engineering Physics	R.K.Gaur and S.L.Gupta, Dhanpatrai Publication New Delhi, 1987	97-8-18-992822-3

❖ **E-REFERENCES:**

- <https://www.britannica.com/science/viscosity>, accessed on 21 June 2021.
- <https://www.livescience.com/58816-photoelectric-effect.html>, accessed on 19 June 2021.

- <https://www.livescience.com/58816-photoelectric-effect.html>, accessed on 19 June 2021.
- <https://www2.lbl.gov/abc/wallchart/chapters/03/4.html>, accessed on 19 June 2021.

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Vernier Caliper (Least count= 0.01 cm and range= 0 to 12 cm)
2. Screw gauge (Least count= 0.001 cm and range= 0 to 2.5 cm)
3. Young's Modulus- Searle's apparatus with micrometer reading 0.001 cm.
4. Travelling microscope (vertical and horizontal scales with range 0- 15 cm with least count 0.001 cm)
5. Resonance apparatus with glass tube and metal reservoir (L= 0- 100 cm)
6. Tuning fork -256, 320, 384, 428, 480, 512 Hz.
7. Boyle's apparatus iron base double steel rod, 25 ml fitted with leveling screw on base
8. Stoke's apparatus with glass tube 50 cm.
9. Stop watch GEM 1/10 sec.
10. Ammeter (DC, 0-5 Amp)
11. Millimeter (DC, 0-1 Amp. G.E. type D 50)
12. Voltmeter (DC, 0-3V)
13. Rheostat single tube of 6.5 cm dia., 30 cm length, 5 Amp, 18 ohm, provided with Bakelite solidier with phosphor, bronze contacts.
14. Joule's calorimeter with mass 198 cal/gms.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.S.B.Raut	Lecturer	Government Polytechnic, Nagpur.
2	Mrs.S.B.Adulkar	Lecturer	Government Polytechnic, Nagpur.
3	Dr.A.R.Karule	Lecturer	Government Polytechnic, Nagpur.
4	Dr.N.V.Pradnyakar	Associate Professor	J D College of Engineering and Technology, Nagpur
5	Dr.V.B.Pawade	Assistant Professor	Laxminarayan Institute of Technology, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/AE/PK/MT/MC/TX
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: AM101G
COURSE TITLE	: ENGINEERING MECHANICS
TEACHING SCHEME	: TH:03;TU:00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TE EXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

Study of this course develops understanding of effect of force on a body. It helps in analytical and graphical solutions to problem related to forces acting on body. It also helps in understanding concept and application of Equilibrium, friction, centroid and centre of gravity. Study of simple machines gives idea about input, output, efficiency and friction of machine. Study of this course is very useful at higher level like strength of materials, Mechanics of Structure etc. It helps in forming base for understanding all the courses, which are related to engineering mechanics.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to—

1. Apply concept of Units, Vector and Scalar Quantities.
2. Select the relevant simple lifting machine for given purpose.
3. Apply various theorems to find the resultant of system of forces.
4. Apply law of equilibrium on different bodies.
5. Locate Centre of gravity and Centroid in various sections.
6. Determine concept of friction in various conditions.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction of Engineering Mechanics	1a. Describe given terms related to Engineering Mechanics. 1b. Classify the given units of scalar and vector quantity.	1.1 Significance of engineering mechanics, necessity and Classification of engineering mechanics. 1.2 Definitions: Space, time, particle, body, rigid body, mass, weight, scalar and vector quantity. Units of measurement, fundamental units and derived units.	02
2. Simple Lifting Machine	2a. Describe given terms related to simple lifting machine. 2b. Describe given types of simple lifting machine. 2c. Determine velocity ratios, efficiency and law of various machines on given data.	2.1 Concept of simple lifting machine, uses of machine, definition of load, effort, mechanical advantage, velocity ratio, efficiency of Machines, reversible and non-reversible machines. 2.2 Ideal machine, friction in machine, law of machine, maximum Mechanical advantage and efficiency. 2.3 Velocity ratios of Simple Axle and Wheel, Differential axle wheel, Single Purchase & Double purchase crab winch, Simple Screw Jack, Weston's Differential pulley block, Geared pulley block, Two Sheaves and Three Sheaves pulley block, Worm and Worm wheel.	08
3. Forces	3a. Describe given Terms related to Force . 3b. Identify the given force system and effect of a force. 3c. Resolve the given single force. 3d. Calculate Resolution of force & Composition of forces by using given law on given data. 3e. Calculate Resultant force on the basis of given data by given method.	3.1 Concept of force, definition of force, unit of force, effects of force, Characteristics of force. 3.2 System of forces. Principle of transmissibility of force. 3.3 Composition of forces & Resolution of forces (Two dimensional), Orthogonal and Non Orthogonal components of a force. Resultant force. Resultant of concurrent, non-concurrent and parallel forces, Law of parallelogram of forces: limitations and its applications 3.4 Definition of moment, sign convention of moments, types of moments. Law of moment, definition of couple, types of couple, properties of couple, Varignon's theorem of moment and its application.	12

		3.5 Introduction to graphic statics, graphical representation of force, Bow's notation, Space diagram, force diagram, polar diagram & funicular polygon.	
4. Equilibrium	4a. Describe given terms related to Equilibrium. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Describe given terms related to Beam, load and supports. 4d. Determine reactions in the given type of beam by given method.	4.1 Equilibrium and Equilibrant. Free body and free body diagram. Analytical and graphical condition of equilibrium 4.2 Lami's Theorem: limitations and its application 4.3 Equilibrium of concurrent, non-concurrent and parallel forces. Beam, span, type of beams, type of supports, types of loading: point load and Uniformly Distributed Load. Analytical and Graphical method to calculate reactions at support for point load and Uniformly Distributed Load on simply supported and overhanging beams	10
5. Centroid & Centre of Gravity	5a. Determine centroids of given plain regular figure. 5b. Calculate centroid of the given compound plain lamina. 5c. Determine the centre of gravity of given solid bodies. 5d. Determine centre of gravity of given compound solids.	5.1 Centroid and centre of gravity, difference between centroid and centre of gravity. Locating centroid of regular figures such as triangle, rectangle, circle, Semi circle, quarter circle.(Formula only) 5.2 Centroid of compound figures, having combination of two different geometric areas only. 5.3 Centre of gravity of solid bodies like cuboid, cylinder, cone, sphere and hemisphere. 5.4 Centre of gravity of compound bodies having combination of only two different geometric shapes.	08
6. Friction	6a. Describe given laws of Friction. 6b. Determine the friction force in the given situation.	6.1 Friction and its importance in engineering, types of friction, laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 6.2 Equilibrium of bodies on horizontal plane subjected to force parallel and inclined to the plane. Body resting on inclined plane subjected to force parallel to the plane. (Excluding ladder friction).	08

Total Hrs.	48
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B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
Group A (Any 10)			
1	Determine M.A., V.R., Efficiency of and law of machine for simple /Differential Axle and Wheel	Simple Machine lifting	02*
2	Determine M.A., V.R., Efficiency and law of machine for Simple Screw Jack		02*
3	Determine M.A., V.R., Efficiency and law of machine for Two Sheave Or three sheave Pulley Block		02
4	Determine M.A., V.R., Efficiency and law of machine for Single purchase Crab Or Double purchase Crab		02*
5	Determine M.A., V.R., Efficiency and law of machine for Worm and Worm Wheel		02
6	Use Force table to determine resultant of concurrent force system using law of Polygon of forces	Forces	02*
7	Determine Forces in the members of jib crane.		02
8	Apply Lamis theorem to determine unknown force	Equilibrium	02*
9	Determine support reactions for simply supported beam		02
10	Locate the centroid of plane lamina by method of suspension	Centroid and Centre of Gravity	02
11	Determine co-efficient of Friction between different surfaces such as Wood and wood, Wood and glass, Wood and metal.	Friction	02*
Group B			
12	Determine resultant of co-planer concurrent forces by graphical method. (Any two problems)	Force	04
13	Determine resultant of co-planer non-concurrent forces by graphical method. (Any two problems)	Force	04
14	Determine beam reactions for Vertical Point Load and UDL by Graphical method. (Any two problems)	Equilibrium	04
Total Hrs			32

- Experiments marked * are compulsory.
- Minimum 12 Practicals should be performed.
- A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. All the above listed practical need to be performed compulsorily, so that the student reaches the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy' as generally required by the industry.

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction	02(00)	00(00)	00(00)	02(00)
2	Simple Lifting Machine	02(00)	03(03)	03(03)	08(06)
3	Forces	02(02)	06(03)	06(03)	14(08)
4	Equilibrium	02(02)	03(03)	09(03)	14(08)
5	Centroid And Centre Of Gravity	02(00)	03(00)	06(06)	11(06)
6	Friction	02(02)	03(03)	06(03)	11(08)
	Total	12(06)	18(12)	30(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

T- Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	3	R	2	4	R	2	6	R	2										
2	2	U	3	3	U	3	3	U	3	2	U	3	3	U	3				3/5
3	4	U	3	5	U	3	6	U	3	4	U	3	6	U	3				3/5
4	2	A	3	3	A	3	3	A	3	2	A	3	3	A	3				3/5
5	4	A	3	4	A	3	4	A	3	4	A	3	6	A	3				3/5
6	5	A	6	6	A	6	5	A	6										2/3

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing figure of simple lifting machine and force diagram, selection of equipment. writing procedure etc.	10
2	Performance	10
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	-	-
2	3	3	-	3	-	-	3	-	-
3	3	3	-	3	-	-	3	-	-
4	3	3	-	3	-	-	3	-	-
5	3	3	-	3	-	-	3	-	-
6	3	3	-	3	-	-	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Applied Mechanics	R.S. Khurmi, S.Chand & Co. New Delhi, 2014	10:8121916437 13:9788121916431
2	Engineering Mechanics	Sunil Deo, Label Book Publishers New Delhi, 2014	10:9381595550 13:978-9381595558
3	Engineering Mechanics	Basu, Tata Mcgraw Hills, 2013	10:125906266X 13:978-1259062667
4	Engineering Mechanics	S Ramamrutham, S Chand & Co. New Delhi, 2008	8187433515 9788187433514
5	Static and Straight of Materials	U.C. Zindal Asian Book Pvt. Ltd New Delhi, 2008	10:8184120737 13:9788184120730

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=-JG9IEqRzQ4> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=4VIhh6sGkrI> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=EcPGKLUE04I> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=ndT35aqDfAQ> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=W9UDs-kSR0g> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=kuAfu0fZOLw> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=Bx-mMA6k8u4> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=9XtGJXVnQxk> Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=k37FJHbSQA8> Accessed on 18th June 2021
- https://www.youtube.com/watch?v=6_D6jjQcAFU Accessed on 18th June 2021
- <https://www.youtube.com/watch?v=AOkeQMMsSrc> Accessed on 18th June 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Simple /Differential axle and wheel
2. Simple Screw Jack
3. Two Sheave or Three sheave Pulley block
4. Single Purchase crab or double purchase Crab wheel
5. Worm and worm wheel
6. Force table apparatus for law of Polygon of forces
7. Jib crane by using triangle law of forces
8. Lamis theorem Force table apparatus
9. Inclined plane Apparatus

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr.Y.K.Chandarana	HOD, Applied Mechanics	Govt. Polytechnic, Nagpur
2	Mr.A.Ateeque Azher	Lecturer in Applied Mechanics	Govt. Polytechnic, Nagpur

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME /PK/MC
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME203G
COURSE TITLE	: ENGINEERING DRAWING
TEACHING SCHEME	: TH: 02; TU:00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 04 HRs
PR. TE EXAM	: --
PT. EXAM	: 02 HR

❖ **RATIONALE:**

The course illustrates techniques of drawing in an engineering field. The concepts of drawing language are used in expressing the ideas, conveying the instructions, which are used in carrying out the jobs on the sites, shop floor etc. It helps to develop the idea of visualizing the actual object or part on the basis of drawings and blue prints. This course is useful in developing drafting and sketching skills of the student. This preliminary course aims at building a foundation for the further course in machine drawing and other allied courses.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Draw sectional orthographic views from given isometric views.
2. Interpret the technique and draw projection of lines and planes,
3. Identify the solids and draw its projection on given conditions.
4. Apply the technique of sections to project sectional views.
5. Convert orthographic views into auxiliary views
6. Apply the technique of free hand sketching to represent machine component.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Sectional Orthographic Views	1a. Visualize given pictorial view. 1b. Draw sectional views.	1.1 Types of section 1.2 Conversions of pictorial views into sectional orthographic view. (Complete objects involving Slots, ribs etc.)	05
2. Projection of Lines and Planes	2a. Draw projections of lines and locate its traces. 2b. Draw projections of planes.	2.1 Lines inclined to both the reference planes. Locate H.T., V.T. (limited to both ends in first quadrant) 2.2 Projection of simple planes. eg. circular, square, rectangular, rhombus, pentagonal and hexagonal-inclined to one reference plane and perpendicular to other (first angle method of projection only)	08
3. Projection of Solids	3a. Identify different types of regular solids. 3b. Draw the projections of regular solids.	3.1 Projections of prisms and cylinder, with their axes inclined to one reference plane and parallel to other. 3.2 Projections of cone, pyramid, tetrahedron and cube with their axes inclined to one reference plane and parallel to other	05
4. Section of Solids	4a. Visualize cut models of different types of regular solids. 4b. Draw the projections of different cut models of regular solids.	4.1 Prism and cylinder -Axis inclined to one reference plane and parallel to other, Axis parallel to both the reference plane, where as section plane is inclined to one reference plane and perpendicular to other. 4.2 Cone, Pyramid, Cube & Tetrahedron , -Axis inclined to one reference plane and parallel to other, where as section plane is inclined to one reference plane and perpendicular to other.	05
5. Auxiliary Views	5a. Visualize given views. 5b. Draw auxiliary views.	5.1 Draw auxiliary views from the given orthographic views. (Simple object) 5.2 Draw projection of regular solids inclined to one reference plane using auxiliary method.	05

6. Machine Parts / Conventional Representation	6a. Draw proportionate freehand sketches of given machine elements. 6b. Select proper fasteners and foundation bolts.	6.1 Keys, threads, pulleys and pipe joints: - Sunk keys: - Taper, woodruff, Gib-headed, feather key Saddle keys: - Round, hollow saddle. Types of Threads: - (i) V- Threads: - B.S.W. , B.A. (ii) Square Threads: - Square thread, Knuckle thread. Acme threads. Pulleys: - Flat belt, V-belt, fast and loose Pulleys. Pipe joints and fitting: - Flanged joint, socket and spigot joint, union joint Nipple, coupler, Reducing socket, tee, cross, plug, elbow and bend. 6.2 Various bends in sheet metal operations such as hat channels, U channel, Hems, Hems with edges, rolled edges, closed channel.	04
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw two problems on sectional orthographic views. (01Sheet)	1. Sectional Orthographic views	10
2	Draw two problems on projection of lines and planes each. (01Sheet)	2. Projection of lines and planes	12
3	Draw two problems on projection of solids. (01Sheet)	3. Projection of solids	12
4	Draw two problems on section of solids. (01Sheet)	4. Section of solids	12
5	Draw two problems on Auxiliary views. (01Sheet)	5. Auxiliary views	08
6	Draw Free Hand proportionate Sketches of the following- two given keys, one given pulley, two given threads, three given sheet metal bends, three given pipe joint. (01Sheet)	6. Machine Parts / Conventional Representation	10
Total Hrs.			64

C. LIST OF ASSIGNMENTS:

Assignment s	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw five problems on sectional orthographic views.(On Practical sketchbook)	1. Sectional Orthographic views	---
2	Draw five problems on projection of lines and planes each. (On Practical sketch book)	2. Projection of lines and planes	---
3	Draw five problems on projection of solids. (On Practical sketch book)	3. Projection of solids	---
4	Draw five problems on section of solids.(On Practical sketch book)	4. Section of solids	---
5	Draw five problems on Auxiliary views. (On Practical sketch book)	5. Auxiliary views	---
6	Draw Free Hand Sketches of the following- keys, pulleys, threads, sheet metal bends, pipe joints & fittings. (On Practical sketch book)	6. Machine Parts /Conventional Representation	---

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Sectional Orthographic views	00(00)	10(00)	00(10)	10(10)
2	Projection of lines and planes	00(00)	10(00)	00(05)	10(05)
3	Projection of solids	00(00)	00(08)	08(00)	08(08)
4	Section of solids	00(00)	00(00)	10(10)	10(10)
5	Auxiliary views	00(00)	00(10)	10(00)	10(10)
6	Free hand sketches	12(08)	00(00)	00(00)	12(08)
	Total	12(08)	20(18)	28(25)	60(51)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	U	10	1	A	10													1/2
2	2	U	5	2	U	5	2	A	5										2/3
3	3	U	8	3	A	8													1/2
4	4	A	10	4	A	10													1/2
5	5	A	10	5	U	10													1/2
6	6	R	4	6	R	4	6	R	4	6	R	4	6	R	4				3/5

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequency	Max Mark s	Min Mark s	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Drawing Answer Sheets	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Practical Sketch Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Drawing Answer Sheets	1,2,3,4,5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	40	--	Rubrics & Assessment Sheets	1, 2, 3,4,5,6
		Journal Writing		Assignments	10	--	Drawing Portfolio	1, 2, 3,4,5,6
				Total	50	20		
	TEE (Term End Examination)	End Exam	Students	End of the Course	---	---	---	---
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
	Nil	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	3	3	-	-	3	3	-
2	3	3	3	3	-	-	3	3	-
3	3	2	2	3	-	-	3	2	-
4	3	3	3	3	-	-	2	3	-
5	3	3	3	2	-	-	3	3	-
6	3	2	3	3	-	-	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S. N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Engineering Drawing Practice For Schools and Colleges IS:SP-46	Bureau of Indian Standards, Third Reprint, October 1998	81-7061-091-2
2	Engineering Drawing	N.D.Bhatt, Charotar Publishing house 2010	978-93-80358-17-8
3	Machine Drawing	N.D.Bhatt & V.M Panchal, Charotar Publishing House 2010	978-93-80358-11-6
4	Engineering Drawing	D.A. Jolhe, Tata McGraw-Hill Edu.2010	978-0-07-064837-1
5	Engineering Drawing	R.K.Dhawan, S.Chand & co.	81-219-1431-0
6	Engineering Drawing	P.J Shaha, S.Chand & co. 2008	81-219-2964-4

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=Ki4TkXX9eik>, accessed on 23/06/2021
- https://www.youtube.com/watch?v=FtugLo9DMw8&list=PLIhUrsYr8yHz_FkG5tGWXaNbIxVcibQvV accessed on 20/06/2021
- <https://www.youtube.com/watch?v=d2LbmKGtObs> accessed on 23/06/2021
- <https://www.youtube.com/watch?v=AzFz8A5HgiQ&list=PLDN15nk5uLiBrAkDoh>

EvkmVPs2UtwfGao accessed on 23/06/2021

- <https://www.youtube.com/watch?v=61hAV3vh3n4> accessed on 22/06/2021
- <https://www.youtube.com/watch?v=EpkusXjByYA> accessed on 15/06/2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Drawing Board with drawing instruments
2. Mini drafter

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rehade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr.T.K.Ghormade	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr.K.S.Thekedar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AI,MC,CE,ME,EE,EC,PK,MT, IT,AU,CM,TX,TR
COURSE CATEGORY	: HUMANITIES & SOCIAL SCIENCE COURSE
COURSE CODE	: EN151G
COURSE TITLE	: BUSINESS COMMUNICATION
TEACHING SCHEME	: TH: 01 TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: --
PR. TEE EXAM	: 02 HRs
PT. EXAM	: --

❖ RATIONALE:

In this current dynamically evolving scenario, competence in communication skills is one of the requirements of industry from technical students. A diploma holder is expected to interact effectively and efficiently with his peers, superiors, subordinates and clients. Business Communication will prepare him to take on the task of effective communication with ease.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Exhibit appropriate communication skills as required
2. Converse skillfully using modes of communication
3. Prepare and present business communication formats effectively
4. Perform coordinated activities within and outside organization
5. Draft business correspondence with minimal errors

❖ **COURSE DETAILS:****A. THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Communication	1a. Apply modern concept of communication. 1b. Identify & Overcome barriers to communicate effectively. 1c. Use appropriate body language.	1.1 Definition, Process, Types: Verbal-Non-Verbal, Formal-Informal, Upward-Downward, Horizontal. 1.2 Barriers of communication: Physical, Mechanical, Psychological, Language, Status. Ways to overcome barriers.	03
2. Communication in Practice	2a. Identify strengths and weakness of self. 2b. Classify different types of Communication and use it effectively. 2c. Plan & perform effective presentations. 2d. Modify intrinsic qualities.	2.1 Non-verbal communication in detail: Body language, Eye contact, Dress and appearance, color, sound, Gestures, Postures, Pictorial representations. (Maps, Charts, Graphs) 2.2 Nonverbal Codes 2.3 Presentation skills – Parameters, Appearance, use of body language, Eye contact, content preparation, Depiction of interest of audience 2.4 SWOT analysis 2.5 Brain Storming	06
3. Business Correspondence	3a. Identify various types of written communication in business situation. 3b. Apply the appropriate correspondence to the situation.	3.1 Letters: Job application and Resume writing Leave letter, Enquiry letter. 3.2 Circular, Notices, Agenda, Minutes, Email messages.	07
		Total Hrs.	16

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Describe Types of Communication.	Communication	04
2	Conduct Self SWOT analysis.	Communication in practice.	02
3	Outline an Introduction for Self & others.	Communication	04
4	Practice the art of LSRW (to be performed in Language lab using software).	Communication in practice.	06
5	Exhibit Professional Etiquettes.	Communication in practice.	02
6	Prepare Job Application.	Business Correspondence.	02
7	Prepare Resume.	Business Correspondence.	02
8	Demonstrate various types of Business Letters.	Business Correspondence.	02
9	Participate in Brain Storming.	Communication in practice	02
10	Practice Email Writing.	Business Correspondence.	02
11	Master the skill of oral presentation by presenting a topic through PowerPoint presentation.	Communication in practice.	02
12	Implement the art of writing Formal drafting by preparing resume & letters.	Business Correspondence.	02
Total Hrs.			32

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)			Test Answer Sheet	
		Class Room Assignments		Assignments			Assignment Book	
	TEE (Term End Examination)	End Exam	Students	End of the Course			Theory Answer Sheets	
				Total				
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Practical Answer Sheets	1.2.3.4.5
		Journal Writing		Assignments	05	--	Journal	1.2.3.4.5
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Practical Answer Sheets	1.2.3.4.5
Indirect Assessment	Student Feedback on Course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5
	End of Course			End of the Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Performance	10
2	Overall presentation of given assignment	10
3	Viva voce	20
4	Activity	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	-	-	-	3	-				
2	3	-	-	-	3	-	2			
3	-	-	-	-	-	3	-			
4	-	-	-	-	-	3	2			
5	-	-	-	-	-	3	-			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Professional Communication skills	S.R.Pravin, S.Chand Publications	81-219-2092-02
2	Developing Communication skills	Macmillan Publications, Revised Edition, 2011	0333929195
3	Business communication and soft skills.	G.S.R.K Babu Rao, Himalaya Publication, First Edition, 2009	978-81-8488-596-5
4	Secret of face-to-face communication.	Peter Urs, Bender, Macmillan Publication	0333937139
5	Technical communication principles and practices	Meenakshi Raman, Prakash Singh, Oxford University Press,	0-19-567695-5
6	Effective English Communication	Krishna Mohan, Raman Tata Mc Graw Hills,	13978-0-19-566804-9
7	Modern Commercial Correspondence	R.S.Pillai, Bhagwati, S.Chand & Co.	812190519-2

❖ **E-REFERENCES:**

1. https://en.wikipedia.org/wiki/Business_communication, accessed on 29th July 2021
2. <https://www.indeed.com/career-advice/career-development/types-of-business-letters> , accessed on 29th July 2021
3. <https://in.indeed.com/career-advice/resumes-cover-letters/communication-skills> , accessed on 29th July 2021
4. <https://www.youtube.com/watch?v=jaxgeXPgAz0> , accessed on 29th July 2021

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.Rupali Londhe	Lecturer in English & Coordinator	Government Polytechnic, Nagpur.
2	Prof. Nitin Pote	Expert, Lecturer in English	Government Polytechnic, Bramhapuri
3	Prof. Ravindra Suryawanshi	Expert, Lecturer in English	NIT Polytechnic, Nagpur
4	Prof.Nitin Pathak	Expert, Lecturer in English	Kamptee Polytechnic, Nagpur
5	Dr.M.M.Machale	Lecturer in English	Government Polytechnic, Nagpur.
6	Mrs.Kamala Grace	Visiting Lecturer in English	Government Polytechnic, Nagpur.
7	Mrs.Swati Mahatme	Visiting Lecturer in English	Government Polytechnic, Nagpur.
8	Ms.Rasika Joshi	Visiting Lecturer in English	Government Polytechnic, Nagpur.
9	Mrs.Barnali Roy	Visiting Lecturer in English	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/ME/EE/EC/AE/PK/MT/TX/MC
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: WS151G
COURSE TITLE	: ENGINEERING WORKSHOP PRACTICE
TEACHING SCHEME	: TH:00; TU: 00;PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: --
PR. TEE EXAM	: 02 HRs
PT. EXAM	: --

❖ **RATIONALE:**

Workshop Practice is an engineering science course. The knowledge of this course is essential for technician industry to perform his/her duties. Working in workshop develops the attitude of groups working and safety awareness. This course provides industrial environment in the educational institute.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Adapt safety precautions in workshop and observe punctuality.
2. Read and interpret job drawing.
3. Use hand tools for various operations.
4. Apply basic techniques in manufacturing processes.
5. Operate different equipment/machineries used in basic shops.
6. Perform jobs according to drawing.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Observe the demonstration of hand tools, machine Tools and equipment used in Carpentry Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Carpentry	04
2	Prepare utility job involving related carpentry operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		08
3	Observe the demonstration of hand tools, machine Tools and equipments used in Welding Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Welding	02
4	Prepare utility job involving related Welding operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		08
5	Observe the demonstration of hand tools, machine Tools and equipments used in Fitting Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Fitting	02
6	Prepare One individual job involving related Fitting operations.		08
7	Observe the demonstration of hand tools, machine Tools and equipments used in Smithy Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Smithy	02
8	Prepare One individual job involving related Smithy operations.		08
9	Observe the demonstration of hand tools, machine Tools and equipments used in Plumbing Shop. Draw the sketches; write specifications, details, applications and safety rules of above tools.	Plumbing	02
10	Prepare One individual job involving related Plumbing operations.		08

11	Observe the demonstration of hand tools, machine Tools and equipments used in Sheet Metal Shop. Draw the sketches; writespecifications, details, applications and safety rules of above tools.	Sheet Metal	04
12	Prepare utility job involving related Sheet Metal Shop operations. (Job to be prepared by group of 2 to 4 students depending on volume of work)		08
Total Hrs.			64

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Nil

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Nil



❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequency	Max Mar ks	Min Mark s	Evidence Collected	Course Outcom es
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	-	-	-	-
		Class Room Assignmen ts		Assign- ments	-	-	-	-
	TEE (Term End Examination)	End Exam	Students	End of the Course	-	-	-	-
				Total	-	-		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessmen t of Practicals	Students	End of Every Practical	20	--	Jobs and Assessment sheet	1, 2, 3,4,5,6
		Journal Writing		Assignment	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25	10	Job and Assessment sheet	1,2,3,4,5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Job Drawing	10
2	Handling Tools, machineries and its operations	10
3	Dimension Accuracy	20
4	Overall finishing of Job	10
Total		50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:****For Mechanical Engineering:**

Course Outcomes (COS)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	-	-	-	2	2	2	2	2	-
2	3	3	-	2	2	2	2	-	-
3	1	1	-	2	2	1	2	-	-
4	1	1	-	3	2	1	2	-	-
5	3	1	-	3	3	1	2	2	-
6	3	2	-	3	3	2	3	2	-

For Other Programs:

Course Outcomes	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	-	-	-	2	2	2	2	2	-
2	3	3	-	2	2	2	2	-	-
3	1	1	-	2	2	1	2	-	-
4	1	1	-	3	2	1	2	-	-
5	3	1	-	3	3	1	2	2	-
6	3	2	-	3	3	2	3	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Course in Workshop Technology	B.S. Raghuwanshi; Dhanpat Rai sons, New Delhi ; 2006, 2011	10-0000017108
2	Elements of Workshop Technology	Hajra; Choudhary; Media Promoters & Publishers Mumbai, 2009	10-8185099146
3	A Textbook of Manufacturing	Gupta J.K., R.S. Khurmi S.Chand & Co. New Delhi	81-219-3092-8

	Process (Workshop Tech.)		
4	Workshop Practice Manual for Engineering Diploma & ITI Students	R K Hegde, Sapna Book House, 2012	13: 9798128005830

❖ **E-REFERENCES:**

- <http://books.google.co.in/books/isbn=9380026757> , accessed on 29 May 2021
- <http://www.asnu.com.au/profile./our-process.aspx> , accessed on 29 May 2021
- <https://www.youtube.com/watch?v=swnEQ17cQW>, accessed on 29 May 2021
- <https://www.youtube.com/watch?v=c-FN4M77qyA>, accessed on 29 May 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Welding Transformer (Air Cooled) Single Phase
2. Welding Transformer (Oil Cooled) Three Phase
3. Gas Welding Set
4. Bench Drilling Machine
5. Hydraulic Power Saw Machine
6. Bench Grinder
7. Bench Vise
8. Wood Turning Lathe Machine
9. Circular Saw Machine
10. Portable Wood Cutting Machine
11. Portable Drilling Machine
12. Carpentry Vice
13. Pipe Bending Machine
14. Pipe Vice
15. Pipe Cutter
16. Black smith Hearth
17. Anvil
18. Swage Block
19. Sheet Bending Machine
20. Sheet Cutting Machine
21. Brazing Equipment
22. All Hand Tools and Measuring Tools use in Carpentry Shop, Fitting Shop, Welding Shop, Plumbing Shop, Smithy Shop and Sheet Metal Shop,

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri A.W.Wankhade	Workshop Superintendent	Government Polytechnic, Nagpur.
2	Shri.K.S.Thekedar	Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
3	Er.A.M.Onkar	Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
4	Shri.G.F.Potbhare	Principal	NIT, Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME201G
COURSE TITLE	: THERMAL ENGINEERING
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

Thermal Engineering forms one of the core engineering subjects for mechanical engineering students. Diploma mechanical engineers have to work with various power producing and power absorbing devices like boilers, turbines compressor, I.C. engines and refrigerators. The course will enable students to establish foundation required to design, operate and maintain these devices. This course includes the study of basic laws & concept of thermodynamics, gas laws, properties of steam and steam generation. Mechanical engineer should understand working and application of various processes of thermal power plants. Students will be able to calculate various parameters required to determine the performance of these devices.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply laws of thermodynamics to devices based on thermodynamics systems.
2. Illustrate the concept of steam generation, steam properties and vapour processes.
3. Analyze the construction and working of boiler and its mountings.
4. Interpret the construction and working of condenser and cooling towers.
5. Interpret the construction and working of steam Nozzle.
6. Illustrate the construction and working of steam turbine.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Basic Concepts of Thermo- dynamics	1a. Clarify fundamental concept of Thermodynamics systems. 1b. Describe the various form of energy in given Thermodynamic systems. 1c. Describe the Various given laws of Thermodynamics. 1d. State the given application of laws of Thermodynamics. 1e. Represent various ideal gas processes on P-V and T-S Diagram.	1.1 Basic Concepts: Concept of Pure Substance, Types of system, properties of systems, Extensive and Intensive properties, flow and non-flow processes, specific volume, temperature, density, pressure, processes and cycles. 1.2 Energy: Work, Heat Transfer and energy Thermodynamic definition of work and heat, difference between heat and work, energy- potential energy, kinetic energy, internal energy, flow work, concepts of enthalpy and entropy. 1.3 Laws of Thermodynamics: Zeroth law, First law of thermodynamics, second laws of thermodynamics, Kelvin Planks, Clausius statements and their equivalence. Reversible and irreversible processes. 1.4 Application of Laws of Thermodynamics Steady flow energy equation and its application to boilers, engine, nozzle, turbine, compressor and condenser. Application of second law of thermodynamics to Heat engine, Heat pump and refrigerator. 1.5 Derivation of characteristics gas equation using Boyle's and Charle's law characteristics gas constant and universal gas constant. Avogadro's Law, Calculate molar volume. Ideal Gas processes- Isobaric, Isochoric, Isothermal, Isentropic, Polytrophic, Throttling and their representation of P-V and T-S diagrams. Determination of work, heat internal energy, enthalpy change and entropy change	12

2. Vapour Cycle	2a. Construct various given Vapour processes on P-V and T-S diagram and solve numerical. 2b. Describe and Draw given cycles on P-V and T-S diagram.	2.1 Vapour processes: Constant pressure, Constant temperature, constant volume, constant enthalpy, and constant entropy process. (Numerical base on Steam table) 2.2 Concept of Carnot cycle, Rankine cycle, P-V and T-S diagram of Carnot cycle and Rankin cycle.	06
3. Steam and Steam Boiler	3a. State the concept of steam Generation. 3b. Solve Numerical base on steam tables and Mollier Chart. 3c. Describe construction and working of given types of boilers and also state the functions of boiler mountings and accessories. 3d. Describe the given types of boiler draught.	3.1 Steam Fundamentals: Application of Steam, Generation of steam at constant pressure with representation on various charts such as T-S & H-S. 3.2 Properties of steam and use of steam table, Mollier chart, Dryness Fraction, degree of superheat, sensible and latent heat, boiler efficiency. (Numerical based Steam Table & Mollier Charts) 3.3 Steam Boiler: Principles of steam generation in high pressure boiler, classification of boilers, Water tube boiler and fire tube boiler, Introduction of Babcock and Wilcox Boiler, Cochran Boiler, List of boiler mountings and Accessories & its function 3.4 Boiler draught: natural & artificial, relative merits & demerits,	08
4. Condensers & Cooling Towers	4a. Describe various given concept related with steam condenser and also state Dalton's law to partial Pressure. 4b. State the source of air Leakage and its effects. 4c. Describe construction and working of given cooling tower.	4.1 Steam Condenser: Dalton Law of partial pressure Functions of condensers, classification of condensers, Construction and working of jet and surface condensers, 4.2 Condenser Performance: Sources of air leakage and its effect, concept of condenser efficiency, vacuum efficiency 4.3 Cooling Tower: Construction and working of forced, natural and induced draught cooling tower.	08
5. Steam Nozzle	5a. Define Mach number and critical pressure. 5b. State the application of steam nozzles.	5.1 Steam nozzle: Continuity equation, Types of nozzle, Concept of Mach number and critical pressure, equation for exit velocity 5.2 Application of steam nozzles. Efficiency of nozzles.	06

6. Steam Turbine	6a. Describe the principle of working of steam turbine. 6b. Describe the Types of Compounding of turbine and also losses in turbine.	6.1 Steam turbine: Classification of turbines, construction and working of Impulse and Reaction turbine. Differentiate between Impulse and reaction Turbine, 6.2 Compounding of turbines and its types. Losses in steam turbine.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare charts for P-V & T-S diagrams of different ideal gas processes and also derive Steady flow energy equation of given application of laws of thermodynamics.	1. Basic Concepts of Thermodynamics	04
2	Prepare Charts of P-H, H-S and T-S Diagrams for given steam processes.	2. Vapour Cycle	02
3	Prepare and present a seminar on Types Boiler, its Mounting and Accessories using appropriate sources of information.	2. Vapour Cycle	04
4	Prepare a report on visit to sugar factory / Steam Power Plant / Dairy Industry with specification of boiler and list of mounting and accessories along with their functions.	2. Vapour Cycle	06
5	Draw Enthalpy – Entropy (Mollier) Chart and represent different vapour Processes on the same using different color combinations.	3. Steam and Steam Boiler	04
6	Draw any two given types of condenser and cooling tower and also explain its construction and working.	4. Condensers & Cooling Towers	04
7	Prepare report in detail given types of Turbine and Turbine nozzle and also derive the continuity equation for the nozzle.	5. Steam Nozzle	04
8	Draw neat sketch of any two given compounding of turbines and explain its construction and working.	6. Steam Turbine	04
Total			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Basic Concept	00(02)	11(00)	06(06)	17(08)
2	Vapour Cycle	02(02)	03(03)	00(00)	05(05)
3	Steam Generator	02(00)	00(03)	06(03)	08(06)
4	Condensers and Cooling Towers	02(02)	03(03)	03(00)	08(05)
5	Steam Nozzles	02(00)	06(03)	03(03)	11(06)
6	Steam Turbines	02(00)	03(03)	06(03)	11(06)
	Total	10(06)	26(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	1	U	2	6/9
	1	R	2	3	R	2	4	R	2										
2	1	U	3	3	U	3	4	U	3	2	U	3	3	U	3				3/5
3	1	U	3	5	U	3	6	U	3	4	U	3	5	U	3				3/5
4	1	U	3	5	U	3	1	A	3	6	U	3	2	A	3				3/5
5	1	A	3	4	A	3	5	A	3	6	A	3	5	A	3				3/5
6	2	A	6	6	A	6	1	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Preparation of experimental set up, Drawing circuit diagram, selection of equipment. writing procedure etc.	10
2	Setting and Operation Performance	20
3	Observation and Recording, Calculation, Result	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	3	-	3	3	-
2	3	-	-	-	3	-	3	3	-
3	3	-	-	3	3	3	3	3	-
4	3	-	-	3	3	3	3	3	-
5	3	-	-	3	3	3	3	3	-
6	3	-	-	-	3	-	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Thermal Engineering	P.L. Ballaney, Khanna Publishers, 24 th Edition, Reprint 2011	10: 8174090312
2	Thermal Engineering	D. K. Chavan & G.K.Pathak, Standard Publishing House, 2 nd Edition, 2013	978-81-89401-20-7
3	Thermal Engineering	R.K.Rajput, Laxmi Publications (P) Ltd. 9 th Edition, 2015	9788131808047
4	Thermal Science and Engineering	Dr. M.L.Mathur & Prof. F.S.Mehta, Jain Book Depot(JBD), 3rd Reprint, 2013	9788183600835
5	Thermal Engineering Vol. I(Thermodynamics and Heat Engines)	Dr. S.S. Khandare, Charotar Publishing House Pvt. Ltd.,2008	9788185594682
6	A Textbook of Thermal Engineering	J. K. Gupta ; R. S. Khurmi	9788121925730

7	Thermal Engineering	S.L. Somasundaram, New Age International Publisher, 1996	10: 8122409792 13: 978-8122409796
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❖ E-REFERENCES:

- <http://www.youtube.com/watch?v=9GMBpZZtjXM> accessed on 23rd January 2022
- <http://www.youtube.com/watch?v=3dyxjBwqF-8> accessed on 23rd January 2022
- <http://www.youtube.com/watch?v=02p5AKP6W0Q> accessed on 23rd January 2022
- <https://www.youtube.com/watch?v=aC7c1NgA-7M>, accessed on 23rd January 2022
- <https://www.youtube.com/watch?v=is5wdVgPOkI>, accessed on 23rd January 2022
- <https://www.youtube.com/watch?v=Wz62eqg0kqs>, accessed on 28th January 2022
- <https://www.youtube.com/watch?v=UW7Pm3kXJT8>, accessed on 28th January 2022
- <http://www.sfu.ca/mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf> accessed on 23rd January 2022
- http://www.rinfra.com/energy_generation.html accessed on 23rd January 2022
- <http://www.youtube.com/watch?v=jv5p7o-7Pms> accessed on 23rd January 2022
- <http://www.youtube.com/watch?v=MulWTBx3szc> accessed on 24th January 2022
- <http://www.ntpel.ac.in/courses/103106101/Module%20-%208/Lecture%20-%202.pdf> accessed on 26th January 2022
- <http://www.learnengineering.org/2013/02/working-of-steam-turbine.html> accessed on 26th January 2022

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:

1. Two stage reciprocating air compressor with intercooler test rig. Maximum Pressure 10 bar. Digital watt meter.
2. Model of Water tube and Fire tube Boilers (Cut section models)
3. Various mounting and accessories of Boiler for assembly and dismantling.
4. Relevant simulation software.
5. Cut section models of Impulse Turbine and Reaction Turbine.
6. Experimental setup with convergent and divergent nozzle.
7. Model of surface steam condenser with assembly and dismantling purpose.
8. Experimental setup of shell and tube steam condenser.

❖ LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1	Prof. P. V. Rekhade	Head of Mechanical Engineering (Shift – First)	Government Polytechnic, Nagpur.
2	Dr. R. G. Choudhari	Head of Mechanical Engineering (Shift – Second)	Government Polytechnic Nagpur
3	Mr. S. B. Bambole	Course Expert & Lecturer , Mechanical Engineering	Government Polytechnic Nagpur
4	Mr. M. T. Gajbhiye	Course Expert & Lecturer , Mechanical Engineering	Government Polytechnic Nagpur
5	Dr. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furniture's, MIDC, Nagpur

6	Shri. G. F. Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri.G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engg.	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

**PROGRAMME : DIPLOMA IN MECHATRONICS/ MECHANICAL ENGG.
AUTOMOBILE ENGG./ PACKAGING TECH.**

COURSE CATEGORY: ENGINEERING SCIENCE COURSE

COURSE CODE : AM201G

COURSE TITLE : STRENGTH OF MATERIALS

TEACHING SCHEME: TH:03; TU:00;PR:02(CLOCK HRs.)

TOTAL CREDITS : 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEEXAM : 03 HRs

PR. TEEXAM : 02 HRs

PT. EXAM : 01 HR

❖ RATIONALE:

Concepts and principles involved in the analysis and design of various machines and machine components alongwith mechanical properties of engineering materials in Mechanical Engineering, Automobile engineering and Packaging technology are covered in this course. Design and analysis of machines and it's components needs the basic understanding of mechanical properties of material and their behavior under stress. The approach of teaching should develop critical thinking in the students. In laboratory the experiments integrate the knowledge and desired skill in students.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Describe behaviour of material and components subjected to various types of loading.
2. Illustrate engineering principles to calculate the reactions, shear forces and bending moments and draw shear force and bending moment diagrams.
3. Demonstrate the parallel and perpendicular axis theorem to calculate moment of inertia for various types of sections.
4. Locate principal planes and obtain principal stresses for an element subjected to various stress combinations.
5. Describe the effect of eccentric loads on various components and draw stress distribution diagrams.

6. Use engineering principles to calculate stresses in shafts.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Simple Stress, Strain and Elastic Properties	1a. Define various terms and compute their values. 1b. Calculate Material Properties Under Longitudinal & Lateral Loads. 1c. Analyse Composite & Compound stress systems. 1d. Calculate design constants for various conditions. 1e. Calculate the change in dimensions and volume of the body subjected to uniaxial, biaxial and triaxial loads/stresses. 1f. Calculate the stress, strain due to temperature variation in homogeneous and compound bars. 1g. Compute Strain Energy under Different Types of loading.	1.1 Definition of stress, strain, elasticity. Definition of rigid, elastic and plastic bodies. Deformation of elastic body under various forces. 1.2 Type of stresses-normal and tangential, normal tensile and compressive stresses, standard stress strain curve for mild steel bar under tension test, Hook's law, elastic limit, modulus of elasticity, factor of safety, yield and working stresses. 1.3 Stress and strain in composite section under axial loading. 1.4 Stress and strain due to temperature variation developed in homogeneous and composite bars. 1.5 Longitudinal and Lateral strain, Poisson's ratio, biaxial and triaxial stresses, volumetric strain, change in volume, Bulk modulus. 1.6 Shear stress and strain, modulus of rigidity, complementary shear stress and induced tension and compression due to it. 1.7 Relation between modulus of elasticity, modulus of rigidity and bulk modulus. 1.8 Type of loading: Sudden, Gradual & Impact Loads 1.9 Define Strain Energy, Proof Resilience modulus of resilience. 1.10 Strain energy stored in a body when subjected to Gradual, Sudden and impact load	12
2. Shear Force & Bending Moment	2a. Define various terms and compute their values. 2b. Draw Shear Force & Bending Moment Diagram for Statically Determinate Beams. 2c. Calculate the shear force and bending moment for determinate beams with load combinations of	2.1 Types of beam, supports and loads. 2.2 Concept and definition of shear force and bending moment. 2.3 Shear force and bending moment diagram for simply supported and one sided over hanging beams subjected to point loads and uniformly distributed loads only. 2.4 Point of maximum sagging and hogging bending moment, point of	08

	point load and uniformly distributed load.	contra-flexure, Relation between load, shear force and bending moment.	
3. Moment of Inertia	3a. Define various terms used in Moment of Inertia. 3b. Compute Moment of Inertia of Symmetric & asymmetric structural sections using parallel and perpendicular axes theorems.	3.1 Definition, M.I. of plane lamina, radius of gyration, parallel and perpendicular axes theorems, M.I. of rectangular, circular, semi-circular and triangular section. 3.2 M.I. of symmetrical and Unsymmetrical I- section, channel section, T-section, angle section, & Hollow sections and built up section about centroidal axes. 3.3 Polar Moment of Inertia of circular sections.	06
4. Principal Planes And Stresses	4a. Define terms related to principal planes and principal stresses. 4b. Calculate Principal Stresses & Principal Plane on a plane in a Strained structural material.	4.1 Definition of principal plane, oblique plane. 4.2 State of stress at a point in two dimensional stress system, different states of stresses. 4.3 Resultant stress, principal stresses – major and minor, position of principal planes	06
5. Direct and Bending Stresses	5a. Mark core or Kernel of section for different cross-sections. 5b. Calculate resultant stress and draw resultant stress variation diagram .	5.1 Concept of bending stresses, Assumptions in theory of simple bending, Equation of bending. 5.2 Moment of resistance, section modulus, bending stress variation diagram. 5.3 Concept of direct and eccentric loads Short compression member (Solid Rectangular, square, circular sections) subjected to eccentric loads about any one centroidal axis.	08
6. Torsion	6a. State torsional equation and moment of resistance for circular shaft. 6b. State assumption made in theory of pure torsion. 6c. Calculate shear strength, torsional rigidity and polar modulus of circular and hollow shaft.	6.1 Theory of torsion, Torsional equation, Moment of resistance, Assumptions made in theory of pure torsion. 6.2 Shear stress distribution across the section of circular shaft, strength of solid circular shaft, polar modulus and power transmitted by shaft.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
GROUP A (Any Two)			
1	Operate Universal testing machine for different types of test.	1. Simple Stress And Strain	02
2	Measure the elongation of steel by using Extensometer.	1. Simple Stress And Strain	02
3	Operate Compression testing machine for compression test.	1. Simple Stress And Strain	02
GROUP B : (Minimum Nine)			
4	Tension test on mild steel bar as per IS 1608 (2005).	1.Simple stress and strain	02*
5	Tension test on HYSD/TOR steel as per IS 1786 (2008).	1.Simple stress and strain	02*
6	Tension test on Aluminium bar as per IS 1608 (2005).	1.Simple stress and strain	02
7	Shear test on different metals such as MS (Mild steel), AL (Aluminium), BR (Brass) and CU (Copper) as per IS 5242.	1.Simple stress and strain	02
8	Evaluate toughness of ductile and brittle materials by conducting Izod impact test as per IS 1757.	1.Strain Energy	02
9	Determine energy absorption capacity of ductile and brittle materials by conducting Charpy impact test as per IS 1598.	1.Strain Energy	02
10	Brinell's hardness test on metals as per IS 1500 (2005).	1.Simple stress and strain	02
11	Calculate Compressive strength of ductile and brittle metals using compression testing machine as per IS 14858.	1.Simple stress and strain	02*
12	Flexure test on wooden beam of rectangular cross section as per IS 1708, IS 2408.	5.Direct and bending stresses	02*
13	Torsion In Circular rod of mild steel as per IS 1717.	6.Torsion	02
GROUP C :(Any One)			
14	Draw shear force and bending moment diagrams of different types of beams and loadings. (Six problems on – Three A2 sizesheets.)	2. Shear force & bending moment	10
15	Draw Shear Force and Bending Moment diagrams for given loading using open source SF/BM simulation software. (Four Problems)	2. Shear force & bending moment	10
Total Hrs			32

- Experiments marked * are compulsory.
- Minimum 12 Practicals should be performed.
- The above list is suggestive and additional practicals may be conducted if felt relevant by the course teacher.

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

R – Remember

U – Understand

A – Analyze / Apply

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Simple Stress And Strain and Elastic properties.	02(02)	03(03)	06(03)	11(08)
2	Shear Force & Bending Moment	02(00)	03(03)	06(03)	11(06)
3	Moment of inertia	02(00)	06(03)	03(00)	11(03)
4	Principal plane and stresses	02(00)	06(03)	00(00)	08(03)
5	Direct And Bending Stresses	02(02)	06(03)	03(06)	11(11)
6	Torsion	02(02)	06(03)	00(00)	08(05)
	Total	12(06)	30(18)	18(12)	60(36)

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Bit 7			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2				6/9
	1	R	2	5	R	2	6	R	2													
2	1	U	3	2	U	3	3	U	3	1	U	3	2	U	3							3/5
3	3	U	3	4	U	4	4	U	3	1	A	3	2	A	3							3/5
4	5	U	3	5	U	3	6	U	3	3	U	3	4	U	3							3/5
5	6	U	3	3	A	3	5	A	3	5	U	3	6	U	3							3/5
6	1	A	6	2	A	6	5	A	6													2/3

T-Unit/Topic Number

R-Remember

L- Level of Question

U-Understand

M-Marks

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3, 4, 5, 6
		Class Room Assignments		Assignments	15	--	Assignment book	1, 2, 3, 4, 5, 6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4, 5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous assessment of practical	Students	End of every practical	20	--	Journal	1, 2, 3, 4, 5, 6
		Journal Writing		Assignment	05	--	Journal	1, 2, 3, 4, 5, 6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1, 2, 3, 4, 5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing free body diagram, selection of equipment, writing procedure etc.	10
2	Performance	10
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	20
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes	Program Outcomes (POs)							Program specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1	3	2	-	3	-	-	-			
2	3	3	-	2	-	-	2			
3	3	2	-	3	-	-	-			
4	3	3	-	3	-	-	-			
5	3	3	-	-	-	-	-			
6	3	3	-	3	-	-	-			

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Textbook of Strength of Materials	Dr. R.K. Bansal Publisher: Laxmi; Publications(P) Ltd. 5 th edition, 2012	978-8131808146
2	Strength of Material	R. S. Khurmi. Publisher: Chand(S.) & Co. Ltd.	978-8121928229
3	Strength of Material	S. Ramamurtham, Dhanpat Rai Publishing Co.	818743354X, 9788187433545
4	Mechanics of Structure Vol 1	S. B. Junnarkar and H. J. Shah, Publisher: Charotar Publishing House Pvt. Ltd., 2012	978-9380358659
5	Strength of Material	Sunil S. Deo, NiraliPrakashan ,2013	978-9383073283
6	Strength of Material	D.P.Kothari, G.K.Awari, S.K.Bhadke New Age International Publishers, 2021	978-9388818209

E-REFERECNES:

- https://www.youtube.com/watch?v=InEpKlYBkvk&feature=player_detailpage accessed on 18th June 2021
- https://www.youtube.com/watch?v=l20kF6fhScA&feature=player_detailpage accessed on 18th June.2021
- https://www.youtube.com/watch?v=RJXJpeH78iU&feature=player_detailpage accessed on 18th June 2021

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:

- Universal Testing machine of capacity 400kN,600kN/1000kN, analog type/digital type with all attachments and accessories.
- Extensometer with least count 0.01mm, maximum extension 25 mm with single dial gauge/ digital display suitable for various gauge length
- Compression testing machine of capacity 2000KN, analog /digital type having facility to measure deformation with all attachments and accessories.
- Izod/Charpy impact testing machine confirming to IS:1757.
- Torsion testing machine hand operated or motorized.
- Accessories: venire caliper, meter scale, weighing balance, weights, punch, file, hammer, screw driver, pliers ,etc.

❖ LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1	Prof.Y.K.Chandarana	Head of Applied Mechanics Dept.	Government Polytechnic, Nagpur.
2	Prof. A.G.Bhaiswar	Lecturer in Applied Mechanics	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME / PK
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME202G
COURSE TITLE	: MACHINE DRAWING
TEACHING SCHEME	: TH: 02; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 04 HRs
PR. TE EXAM	: --
PT. EXAM	: 02 HR

❖ **RATIONALE:**

The course illustrates techniques of drawing in an engineering field. A mechanical engineer diploma holder, irrespective his field of operation in an industry is expected to possess a thorough understanding of drawing which includes clear visualization of object and the proficiency in reading and interpreting a wide variety of production drawings. Course aims at developing the ability to visualize and draw curves of intersection and develop lateral surfaces of given solid. Knowledge of conventional representation, limit, fit and tolerances, geometrical tolerances surface roughness representation are also important in reading and drawing of various production drawing. In industry components are manufactured on the basis of detailed drawing. These drawing comprises of all the information required to produce the component.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Draw development of lateral surfaces of solids.
2. Interpret curves of intersection of various solids.
3. Apply various drawing codes, conventions per SP46.
4. Draw production drawings used to produce products.
5. Interpret the technique of drawing details and assembly of machine components.
6. Draw the details and assembly of machine components.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Development of Surfaces of Solid.	1a. Develop the lateral Surfaces of given solids / sheet metal /non metal parts. 1b. Identify parts where concept of development of the given surface is required.	1.1 Develop the lateral surfaces of regular solids viz. Cube, Prism, cylinder, Pyramid, Cone. 1.2 Development of surfaces of solids in section and solids with holes and slots. Applications of development of surfaces Such as Funnel, Chimney.	04
2. Intersection of Solids	2a. Identify parts where concept of intersection of the given solid required. 2b. Visualize & draw curves of intersection of surfaces of given solids	Curves of intersection of the surfaces of the solids in following cases 2.1 Prism with prism, cylinder with cylinder, Square prism with cylinder when- i) axes are at 90° & intersect ii) axes are at 90° & offset 2.2 Cylinder with cone when the axes of the cylinder is parallel to both the reference planes & cone resting on base on H.P. & with axis intersecting and offset from axis of cylinder.	06
3 Conventional Representation	3a. Use IS SP-46 (1988) codes 3b. Interpret standard convention used in the given mechanical working drawing. 3c. Use the conventional representation in drawing.	Standard convention using SP- 46 (1988) 3.1 Materials — C.I., M.S., Brass, Bronze, Aluminum, Wood, Glass, Concrete & Rubber 3.2 Long & Short break in pipe, rod & shaft. Various sections like half, removed, revolved, offset, partial & aligned section 3.3 Conventional representation of standard parts like Ball & roller bearing, Springs with square & flat ends, gears, sprocket wheels & chain wheels, Knurling, serrated shafts, splined shafts and machining operations as Countersunk & counter bore, tapers	03

4. Production Drawing	4a. Calculate tolerances on the given machine component. 4b. Identify Fit between mating parts of machine component based on given tolerance values. 4c. Interpret the welding symbols in the given working drawing. 4d. Interpret surface roughness characteristics from the values given on component drawing.	Limits, fits and tolerances 4.1 Definitions, Introduction to ISO system of tolerancing- unilateral and bilateral and its representation on drawing, dimensional tolerances, elements of interchangeable system, hole & shaft base systems, tolerance diagram, Types of fit and its selection (clearance, transition and interference) for engineering applications. 4.2 Geometrical tolerances Definitions, Tolerances of form and position and its geometric representation- tolerance frame, datum feature, magnitude of tolerance and symbol, interpretation of a given symbol on drawing, simple examples. 4.3 General welding symbols, length and size of weld surface contour and finish of weld all round and site weld Symbolic representation in Engineering practices and its interpretation. 4.4 Machining symbol and surface texture: Indication of machining symbol showing direction of lay, sampling length, roughness grade, machining allowance manufacturing method. Representation of surface roughness on drawing.	05
5. Details to Assembly	5a. Apply the standard procedure for assembly of component. 5b. State details of components and the sequence of components of the given assembly and draw assembly drawing from given details	5.1 Introduction — basic principles of process of assembly 5.2 Preparation of assembly drawing from the given details of components i) Universal & Oldham's Coupling ii) Footstep & pedestal bearing iii) Lathe tool post, tailstock iv) pipe vice v) Screwjack vi) Drill Jig vii) Gland & stuffing box	07
6. Assembly toDetails	6a. Identify various component in the given assembly and the sequence of dismantling it 6b. Apply the procedure	6.1 Introduction — basic principles of dismantling process 6.2 Preparation of detailed working drawing of the following: i. Universal & Oldham's Coupling ii. Footstep & pedestal bearing	07

	for dismantling the assembly into parts and draw details from given assembly drawing.	iii. Lathe tool post, tailstock iv. pipe vice v. Screwjack vi. Drill Jig Gland & vii. stuffing box	
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Unit s	Hrs.
1	Draw two problems on development of surfaces of solid. (01 Sheet)	1. Development of surfaces of solid	08
2	Draw two problems on Intersection of solids. (01 Sheet)	2. Intersection of solids	12
3	Draw minimum 10 conventional representation symbols. (01 Sheet)	3 Conventional representation	06
4	Draw Dimensional and geometrical tolerances, welding symbols, surface roughness and machining symbol on given figure and tables. (01 Sheet)	4. Production Drawing	10
5	Draw two assembly drawings from the given detailed drawing showing conventional representation, dimensional and geometrical tolerances and surface finish symbol. (01 Sheet)	5. Details to assembly	14
6	Draw two detailed drawings from the given assembly drawing showing conventional representation, dimensional and geometrical tolerances and surface finish symbol. (01 Sheet)	6. Assembly to details	14
Total Hrs.			64
Note:-Use A2 Size of drawing sheets.			

C. LIST OF ASSIGNMENTS:

Practical	Specific Learning Outcomes (PsychomotorDomain)	Units	Hrs.
1	Draw four problems on Development of surfaces of solid.(On Practical sketch book)	1. Development of surfaces of solid	---
2	Draw four problems on Intersection of solids .(On Practical sketch book)	2. Intersection of solids	
3	Draw Conventional representation symbols. (On Practical sketch book)	3. Conventional representation	
4	Draw Dimensional and geometrical tolerances, welding symbols, surface roughness and machining symbol on given figure and tables.(On Practical sketch book)	4. Production Drawing	---
5	Draw two assembly drawings from the given detailed drawing showing conventional representation, dimensional and geometrical tolerances and surface finish symbol. (On Practical sketch book)	5. Details to assembly	---
6	Draw two problems on detailed drawings from the given assembly drawing showing conventional representation, dimensional and geometrical tolerances and surface finish symbol (On Practical sketch book)	6. Assembly to details	---

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Development of surfaces of solid	00(00)	08(00)	00(08)	08(08)
2	Intersection of solids	00(00)	08(08)	00(00)	08(08)
3	Conventional representation	08(04)	00(00)	00(00)	08(04)
4	Production Drawing	04(00)	04(00)	00(04)	08(04)
5	Details to assembly	00(00)	00(00)	14(14)	14(14)
6	Assembly to details	00(00)	00(00)	14(00)	14(00)
	Total	12(04)	20(08)	28(26)	60(38)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	U	8	1	A	8													1/2
2	2	U	8	2	A	8													1/2
3	3	R	2	3	R	2	3	R	2	3	R	2	3	R	2	3	R	2	4/6
4	4	R	4	4	U	4	4	A	4										2/3
5	5	A	14	5	A	14													1/2
6	6	A	14																1/1

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1R2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assign-ments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	40	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assign-ments	10	--	Journal	1, 2, 3,4,5,6
				Total	50	20		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
NIL		

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	3	3	-	-	3	3	-
2	3	3	3	3	-	-	3	3	--
3	3	3	3	3	-	-	3	3	-
4	3	3	3	3	-	-	3	3	-
5	3	3	3	3	-	-	3	3	-
6	3	3	3	3	-	-	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Machine Drawing	N. D. Bhatt & V. M Panchal, Charotar Publishing house 2010	978-93-80358-11-6
2	Engineering Drawing Practice for Schools and Colleges IS:SP-46	Bureau of Indian Standards, Third Reprint, October 1998	81-7061-091-2
3	A Text book of Machine Drawing	Gill P.S. S.K.Kataria & Sons New Delhi 2007	978-93-50144-16-9
4	Machine Drawing	Sidheshwar, Mc Graw Hills, New Delhi 2009	9780074603376
5	Production Drawing	Narayanan L.K., Kannaich P. Venkat Reddy K., New Age International publication New Delhi 2009	9788122435016
6	Engineering Drawing	P. J Shaha, S. Chand & co. 2008	81-219-2964-4
7	Engineering Drawing	R. K. Dhawan, S. Chand & co.	81-219-1431-0

8	Engineering Drawing	N. D. Bhatt, Charotar Publishing house 2010	978-93-80358-17-8
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❖ **E-REFERENCES:**

- <http://www.weldingtechnology.org>
- <http://www.newagepublishers.com>
- <https://www.youtube.com/watch?v=zXrTnNBn9Hk>
- <https://www.youtube.com/watch?v=7RNiaieFAI>
- <https://www.youtube.com/watch?v=l4KiyOK-cJI>
- <https://www.youtube.com/watch?v=-GXUZJEJkkY>
- <https://www.youtube.com/watch?v=m9fOAX1F63Q>
- <http://npkauto.com/assignments>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Drawing Board with drawing instruments
2. Mini drafter
3. Paper model of objects for development of Lateral surfaces of solids.
4. Models of solid showing curves of intersection.
5. Models of machine component for conventional representation.
6. Assemblies of models mentioned in Unit V & VI

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Prof. P. V. Rekhade	Head of Mechanical Engineering (Shift – First)	Government Polytechnic, Nagpur.
2	Dr. R. G. Chaudhari	Head of Mechanical Engineering (Shift – Second)	Government Polytechnic Nagpur
3	Mr. T.K.Ghormade	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr.K.S.Thekedar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Dr. A. M. Onkar	PBOS member & Chief Executive Officer	Onkar Furniture's, MIDC, Nagpur
6	Shri. G. F. Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engg.	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME204G^{\$}
COURSE TITLE	: MEASUREMENT AND METROLOGY^{\$}
TEACHING SCHEME	: TH: 04; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 05 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

The knowledge and skill of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also importance in many types of instrumentation devices and innovations. The course aims at making a Mechanical Engineering student familiar with the principles of measurement, instrumentation, transducers & measurement of dimensional parameters such as length, angle, threads and gear measurement, measurement of Non-electrical parameters like temperature, pressure, flow, speed, torque and the methods of automatic control systems for engineering applications. This course is very important in the industries with automated processes, such as chemical industries, pharmaceutical industries or manufacturing industries, with the goal of improving system productivity, reliability, safety, optimization and stability.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Select appropriate instrument for measurement of various parameters.
2. Identify different instruments.
3. Draw the set-up of different instruments.
4. Understand the construction and working of various instruments.
5. Measure the various process parameters.
6. Understand the various precautions for various instruments.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction and Significance of Measurement	1a Illustrate the various system characteristics. 1b Analyze the various errors in measurement. 1c Describe the working principle of various transducers.	1.1 Types of measurement , classification of instruments, Static characteristics- Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Dead zone, Drift, Sensitivity, Stability, Threshold and Resolution, Repeatability and Reproducibility, Linearity and non-linearity, Measurement of error- Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. 1.2 Dynamic characteristics - Speed of response and measuring lag, Dynamic errors, Overshoot. 1.3 Transducers : Classification of transducers, active and passive transducers, resistive, inductive, capacitive, piezo-resistive, thermo-resistive, thermo-electric, piezo-electric, photo-electric, mechano-electric, electro-mechanical transducers.	12
2. Linear and Angular Measurement	2a. Select a suitable type of instrument for Linear measurement on given situation. 2b. Select a suitable type of instrument for Angular measurement on given situation.	2.1 Length measurement - Abbe's Principle of Alignment, Slip gauge and its accessories, Vernier Callipers (Mechanical Type / Dial Type / Digital Type), Vernier Height Gauge, Micrometer, Dial Indicator and Magnetic Stand, V – block, Filler Gauge, Radius and Fillet Gauge, Steel Tri-square.- 2.2 Angle measurement - Instruments For Angular, Measurements, Working And Use of Universal Bevel Protractor, Optical Bevel Protractor, Sine Bar, Sine Table, Spirit Level, Clinometer, Angle Gauges and Angle dekkor as an angular comparator.	10
3. Screw Thread and Gear	3a Select a suitable type of instrument for Screw Thread measurement.	3.1 Screw thread Measurements - Screw Thread Terminology, Types of threads, Metric Threads, British Threads, Measurement of different	10

Measurement	3b Select a suitable type of instrument for Gear measurement.	parameters for internal and external threads, such as-major diameter, minor diameter, effective diameter, Pitch, Thread Angle, Lead Angle, Errors in threads, etc, by using Screw Pitch Gauge, Screw Thread Micrometer. 3.2 Gear Measurements –Gear Terminology, Types of Gears, Spur Gears, Bevel Gears, Measurement of Chordal tooth thickness & Chordal Addendum by Gear Tooth Vernier Calliper, Errors in gears such as backlash, run-out, eccentricity, use of Parkinson gear tester.	
4. Pressure and Temperature Measurement	4a. Select a suitable type of instrument for pressure measurement. 4b. Illustrate the various non-electrical type thermometers. 4c. Illustrate the various electrical type thermometers. 4d. Select and illustrate the various types of pyrometers.	4.1 Pressure Measurement: Low pressure gauges- McLeod Gauge, Ionization gauge, Thermocouple vacuum gauge. High Pressure gauge- Diaphragms, Bellow type pressure gauge, Bourdon tube pressure gauge, Electrical resistance type, piezoelectric type, Variable capacitor type pressure gauges. 4.2 Temperature Measurement : Non-electrical methods- Bimetallic Thermometer, Liquid in glass thermometer and Pressure thermometer. Electrical methods- RTD, Platinum resistance thermometer, Thermistor Gauge, Thermocouple Gauge. Pyrometers- Total Radiation Pyrometer and Optical Pyrometer.	10
5. Flow & Liquid Level Measurement.	5a. Illustrate the various types of variable area flow meter. 5b. Select and illustrate the Special Flow meters.	5.1 Variable area flow meters- Rota meter, Nutating Disc type flow meter. 5.2 Special flow meters- Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter ,Turbine flow meter 5.3 Liquid level measurement by using Float and shaft gauge, Capacitive liquid level gauge, Gamma ray level sensor.	10
6. Speed & Torque Measurement	6a. Select and use a specific instrument for speed measurement. 6b. Select and use a	6.1 Speed measurement –Mechanical Tachometer, Electrical Non-contact type Tachometer, Inductive Pick Up, Capacitive Pick Up. 6.2 Torque measurement – Static	12

	specific instrument for torque measurement.	Torque Measurement by using Torque-Wrench & Dynamic Torque Measurement by using Rope Brake Dynamometer.	
Total Hrs			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Know the measurement and control laboratory and study the specifications of measuring instruments /devices.	1. Introduction and significance of Measurement	02
2	Measure lengths by using Vernier Calliper, Vernier Height Gauge, Micrometer, Dial Indicator with Magnetic Stand.	2. Linear and Angular Measurement	04
3	Measure the Taper Angle of work piece by using Vernier Bevel Protractor, Optical Bevel Protractor, Clinometer& by using Angle Dekkor with Angle Gauges & by using Sine bar with Slip Gauges.	2. Linear and Angular Measurement	04
4	Measure screw thread parameters by using Screw Thread Micrometer & Screw Pitch Gauge.	3. Screw Thread & Gear Measurement	02
	Measure gear parameters by using GTVC & Digital Vernier Calliper.	4. Screw Thread & Gear Measurement	02
5	Measure Linear displacement by using LVDT & Angular displacement by using RVDT.	2. Linear and Angular Measurement	04
6	Measure pressure and vacuum by using Bourdon Tube type Gauges.	4. Pressure and Temperature Measurement	02
7	Measure temperature by thermocouple gauge / RTD-PT-100 and compare it by Mercury-in-Glass thermometer.	4. Pressure and Temperature Measurement	04
8	Measure flow-rate of liquid by Rotameter and compare it by Quantity-meter.	5. Flow & Liquid level measurement.	04
9	Measure speed of rotating shaft by using Mechanical Tachometer & compare it with Optical Tachometer.	6. Speed & Torque Measurement	02
10	Measure Static torque of machine shaft by using analog / digital type Torque-Wrench or by using Torque-Lever method.	6. Speed & Torque Measurement	02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction and significance of Measurement	02(02)	03(00)	00(00)	05(02)
2	Linear and Angular Measurement	02(02)	03(03)	00(03)	05(08)
3	Screw Thread & Gear Measurement	00(00)	11(00)	03(00)	14(00)
4	Pressure & Temperature Measurement	02(00)	03(03)	03(03)	08(06)
5	Flow & Liquid level Measurement	02(00)	06(09)	03(03)	11(12)
6	Speed & Torque Measurement	02(02)	12(00)	06(06)	17(08)
	Total	10(06)	38(15)	12(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	U	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	2	R	2	6	R	2										
2	1	U	3	2	U	3	3	U	3	2	A	3	2	U	3				3/5
3	3	U	3	3	U	3	3	A	3	5	U	3	4	A	3				3/5
4	4	U	3	4	A	3	5	A	3	4	U	3	5	U	3				3/5
5	5	U	3	5	U	3	6	A	3	5	A	3	5	U	3				3/5
6	6	U	6	6	U	6	6	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	40	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	10	--	Journal	1, 2, 3,4,5,6
				Total	50	20		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing the figure of equipment, selection of equipment, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	3	1
2	3	2	3	-	3	-	-	3	-
3	3	2	3	2	-	-	-	-	-
4	3	2	3	-	3	-	1	-	1
5	3	2	-	-	3	1	-	3	1
6	3	-	3	-	3	-	1	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **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	ISBN: 9788189928452
2	Metrology	M. Mahajan ; Dhanpat Rai & Co. Pvt. Ltd., New Delhi.	ISBN13:9788177000511
3	Mechanical Measurements & Control	D.S.Kumar; Metroplitan Book Co. Pvt. Ltd.; 5 th Edition.	81-200-0437-X
4	Mechanical & Industrial Measurements	R.K. Jain; Khanna Publishers ;	ISBN13-9788174091912
5	A Course in Mechanical Measurements and Instrumentation & Control	A.K. Sawhney; Dhanpat Rai & Co. Pvt. Ltd.	ISBN - 9788177000238

6	Measurement Systems	E. O. Doebelin ; Ernest Doebelin & Dhanesh Manik; World of Books , UK.	ISBN10: 0070699682
7	Instrumentation Devices & Systems	C.S. Narang ; Tata Mc-Graw Hill Publications, New Delhi.	ISBN: 978-0074633502.
8	Instrumentation Measurement and Analysis	B. C. Nakraand, K.K. Chaudhary; Tata Mc-Graw Hill Publications, New Delhi.	ISBN 10: 9385880624 / ISBN 13: 9789385880629
9	Mechanical Measurement	Thomas Beckwith; Published by Addison-Wesley	ISBN-10 : 0201569477; ISBN-13 : 978-0201569476

❖ E-REFERENCES:

- <https://www.theengineerspost.com/mechanical-measurements/>, access on 27th Jun, 2021
- <https://pace.edu.in/>, access on 27th Jun, 2021
- <http://kaizenha.com/>, access on 27th Jun, 2021
- <https://www.brainkart.com/>, access on 27th Jun, 2021
- <https://www.smar.com/>, access on 27th Jun, 2021
- <https://web.mst.edu/>, access on 27th Jun, 2021
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- <https://www.sciencedirect.com/>, access on 27th Jun, 2021
- <https://controltheorymaster.files.wordpress.com/>, access on 27th Jun, 2021

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:

1. Optical bevel protractor
2. Combined pressure & vacuum gauge –Pressure Range 0 to 30 Bar, Vacuum Range 0 to -30 Inch Hg
3. Screw thread micrometer
4. Gear tooth vernier calliper
5. Nutating discs type flow meter
6. Analog or digital type torque wrench
7. Mechanical tachometer
8. Optical tachometer
9. Spring Balance of 0 to 25 Kg capacity

❖ LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Y.K. Gaiky	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.

4	A.S. Bahendwar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M. Onkar	PBOS member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F .Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/MC
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: WS201G⁵
COURSE TITLE	: MANUFACTURING PROCESSES
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

Diploma Engineers often comes across various types of basic manufacturing processes. He /she is required the knowledge of core principles of manufacturing processes to select, design, analyze, operate and control the appropriate processes with respect to machines, specific cutting tools, cutting fluids for specific applications in order to convert raw material into finished products as per the requirement of drawings. This course intends to help the students in performing various operations on Lathe, Drilling, Shaper, Planer, Slotter, Welding and Foundry shop. He /she is also required to know about latest improvements in manufacturing processes. With sound knowledge of this course, the diploma engineers will be able to handle and control practical situations more effectively and confidently.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Choose proper tools, equipments and machineries for specific applications.
2. Select cutting tools, cutting fluids and manufacturing processes for the desired output.
3. Identify proper metal joining processes to produce job.
4. Produce the job by selecting proper process as per given drawing.
5. Prepare product using different forming processes.
6. Prepare product using different casting processes.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Fundamentals of Machining	1a. Identify different machining operations to be performed for given job. 1b. Describe with sketch the metal cutting principle. 1c. Compare Oblique and Orthogonal cutting 1d. Draw cutting tool diagram showing its various nomenclature	1.1 Basic elements of machining 1.2 Principles of metal cutting and forces involved in metal cutting, Oblique and Orthogonal cutting 1.3 Chip formation, Types of chips. 1.4 Cutting tool nomenclature, tool signature and Cutting parameters.	04
2. Cutting Fluid and Tool Materials	2a. Classify cutting fluids. 2b. Select cutting fluids for various machining operations 2c. Identify characteristics of various tool materials. 2d. Describe the procedure of tool re-sharpening. 2e. Find factors affecting machinability.	2.1 Cutting Fluid - Introduction, classification of cutting fluid, solid & liquid cutting fluid, chemical coolants. 2.2 Selection of cutting fluids and its application during machining operation. 2.3 Tool Material - Introduction, characteristics of tool material, types of tool material such as plain carbon steel, high carbon steel, high speed steels, carbide tools, ceramics, diamond tools, cemented oxides, abrasives & CBN. 2.4 Tool life & tool wear, types of tool failure. Re-sharpening of cutting tools. 2.5 Machinability, factors affecting Machinability.	06
3. Metal Joining Processes	3a Classify metal joining process. 3b Describe with sketches various welding processes. 3c Identify welding defects and its causes. 3d Describe with sketches the tools and equipments used	3.1 Introduction to Processes of joining, Fusion process. 3.2 Welding processes –Types, working principle & applications: Gas welding, carbon arc welding, shielded metal arc welding, TIG welding, MIG welding, plasma arc welding, Resistance Welding- Spot, Seam and Projection. 3.3 Welding defects. 3.4 Tools & equipments used in gas	10

	in gas welding. 3e Compare soldering and brazing. 3f Select relevant fillers, heating methods for given application.	welding. 3.5 Introduction to soldering and brazing Process. 3.6 Fillers, heating methods & applications.	
4. Machining Operations	4a. Classify lathe machines. 4b. Describe with sketches the procedure of performing the given lathe machine operation on a job. 4c. Identify proper drill for particular application. 4d. Classify drilling machines. 4e. Describe with sketches the procedure of performing the given Drilling machine operation on a job. 4f. Describe with sketches to measure cutting speed, feed and depth of cut for the given job in turning and drilling operations. 4g. Describe with sketches the working of Shaping, Planning and Slotting Machine. 4h. Compare Shaping, Planning and Slotting Machine.	4.1 Lathe Machines - Introduction, classification, Centre lathe and its details. 4.2 Different lathe operations like facing, plain turning, taper turning, thread cutting, chamfering, grooving, knurling. 4.3 Lathe accessories and its attachments. 4.4 Drilling Machine: Introduction, twist drill nomenclature, Classification. 4.5 Working principle & applications of drilling machine, like portable, sensitive, upright, radial, gang, multiple spindle etc, Automatic drillers & turret drilling machine. 4.6 Cutting speed and feed of different operations performed on drilling machines like drilling, reaming, boring, counter sinking, counter boring, spot facing. 4.7 Shaping, Planning and Slotting Machine: Introduction, Elements of shaping, slotting & planning machine. Working principles, classification of shaping, slotting & planning machine, Stroke length and its adjustment. Comparison between them.	12
5. Press Working and Forming Processes	5a. Classify operations of press machine. 5b. Select the relevant forming processes for the given component with justification. 5c. Identify the point of	5.1 Press Working – Introduction, Classification, Press operations like Punching / Piercing, Blanking, Notching and Lancing. 5.2 Forming Operations - Bending and Drawing. 5.3 Drop Forging - Introduction to forging, Upset forging, Press	06

	difference between forging, rolling and extrusion process with justification and sketches. 5d. Compare Open and Close die forging operation. 5e. Describe with sketches the extrusion process for given application.	forging, Open die and Closed die forging operations. 5.4 Rolling - Principle of Rolling, Hot and Cold Rolling, Types and applications of Rolling Mill. 5.5 Extrusion - Direct and Indirect Extrusion, Advantages and Disadvantages, Applications of extrusion process.	
6. Casting Process	6a. Describe the basic steps in making pattern. 6b. Design a pattern for the given job. 6c. Design a mould for the given job. 6d. Describe various moulding methods. 6e. Select the relevant furnace for the given raw material with justifications. 6f. Identify various casting defects their causes and remedies. 6g. Compare Hot chamber and cold chamber die casting.	6.1 Pattern making - Basic steps in making pattern. 6.2 Pattern - types, materials, tools and allowances. 6.3 Color coding of patterns. 6.4 Moulding: Types of moulding sands, properties of sand, moulding methods, cores and core prints, elements of gating system, bench moulding, floor moulding, pit moulding, machine moulding. 6.5 Casting - Furnaces: Construction and working of cupola furnace, electric arc furnace. - Methods & applications of - Centrifugal casting, shell moulding, investment casting, Casting defects - Causes & remedies. 6.6 Hot chamber and cold chamber die casting, Die casting defects - Causes & remedies. 6.7 Safety practices and precautions in foundry shop.	10
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Collect information of recent advancement in manufacturing processes, machine tools and their specifications/ manufacturer and application in the industries.	1. Fundamentals of Machining	02
2	Collect information of cutting fluid and cutting tool materials used in manufacturing industry and their application.	2. Cutting Fluid and Tool Materials	02
3	Perform one simple job on TIG / MIG welding setup or prepare report on visit to TIG / MIG welding shop.	3. Metal Joining	04

		Process	
4	Perform one turning job on lathe containing the operations like plain turning, step turning, taper turning, grooving, knurling and chamfering. • Read and interpret job drawing • Raw material size – Bar dia. 40 to 50 mm, length 80 to 100mm. • Set the tool and select the cutting parameters for machining operations • Inspect various dimensions of jobs by using measuring instruments.	4. Machining Operations	06
5	Perform job with drilling, reaming, tapping and countersinking operation as per given drawing.	4. Machining Operations	04
6	Perform one composite job containing the operations on Shaper/ Planer/ Slotter machine.	4. Machining Operations	04
7	Visit an industry where the operation like drop forging, rolling and extrusion are carried out. Collect information on types of these machines, their specification and observe various activities performed and characteristic of output product.	5. Press Working and Forming Processes	02
8	Produce a wooden solid pattern and mould as per given drawing.	6. Casting Process	08
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Fundamentals of Machining	02(02)	03(00)	00(00)	05(02)
2	Cutting Fluid & Tool Materials	02(00)	00(03)	06(03)	08(06)
3	Metal Joining processes	02(00)	06(03)	03(03)	11(06)
4	Machining Operations	00(02)	11(03)	06(06)	17(11)
5	Press Working and Forming Processes	02(02)	03(03)	03(00)	08(05)
6	Casting process	02(00)	03(03)	06(03)	11(06)
	Total	10(06)	26(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	2	R	2	3	R	2	4	U	2	5	R	2	6	R	2	6/9
2	1	U	3	3	U	3	3	U	3	2	U	3	2	A	3				3/5
3	3	A	3	4	U	3	4	U	3	3	U	3	3	A	3				3/5
4	4	U	3	4	A	3	4	A	3	4	U	3	5	U	3				3/5
5	5	U	3	5	A	3	6	U	3	6	U	3	6	A	3				3/5
6	2	A	6	6	A	6	4	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Job work, Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Job work, Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Jobs, Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3,4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Job drawing, selection of equipment , writing procedure, precautions etc.	10
2	Performance	20
3	Skill	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	3	3	-	3	3	3
2	3	-	-	3	3	-	3	3	3
3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3
5	3	3	-	3	3	-	3	3	3
6	3	3	3	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Workshop Technology (Vol. – I and II)	B. S. Raghuvanshi. Dhanpat Rai & co. pvt. Ltd., New Delhi	10:0470534915
2	Elements of Workshop Technology Vol. II	S. K. Hazara Chaudhary. Media Promoters & Publishers.	0-210-98173-3
3	Production Technology	R.K. Jain & S.C. Gupta. Khanna Publishers.	978-0534934293
4	A Text Book of Foundry Technology	O. P. Khanna, Dhanpat Rai & co. pvt. Ltd., New Delhi	9788189928346
5	Manufacturing Science and Technology (Vol.-I,II& III)	Suresh Dalela. Umesh Publication	81-7611-179-1

6	Workshop Technology (Vol. – I and II)	H. S. Bawa, McGraw- Hill Education, New Delhi	13:EBK0009651
7	Workshop Technology Part – I and II	Chapman W., Taylor and Francis, New Delhi	13:9780415503020
8	Manufacturing Processes	Begeman, Myron L. Amstead, B.H. John Wiley & Sons Inc.	0471062405
9	Fundamental of metal cutting and machine tools	B. L. Juneja, G.S.Sekhon, NitinNew Age International Pvt Ltd Publishers, 2008	10: 8122414672 13: 978-8122414677

❖ **E-REFERENCES:**

- <http://nptel.ac.in> , access on 23rd March 2021.
- www.basicmechanicalengineering.com/lathe-machine-operations-basic-turning- , access on 23rd March 2021
- www.mechengg.net/2016/operation-performed-on-shaping-machine.html , access on 23rd March 2021
- www.protolabs.com/injection-molding/plastic-injection-molding/ , access on 23rd March 2021
- www.thelibraryofmanufacturing.com/forming_basics.html , access on 23rd March 2021
- www.themetalcasting.com/casting-process.html , access on 23rd March 2021
- <https://www.youtube.com/watch?v=aC7c1NgA-7M>, access on 23rd March 2021
- <https://www.youtube.com/watch?v=is5wdVgPOkI>, access on 23rd March 2021

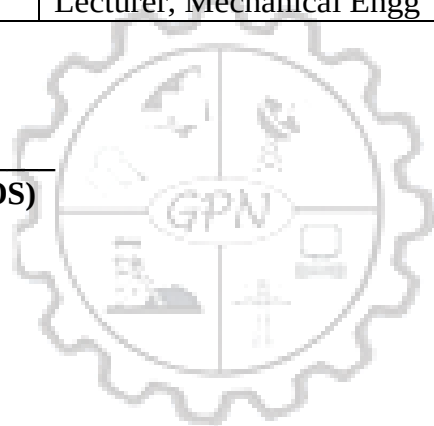
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Lathe Machine with all accessories
2. Drilling Machine pillar type with all accessories
3. TIG/MIG welding set up with suitable specification
4. Soldering machine
5. Rolling mill made for Laboratory work
6. Extruder and extrusion dies.
7. Forging Press
8. Dies and Punches for press forging
9. Shaping/ Planning/ Slotting Machines with all accessories
10. Pattern making, moulding tools and equipments as per requirement.
11. Plastic Hand Moulding Machine
12. Reheating furnace

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. P. V. Rekhade	Head of Mechanical Engineering	Government Polytechnic, Nagpur.
2	Dr. R. G. Chaudhari	Head of Mechanical Engineering	Government Polytechnic, Nagpur.
3	Mr. Y. B. Dupare	Course Expert & Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr. A. S. Bahendwar	Course Expert & Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
5	Mr. A. W. Wankhade	Workshop Superintendent,	Government Polytechnic, Nagpur.
6	Mr. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
7	Mr. G. F. Potbhare	PBOS Member & Principal	NIT Polytechnic, Nagpur
8	Mr. G. H. Dahole	MSBTE Representative & Lecturer, Mechanical Engg	Government Polytechnic, Gondia

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME251G
COURSE TITLE	: COMPUTER AIDED DRAFTING
TEACHING SCHEME	: TH: 01; TU: 00; PR: 04(CLOCK HRs.)
TOTAL CREDITS	: 03 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: --
PR. TE EXAM	: 02 HRs
PT. EXAM	: --

❖ **RATIONALE:**

Now-a-day a manual drafting is obsolete in industry. Moreover, the technology driven competitive environment in today's market is compelling design/consulting engineering firms and manufacturing companies to seek CAD conversion of their existing paper based engineering documents. Computers being the inevitable part in an engineer's life due to its inbuilt characteristics which helps him to do various task with acceleration. Using computers and Computer Aided Design and Drafting (CADD) software it is easy to create and modify a drawing which ultimately saves time. The focus of this course is to provide the students with hands-on experience in drafting and editing of an industrial production drawing using one of the commercial Computer Aided Drafting software with particular emphasis on the application of CAD software. It also may be useful to generate assembly and manufacturing drawings.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Create CAD drawing files using various draw tools bar commands.
2. Draw complex 2D Geometric figure using CAD software.
3. Create complex 2D Geometric figure using CAD software.
4. Use CAD software to dimension and write text on existing 2D geometric entities.
5. Create Isometric drawing using CAD software and insert Layers and Blocks.

6. Create an Assembly drawing from the given Detailed Drawing and Working drawing from given Assembly Drawing using CADD software.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. CAD Drawing Basics	1a. Describe various CAD Software use in drafting. 1b. Describe the AutoCAD workspace and interface given. 1c. Use of user coordinate System and world coordinate System. 1d. Identify components of CAD screen given. 1e. Describe the various given procedures of object selection methods. 1f. Illustrate the process of Open, save, close, new and given drawings or templates.	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Software for CAD. 1.2 Getting acquainted with CAD, Starting CAD and CAD screen layout, drawing area, menu and toolbars, status bar. 1.3 Co-ordinate System- Cartesian and Polar, Absolute, Relative mode, UCS, WCS. 1.4 CAD initial setting commands – Snap, Grid, Ortho, Limits, Units, scale, Object Tracking. 1.5 Object Selection Methods – Picking, Window, Crossing, Fence, last and previous. 1.6 Opening, saving and closing a new and existing drawing or template.	02
2. Two Dimensions (2D) Drawing	2a. Describe the given 2D drafting setup to create 2D drawing. 2b. Identify and select proper draw commands for 2D drawing. 2c. Describe the given various viewing commands to see the object in different views.	2.1 Drafting set-up- units, angle, area, coordinate system, limits, grid, object snap, line type and line weight. 2.2 Draw commands- Drawing line, ployline, spine, rectangles, polygons creating construction lines, creating rays, Drawing circles, arcs, ellipses, Donuts, placing points, changing point style, text. Creating two dimensional drawings using draw commands, 2.3 Viewing your drawing- zoom, pan, window, Arial view, viewport, undoing and redoing action, save and exit.	03

3. Edit and Modify Commands	3a. Illustrate the 2D drawing with various modify commands 3b. Illustrate the procedure to Use various editing commands	3.1 Modify Commands – Erase, Trim, Extend, Copy, Mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode, align. 3.2 Grip Editing- Move, Copy, Stretch Understanding objects selection basic.	03
4. Dimensioning, Text and Plot Commands.	4a. Identify various dimensioning Commands use for in particular dimension. 4b. Create text on given 2D diagram. 4c. Illustrate the procedure to Plot given 2D drawing using proper plotting parameters.	4.1 Dimensioning commands- Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 4.2 Text commands- dtext, mtext commands. 4.3 Plotting a drawing: paper space, model space, creating table, plot commands.	02
5. Isometric Drawings, Layer and Block.	5a. Create isometric Drawing. 5b. Create isometric object from given orthographic views. Environment. 5c. Create user define dimension and test styles for a given Isometric drawing. 5d. Describe the procedure to draw Isometric drawing. 5e. Use layers for 2D drawing. 5f. Create and modify blocks for given 2D diagram.	5.1 Isometric drafting mode – Isogrid, Isoplane, Ployline, Isocircle. Orientation of crosshairs, isotop, isoright and isoleft 5.2 Dimensioning Isometric drawings, Drawing isometric circles- set isoplane, use ellipse-isocircle 5.3 Text writing on Isometric drawing. Text-oblique, angle, rotation angle, style, dynamic text. 5.4 Creating isometric drawing. 5.5 Layer, Layer properties and applications. 5.6 Blocks – create modify and use in same file and in another file.	03
6. Assembly & Details Drawing by CAD	6a. Describe the procedure to create customized template. 6b. Create Assembly drawing from given Details Drawing. 6c. Create Working drawing from given Assembly drawing.	6.1 Creating new drawing with template. 6.2 Details to Assembly and Assembly to Details drawing: Basic principles of process of assembly and dismantling process. 6.3 Draw Details to Assembly and Assembly to Details drawing of any mechanical components like - (i) Joint – Universal joint / Knuckle joint	03

		(ii) Couplings – Universal couplings / Oldham's Coupling, (iii) Bearing – Foot Step Bearing / Pedestal Bearing (iv) Tool Post – Lathe (Including Square tool post), shaper (v) Screw Jack (vi) Machine vice / Pipe Vice Note: Select any one mechanical Component from above.	
Total Hrs.			16

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify and locate components of CAD classic screen by creating a new drawing.	1. CAD Drawing Basics	06
2	Draw a line diagram using absolute coordinate method.	2. Two Dimensions (2D) Drawing	08
3	Draw a line diagram using relative coordinate and relative polar coordinate method.		08
4	Create a 2D diagram using Draw and Modify commands. (Any one mechanical component like gear, pulley, bearing etc. may be selected)	3. Edit and Modify Commands	08
5	Apply the different types of dimension style and suitable Text on previously saved Mechanical Components 2D Diagram file in Practical no. 4	4. Dimensioning, Text and Plot Commands.	08
6	Create isometric drawing of given mechanical component.	5. Isometric Drawing, Layer and Block.	08
7	Create the customized template by using various Layer command and Draw 2D Drawing for Block save it and insert on other drawing sheet.		08
8	Use the CADD software to draw an Assembly drawing from the given details drawing showing conventional representations. Plot the same Assembly Drawing on A2/A3 size the customized template with title block and institute logo	6. Assembly & Working Drawing by CAD	10
Total Hrs.			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
NIL					

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Options
NIL							



❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Class Room Assignments		Assignments	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Using drafting setup /aids	10
2	Drawing diagrams of 2D or Isometric given figure	20
3	Dimensioning figure	10
4	Viva- voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	--	--	3	3	3	3	3	3
2	3	--	3	3	3	3	3	3	3
3	3	--	3	--	--	3	3	3	3
4	3	--	--	3	3	3	3	3	3
5	3	--	3	3	3	3	3	3	3
6	3	--	--	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

Sr. No.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Auto CAD 2002 Bible	Ellen Finkelstein, IDG Books India(P) Ltd., First Edition, 2001	81-265-0233-9
2	Auto CAD 2016 and Auto CAD LT 2016	Donnie Glad felter, John Wiley and Sons. Inc. Indian, First Edition, 2016	978-1-119-05955-4
3	AUTO CAD IN 3D	FrankJ. Johnson, McGraw Hill Inc., New Delhi, First Edition, 1992	0-07-112653-8
4	Mastering Auto CAD13	George Omura, BPB Publication, New Delhi, First Edition, 1997	81-7029-785-0
5	Engineering Drawing	N.D.Bhatt, Charotaar Publishing House Pvt. Ltd., Anand, Gujrat, 51th Edition, 2012	978-93-80358-55-0

6	A text book of Engineering Drawing	P.J.Shah, S.Chand and Co.Ltd., New Delhi, First Edition, 2008	81-219-2964-4
7	Engineering Drawing with introduction to Auto CAD	Dhananjay A Jolhe, Tata Mc Graw-Hill Co.Ltd., New Delhi, 2 nd Edition, 2008	978-0-07-064837-1
8	Auto CAD 2016 exercise workbook for windows	Cheryl R. Shrock and Steve Heather, Industrial Press Inc. South Norwalk, USA, First Edition, 2016	978-0-8311-3518-8

❖ E-REFERENCES:

- http://www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm, accessed on 25th January, 2022
- <http://www.cadlearning.com/courses/autocad-mechanical-training-tutorials/>, accessed on 25th January, 2022
- <http://www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf>, accessed on 27th January, 2022
- https://www.youtube.com/watch?v=yruPUj_61bw, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=Nv8skZZcUlw>, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=Lz6piHlBn7g>, accessed on 27th January, 2022
- <http://www.cad-training-course.com> Accessed on 28th January 2022
- <http://www.au.autodesk.com/au-online/overview> accessed on 28th January 2022
- <https://www.youtube.com/watch?v=xqul8gedwbs> accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=JTOP6TV4MVW> accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=x&X25Xpa07o>, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=Si93Y36tUmY>, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=D8dPWKjkhEo>, accessed on 27th January, 2022

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:

1. CPU with Intel(R) Core(TM) i3 processor or higher latest version
2. A color monitors with highest 32bit/64 bit color display and with screen resolution 1024 by 768 pixels.
3. A scroll mouse.
4. Laser printer
5. Windows-7 operating system or latest operating system
6. Any one open source Auto CAD software at AICTE website
- 7.

❖ LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1	Prof. P. V. Rekhade	Head of Mechanical Engineering (Shift – First)	Government Polytechnic, Nagpur.
2	Dr. R. G. Choudhari	Head of Mechanical Engineering (Shift – Second)	Government Polytechnic Nagpur
3	Prof. N. E. Pise	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic Nagpur

4	Mr. S. B. Bambole	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic Nagpur
5	Dr. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G. F. Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE Representative & Lecturer in Mechanical Engg	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME205G
COURSE TITLE	: FLUID POWER
TEACHING SCHEME	: TH:03;TU:00;PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

Fluid power is the use of fluids under pressure to generate, control, and transmit power. Fluid Power is a traditional subject. This course introduces Fluid Mechanics and machines establishing its relevance in Mechanical Engineering. It deals with fundamental concepts and principles in hydro kinematics, kinematics, hydrodynamics, hydraulics and their application in fluid mechanics problems.

This course also covers the hydraulic pumps such as Centrifugal pump, Submersible pump and Reciprocating pump, which are generally used for various pressure and volume flow applications. Their maximum pressure is limited to 250-300 psi (1.7 - 2.0 MPa). These types of pump are primarily used for transporting fluids from one location to another.

This course also covers the Hydraulic turbines which are the prime movers that convert the energy of the falling water into a rotational mechanical energy and consequently to an electric energy through the use of the generators that are connected to the turbines.

This course also covers the Flow through pipes, which is necessary for the designing of Piping System for the fluid flow.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply fundamental concepts of fluid mechanics and various application of fluid flow.
2. Apply principles of Fluid Machine's and recommended it for particular application.

3. Measurement of characteristics using flow and pressure measuring device.
4. Analysed the energy available at input level for developing the power
5. Operate various hydraulic machines and interpret its result.
6. Analysis of operational characteristics by performing the operations on Centrifugal and Reciprocating pump.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Properties of Fluid and Pressure Measurement	1a. Describe the various given terms related to properties of fluid. 1b. Clarify terms related to vapour pressure. 1c. Describe the process of using different Manometers and pressure Gauge to measure pressure of fluid in pipes. 1d. Calculate pressure by using manometers. Bourdon Tube Pressure Gauge. 1e. Describe total pressure and centre of pressure.	1.1 Density, Specific gravity, viscosity, Newton's law of viscosity Types of fluids.(Numerical Problem based on it.) 1.2 Surface tension, Capillarity, Compressibility, Vapour Pressure and Cavitations. 1.3 Pressure measurement, Pascal's law, Pressure head, Concept of measurement of pressure 1.4 Measuring devices of Pressure of the fluid, Manometer and mechanical gauges (Numerical based on it.) 1.5 Total Pressure and Centre of pressure on Horizontal, Vertical and Inclined Plane surface. Calculate pressure of liquid on Submerged body. (Numerical based on it.)	07
2. Fundamentals of Fluid Flow	2a. Describe the given types of fluid flow. 2b. Identify and differentiate the given types of fluid flow pattern. 2c. Apply continuity equation to calculate velocity and discharge of liquid. 2d. Classify the given types of Orifice and Calculate the coefficient of velocity, coefficient	2.1 Kinematics of flow : Types of fluid flows 2.2 Flow Patterns : Types of flow lines, Rate of flow or discharge, Continuity Equation. 2.3 Fluid Dynamics : Different types of heads of liquid in motion, Bernoulli's equation for real fluid, Practical Application of Bernoulli's equation, (Numerical based on it.) 2.4 Orifice - Its Classification, flow through orifices, Hydraulic coefficients.	07

	of contraction , coefficient of discharge.		
3. Flow Through Pipes	3a. State laws of friction for laminar and turbulent flow. 3b. Calculate Major and minor losses in pipes. 3c. Darcy's- Weibach Equation and Chezy's Equation for frictional losses in pipes. 3d. Describe total gradient and hydraulic gradient. 3e. Describe water hammer in pipes.	3.1 Loss of Energy (or Head) in the pipe 3.2 Major Energy losses i.e. Darcy's- Weibach equation and Chezy's equation for frictional losses in pipes. 3.3 Minor energy losses (Numerical based on it.) 3.4 Hydraulic gradient line and total energy line 3.5 Water Hammer in Pipes.	06
4. Impact of Jets	4a. Describe the impact of jet on the basis Stationary plates. 4b. Describe the impact of jet on the basis moving plates.	4.1 Force exerted by the jet on a stationary plate when the a) plate is vertical to the jet b) Plate is inclined to jet c) plate is curved 4.2 Force exerted by the jet on a moving plate when the a) plate is vertical to the jet b) Plate is inclined to jet c) plate is curved	04
5. Hydraulic Turbines	5a. Draw general layout of Hydroelectric power plant. 5b. Classify the Hydraulics turbine. 5c. Describe various Component and working of hydraulic turbines. 5d. Describe the Construction and working of Impulse and reaction turbine. 5e. List function of draft tube in hydraulic turbines. 5f. Clarify the concept of cavitations in turbine and specific speed.	5.1 General Layout of hydroelectric power plant, surge tank and its need. 5.2 Head and efficiency of hydraulic Turbines. 5.3 Classification of hydraulic Turbines and their applications. 5.4 Construction, Working principle and Components of a) Impulse Turbine b) Reaction Turbine. 5.5 Draft tubes: Its types, construction and function. 5.6 Selection of Hydraulic Turbine 5.7 Concept of Cavitation in turbines and specific speed. (Simple Numerical based on it.)	12
6. Pumps	6a. Describe working of Centrifugal pump. 6b. Classify given types	6.1 Centrifugal Pump: Classification, Construction, principle of Working. 6.2 Types of casings and impellers.	12

	of casing and impellers. 6c. Describe centrifugal pumps efficiencies, Heads, Work done. 6d. Describe Submersible pumps and jet pump. 6e. Describe the Working principle of reciprocating pump and state the importance of air vessels.	6.3 Definition of Heads and efficiencies of centrifugal pump. Specific speed, Net Positive Suction Head (NPSH), cavitation, Priming of a centrifugal pump. 6.4 Pumps in series and parallel, Submersible pumps and jet pump. Various heads, Efficiencies. 6.5 Reciprocating Pump: Construction, working principle and applications of single and double acting reciprocating pumps. Slip, Cavitation and separation. Use of Air Vessels.(Simple Numerical based on it.)	
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Measurement of pressure by using different pressure measuring devices.	1. Properties of fluid.	02
2	Determine the sum of pressure energy, kinetic energy and potential energy at section of conduit is constant to Verify Bernoulli's Theorem.	2. Fundamentals of Fluid Flow	02
3	Determine coefficient of discharge for Venturimeter.	2. Fundamentals of Fluid Flow	02
4	Determine coefficient of discharge for Orifice meter.	2. Fundamentals of Fluid Flow	02
5	Determine minor friction loss for flow in pipes Fittings	3. Flow Through Pipes	04
6	Analysis of Impact of Jet.(All conditions)	4. Impact of jet	04
7	Determine overall efficiency of Pelton Turbine.	5. Hydraulic Turbine	04
8	Determine overall efficiency of Francis Turbine.	5. Hydraulic Turbine	04
9	Determine overall efficiency of Centrifugal& plot its operating characteristics.	6. Pumps	04
10	Determine overall efficiency of Reciprocating Pump.	6. Pumps	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Properties of fluid	02(00)	03(03)	03(03)	08(06)
2	Fundamentals of Fluid Flow	02(00)	03(03)	03(00)	08(03)
3	Flow Through Pipes	02(02)	03(03)	03(00)	08(05)
4	Impact of Jets	02(00)	03(00)	03(03)	08(03)
5	Hydraulic Turbines	02(02)	06(03)	06(03)	14(08)
6	Pumps	02(02)	06(03)	06(06)	14(11)
	Total	12(06)	24(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	3	R	2	5	R	2	6	R	2										
2	1	U	3	1	A	3	2	U	3	1	U	3	1	A	3				3/5
3	2	A	3	3	U	3	3	A	3	2	U	3	3	U	3				3/5
4	4	A	3	4	U	3	5	A	3	4	A	3	5	A	3				3/5
5	5	A	3	6	A	3	6	A	3	5	U	3	6	U	3				3/5
6	5	U	6	6	U	6	6	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipments, Drawing sketch of Apparatus, Writing Procedure, Observation Tables.etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	3	3
2	3	3	3	-	3	-	-	3	-
3	3	3	3	2	-	-	-	-	3
4	3	3	3	2	3	-	3	3	3
5	3	3	-	-	3	2	-	3	3
6	3	3	3	-	3	2	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Text Book of Fluid Mechanics and Hydraulic Machines	R. K. Bansal Laxmi Publication (P)ltd, Revised Ninth Edition, 2017.	978-81-318-0815-3
2	A Text Book of Fluid Mechanics and Hydraulic Machines part-1	R.K.Bansal S.Chand& company pvt.ltd Revised sixth Edition, 2014	978-81-219-1667-7
3	A Text Book Fluid Mech. Hydraulic Machines (in Si Units)	R.K. Rajput ; S. Chand Publishing, New Delhi	9789385401374
4	Hydraulics, Fluid Mechanics & Hydraulic Machines	R.S. Khurmi ; S. Chand Publishing, New Delhi	988121901628

5	A Text Book of Fluid Mechanics	Frank M. White ; McGraw-Hill; Fourth edition (28 May 2019)	9353166217
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❖ **E-REFERENCES:**

- <https://www.teachengineering.org>
- <https://people.utm.my>
- <https://link.springer.com>
- <https://fluidpowerjournal.com>
- <https://www.researchgate.net>
- <https://www.sciencedirect.com>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Piezometer, Differential U-Tube manometer, Bourdon pressure Gauge, stop watch, weights.
2. Hydraulic Bench Containing Piezometer, scale, Measuring tank, valve.
3. Test Rig of flow through Pipe for measuring losses in different pipe.
4. Experimental setup of determination of Darcy coefficient factor in pipe of three different materials
5. Experimental set up of discharge of Orifice meter and Venturimeter.
6. Experimental setup for Proving Bernoulli's Theorem.
7. Test rig of Pelton Wheel.
8. Test Rig of Francis Turbine.
9. Test Rig of Centrifugal Pump.
10. Test Rig of Reciprocating Pump.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri - P.V.Rekhade	Head, Dept. of Mechanical Engg.	Government Polytechnic Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Shri.N.S. Pawar	Course Expert & Lecturer (Selection Grade), Dept. of Mechanical Engg.	Government Polytechnic Nagpur
4	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
6	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	:	DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	:	PROGRAMME CORE COURSE
COURSE CODE	:	ME206G
COURSE TITLE	:	ENERGY CONVERSION ^s
TEACHING SCHEME	:	TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	:	04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH.TEE	:	03 HRs.
PR.TEE	:	02 HRs.
PT.	:	01 HR.

❖ RATIONALE:

Energy Conversion equipment finds applications in almost all sectors of industry due to automation and in automobile fields due to increase in transportation of goods & people day by day, also energy conversion equipments are one of the major contributors of air pollution. Hence, it is necessary to understand constructional, working & thermodynamic features of energy conversion equipments as Diploma technicians deal with working, testing and maintenance of it. Therefore, Energy Conversion course has been considered highly relevant for mechanical technician.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different components of I.C. engines, air compressor, gas turbine and jet engine.
2. Develop ability to dismantle and assemble of I.C. Engine and its components.
3. Interpret different system in IC Engine, Gas Turbine and Air-compressor
4. Test the performance of I.C. Engine.
5. Maintain reciprocating air compressor by analyzing its performance.
6. Identify different components of Refrigeration and Air-conditioning.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to I. C. Engine	1a. Classify I.C. engine on given basis. 1b. State the applications of I.C. engines 1c. Describe the functions of various parts of IC engines. 1d. Describe with sketches working of 4- stroke engines. 1e. Compare IC engine on given basis. 1f. Calculate performance of given engine based on corresponding air standard cycles.	1.1 Classification , applications of I.C. engine, Different parts of I.C. engines and their functions, 1.2 Basic engine terminology: (Bore, stroke, TDC, BDC, Clearance volume, Swept volume, Compression ratio, Piston speed and Cut off ratio) 1.3 Power Cycles: Working of 4 stroke engines (Otto cycle, Diesel cycle), 1.4 Valve timing diagram of 4-stroke Otto and Diesel engines. 1.5 Comparison: (Four stroke and two stroke, S.I. and C.I. engines) 1.6 Calculate Air standard efficiency of Diesel and Otto cycles.	08
2. I. C. Engine Ignition Systems	2a. Describe the given fuel supply / injection system of S.I system with neat sketch. 2b. Compare battery and magneto ignition system on given points. 2c. Describe detonation and pre-ignition. 2d. Describe the given fuel supply / injection system of C.I system with neat sketch. 2e. Advantages of supercharging over turbo-charging.	Spark Ignition system: 2.1 Carburetion: Fuel supply system, Function of carburetor, air fuel mixture and fuel requirements of S.I. engines., Concept of Simple carburetor and its drawback, Petrol injection system, Port and Throttle MPFI system, Electronic fuel injection - D-MPFI system , L-MPFI system 2.2 Ignition: Requirements for ignition, Battery and Magneto ignition system and its comparison, Concept of electronic ignition systems, Concept of digital twin spark ignition Engine. (DTSI Engine) 2.3 Concepts of pre-ignition and detonation. Compression Ignition system: 2.4 Fuel injection: Function of fuel injection system, types of fuel injection systems, working of	10

		fuel injector, fuel pump -Bosh type only, CRDI concept, need of electronic injection system 2.5 Concept, advantages and applications of supercharging and turbo-charging	
3. I.C. Engine Cooling and Lubrication	3a. Classify cooling system . 3b. State the need and application of given cooling system and lubricating system. 3c. Compare natural and forced circulation. 3d. Compare different cooling system. 3e. Describe different types of coolants used in IC engine. 3f. Illustrate use of cooling system, lubrication system and lubricant additives.	3.1 Cooling: - Need of cooling of an IC. Engine, Types of cooling system. 3.2 Air cooling, its applications and advantages. 3.3 Water / liquid cooling(natural and forced circulation of water), application and advantages 3.4 Comparison between water and air cooling. 3.5 Different types of coolants. 3.6 Need of lubrication in an I.C. engine. Functions of lubrication system. Types of lubrication system and its application, splash, pressure and charge lubrication system, Lubricant additives and their function	06
4. I.C. Engine Testing and Emission Control	4a. State the procedure to calculate the performance parameter of the given I.C. Engine. 4b. Describe the procedure to calculate indicated power of the given engine using Morse Test for given engine. 4c. Describe pollutants and its effects on environment. 4d. Describe BS VI norms for given engine. 4e. Describe various catalytic converter.	4.1 I.C. Engine testing: Need of testing, I.P, B.P, BSFC, mean effective pressure, compression ratio. Thermal and mechanical efficiency. Heat balance sheet, Morse test. 4.2 Calculate I.P., B. P., Thermal efficiency, Mechanical efficiency and heat balance sheet. 4.3 Pollutants in exhaust emissions of petrol and diesel engines, their effects on environment, Effect of air – fuel ratio on exhaust emission, 4.4 Bharat stage VI norms, 4.5 Catalytic converter and SCR Selective Catalytic Reduction	08
5. Study of Air Compressors and Gas Turbine	5a. Classify air compressor on given basis. 5b. Interpret multistage of compressor and concept of Inter cooling and after cooling and its effects on	5.1 Introduction to Air Compressor: Use of compressed air, Classification of air compressor, Air compressor terminology (Pressure ratio, Compressor capacity, F.A.D., Swept	08

	efficiency. 5c. Calculate given efficiency and power of Air compressor & analyze P-V diagram with inter-cooling. 5d. Classify gas Turbine. 5e. Compare close cycle and open cycle gas turbine.	volume) 5.2 Reciprocating Air Compressor- Construction and working of single and two stage compressors. Volumetric, Isothermal and Mechanical efficiency. Advantages of multi-staging, concept of Inter cooling and after cooling. 5.3 Numerical to calculate volumetric, mechanical and isothermal efficiency, power required. (No derivation) 5.4 Classification and applications of gas turbine. 5.5 Working of Constant pressure, Closed cycle and open cycle gas turbines, and their comparison, Brayton cycle	
6. Study of Refrigeration and Air Conditioning	6a. Describe vapour compression refrigeration cycles. 6b. Identify different components of Vapour absorption system with justification. 6c. Describe given psychometric processes with neat sketch. 6d. Describe Construction and working of split air conditioner.	6.1 Refrigeration ---- Tonnes of Refrigeration, coefficient of performance. Vapour compression system, Vapour compression refrigeration cycles. Sub-cooling and Superheating Representation on P-H, T-S diagrams. Basic components of Vapour Compression Cycle, their function and location 6.2 Simple vapour absorption refrigeration system. Applications- Water cooler, Domestic refrigerator, Ice plant & cold storage 6.3 Psychrometry: Properties of moist air-DBT, WBT, DPT, Specific humidity and relative humidity, Dalton's law of partial pressure psychrometric chart & psychrometric processes-sensible heating/cooling, humidification, Dehumidification, evaporative cooling. 6.4 Air conditioning systems : Definition and classification of Air conditioning Systems.	08

		Construction and working of split air conditioner.	
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Observing dismantling & assembly of four stroke C.I and S.I. engine , locate and identify various I.C. engine parts and draw its neat sketches.	1. Introduction to I. C. Engine	02
2	Perform dismantling & assembly of Simple carburettor / Fuel injection pump (Bosch type).	2. I. C. Engine ignition systems	02
3	Re-create or Observe different parts of cooling & lubrication system, identify its component and draw its neat sketches.	3. I.C. Engine Cooling and lubrication	04
4	Conduct test on I.C. engine to prepare heat balance sheet .	4. I.C. engine testing and Emission control	04
5	Conduct Morse Test on multi cylinder petrol engine to determine its indicated power and mechanical efficiency.	4. I.C. engine testing and Emission control	04
6	Conduct test on two-stage reciprocating air compressor to determine its volumetric efficiency.	5. Study of Air Compressors and Gas turbine	04
7	Conduct trial on Vapour Compression refrigeration test rig to determine C.O.P.	6. Study of Refrigeration and Air Conditioning	04
8	Identify the components of window air conditioner and trace the flow of refrigerant through various components.	6. Study of Refrigeration and Air Conditioning	04
9	Prepare a report on visit to engine maintenance Workshop.	All Units	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to I. C. Engine	02(00)	05(03)	03(03)	10(06)
2	I. C. Engine Ignition Systems	02(00)	06(02)	03(06)	11(08)
3	I.C.Engine Cooling and Lubrication	02(00)	03(03)	03(03)	08(06)
4	I.C. engine testing and Emission Control	02(00)	06(00)	06(06)	14(06)
5	Air Compressors and Gas Turbine	02(02)	03(03)	06(03)	11(08)
6	Refrigeration and Air Conditioning	00(02)	03(00)	03(00)	06(02)
	Total	10(04)	26(11)	24(21)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	1	U	2	2	R	2	3	R	2	4	R	2	5	R	2	6/9
	2	U	2	5	R	2	6	R	2										
2	1	U	3	1	A	3	2	U	3	1	U	3	1	A	3				3/5
3	2	U	3	2	A	3	3	U	3	2	A	3	2	A	3				3/5
4	3	A	3	4	A	3	5	U	3	3	U	3	3	A	3				3/5
5	6	U	3	6	A	3	4	A	3	5	U	3	5	A	3				3/5
6	4	U	6	5	A	6	4	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max.Marks
1	Drawing diagrams of various parts of IC engines, selection of equipment & tools, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	3	3
2	3	2	1	-	3	-	-	3	3
3	3	2	-	-	3	-	2	3	3
4	3	2	-	1	3	-	2	3	-
5	3	-	1	-	3	-	2	3	3
6	3	-	-	-	-	-	2	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Internal Combustion Engine	R. P. Sharma, Dhanpat Rai Publication , 2010	9788189928469
2	A Course in Internal Combustion Engine (SI Units)	V.M. Domkundwar, Dhanpat Rai & Co. Ltd. Publication, Fourth edition,2014	978-81-7700-116-7
3	Internal Combustion Engine	V. Ganeshan, Mcgraw Hill Education, 4 th Edition, 2012	13-9781259006197 10 1259006190
4	Internal Combustion Engine	H. B. Keswani, Standard Book , 4 th Edition 2003	81900893511
5	Refrigeration and Air Conditioning	Sadhu Singh, Khanna Publishing House	978-9386173089

6	Refrigeration and Air Conditioning	C P Arora, McGraw Hill	9789390385843
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❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=pqa4zCo4erY>, accessed on 23rd August, 2021
- <https://www.youtube.com/watch?v=s2WGFELXPN> accessed on 23rd August, 2021
- automobiletechinfo.blogspot.com/.../dtsi-digital-twin-spark-ignition-system.html accessed on 23rd August, 2021
- <https://www.youtube.com/watch?v=H2J0lSTYVhQ> accessed on 23rd August, 2021
- <https://www.youtube.com/watch?v=H2J0lSTYVhQ> accessed on 23rd August, 2021
- www.cpcb.nic.in/Vehicular_Exhaust.php accessed on 23rd August, 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Test rig of four stroke diesel engine
2. Test Rig of Two stage reciprocating compressor Working Model of fuel pump, injector & carburetor
3. Working Model of C.I. engine
4. Demonstration Model & chart of cooling , lubrication & fuel supply system of I. C. engine.

❖ **LIST OF EXPERTS AND TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. P. V. Rekhade	HOD (Mechanical Engineering)	Government Polytechnic, Nagpur.
2	Dr. R. G. Choudhari	HOD (Mechanical Engineering)	Government Polytechnic, Nagpur.
3	Mr. S. R. Kaduskar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr. S. B. Bambole	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G. F. Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Dr. G. H. Dahole	MSBTE Representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME207G^{\$}
COURSE TITLE	: HEAT TRANSFER^{\$}
TEACHING SCHEME	: TH:03; TU: 00;PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

This course is classified under Professional Electives. The basic principles of heat transfer shall help students to solve problems related to heat transmission in the process. Heat transfer plays vital role in refrigeration, power plant engineering, automobile engineering and process industries. They are considered as most common elements that come across to mechanical engineers in different industries.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Classify convection and radiation phenomenon to different mechanical systems that affects the environment.
2. Analyze the heat transfer rate through composite slab and solve conduction problems encountered in practical field and
3. Compute the efficiency and effectiveness of fins.
4. Classify and distinguish convection phenomenon.
5. Calculate the heat flow rate between two surfaces.
6. Classify and utilize various heat exchangers in industrial/domestic applications.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Heat Transfer	1a. Classify Heat transfer and its laws 1b. State the principle of different modes of heat transfer. 1c. State various laws of Heat transfer 1d. Describe the concept of electrical analogy with heat transfer	1.1 Modes of Heat Transfer and its effect on environment and Fourier's law of Heat conduction. 1.2 Definition and Expression for thermal conductivity. 1.3 Newton's Law of cooling for convection and Stefan Boltzman's law of Radiation 1.4 Electrical Analogy with Heat Transfer and Concept of Thermal resistance	04
2. Steady State Conduction	2a. Define thermal diffusivity 2b. Calculate the heat flow rate through slab, cylinder, and sphere. 2c. State the equation for overall heat transfer coefficient for slab 2d. Describe the concept of unsteady state conduction. 2e. Differentiate between steady and unsteady state of heat conduction.	2.1 Three dimensional Fourier conduction equation in Cartesian coordinate and Concept of thermal diffusivity (no derivation) 2.2 Heat flow through single Slab and Heat flow through Composite slab (two layers) 2.3 Heat flow through hollow cylinders (single layer) and Heat flow through Sphere (single layer) 2.4 Overall Heat Transfer coefficient for slab (two layers) – definition, equation (numerical to calculate heat flow rate, overall heat transfer coefficient and temperatures on all above topics) 2.5 Concept and application of unsteady state of heat conduction.	08
3 Heat Transfer Through Fines	3a. Define various terms related to fins. 3b. State different types of fins. 3c. State the application of fins 3d. Determine the heat dissipation from various types of fins. 3e. Compute fin efficiency and fin effectiveness	3.1 Introduction – Definition, Need, Types of fins, applications 3.2 Heat transfer through finite fin 3.3 Heat transfer through fin insulated at the tip 3.4 Heat transfer through infinite long fin 3.5 Efficiency and Effectiveness of fin	08
4. Convection	4a. Describe the principle of Natural convection and force	Free (or Natural) convection 4.1 Principle of Natural convection and its applications	10

	convection 4b. Define various non dimensional numbers 4c. State the various applications of Natural convection and force convection 4d. Define Non-Dimensional number 4e. State principle of forced convection 4f. Define given non dimensional numbers for forced convection 4g. Determine the heat transfer coefficient in Natural convection and force convection 4h. Describe principle of working of combined free and force convection 4i. Compare Natural convection and force convection	4.2 Dimensionless numbers – Grashoff Number, Prandtl Number, Nusselt Number 4.3 Equations for free convection from flat plate (Numerical to calculate heat transfer coefficient and heat flow rate by using given equation) 4.4 Non Dimensional Numbers Forced convection 4.5 Principle of Forced convection and its application. 4.6 Dimensionless numbers – Reynold Number, Prandtl Number, Nusselt Number 4.7 Equations for force convection from flat plate (Simple Numerical by using given equation) 4.8 Combined free and forced convection. – Principles of working 4.9 Comparison between Natural convection and force convection	
5. Radiation	5a. Draw Electromagnetic spectrum to indicate Thermal Radiation 5b. Justify the relation between reflectivity, transitivity and absorptivity 5c. State different radiation properties 5d. Describe the concept of black body and grey body 5e. State the various laws of radiation 5f. State the effect of radiation shield on heat transfer. 5g. Calculate the heat flow rate between two surfaces.	5.1 Thermal Radiation in Electromagnetic spectrum and Radiation properties such as reflectivity, transmittivity and absorptivity, 5.2 Emissive properties – Emissive power, emissivity, monochromatic emissive power, monochromatic emissivity 5.3 Concept of Specular, diffuse Radiation, black and grey body 5.4 Laws Radiation – Planks law, Kirchoffs law, Wein Displacement law, Stefan Boltzman law 5.5 Radiation from Real surfaces 5.6 Heat exchange by Radiation between grey surfaces, 5.7 Radiation shields – effect on heat transfer (Numerical to calculate heat flow rate between two surfaces)	10
6. Heat Exchanger	6a. List the various types of heat exchangers 6b. Determine the	6.1 Introduction – Definition, classification, application 6.2 Construction and working of parallel flow, counter flow, shell	08

	LMTD and heat flow rate through various heat exchangers 6c. State the functions of condensers, radiators, cooling tower, solar appliances 6d. Interpret the use of various heat exchangers in industry or domestic appliances. 6e. Differentiate condensers and Radiators 6f. Examine solar cooker	and tube type heat exchanger 6.3 Concept of Logarithmic Mean Temperature Difference (LMTD) for parallel flow and counter flow. (Numerical to calculate LMTD, heat flow rate) 6.4 Effectiveness of heat exchanger 6.5 Condensers, Radiators and Cooling Towers – Types and its functions 6.6 Domestic Appliances – working principles and uses of Solar Cooker, Solar water heater and Solar drier.	
		TOTAL HRS	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify the different apparatus used in various modes of heat transfer.	1. Introduction to Heat transfer	04
2	Determine the thermal conductivity of a metal rod.		02
3	Determine the thermal conductivity of insulating powder.	2. Steady State Conduction.	02
4	Determine the thermal conductivity of composite walls.		02
5	Determine the heat transfer coefficient, heat flow rate, fin efficiency and effectiveness using Pin fin apparatus for free convection	3. Heat Transfer Through Fins	04
6	Determine the heat transfer coefficient, heat flow rate, fin efficiency and effectiveness using Pin fin apparatus for force convection	4. Convection	04
7	Determine the Stefan Boltzmann constant.	5. Radiation	02
8	Determine the heat transfer rate of solar radiation apparatus		02
9	Determine the LMTD and heat transfer of shell and tube heat exchanger	6. Heat Exchanger	04
10	Determine the LMTD and heat transfer of parallel flow heat exchanger		02
11	Determine the LMTD and heat transfer of counter flow heat exchanger		02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Heat transfer	02(02)	06(03)	06(03)	14(08)
2	Steady State conduction	02(00)	03(00)	06(06)	11(06)
3	Heat transfer through Fins	02(00)	03(03)	03(03)	08(06)
4	Convection	02(00)	06(03)	06(03)	14(06)
5	Radiation	02(02)	03(03)	00(00)	05(05)
6	Heat Exchanger	02(02)	03(00)	03(03)	08(05)
	Total	12(06)	24(12)	24(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	5	R	2	6	R	2										
2	1	U	3	1	U	3	2	U	3	1	U	3	1	A	3				3/5
3	2	A	3	2	A	3	3	U	3	3	U	3	3	A	3				3/5
4	4	U	3	4	U	3	5	U	3	4	U	3	4	A	3				3/5
5	5	U	3	6	U	3	6	A	3	5	U	3	6	A	3				3/5
6	1	A	6	4	A	6	2	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagrams of experiment set up, equipment, writing	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	-	3	-	-	-	-	3	3	-
2	-	3	-	-	-	-	3	3	-
3	-	3	-	-	-	3	-	3	-
4	-	3	2	-	-	3	-	3	-
5	-	3	2	-	-	3	-	3	-
6	-	3	2	-	-	3	-	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S. N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Heat and mass transfer	Prof. D.S. Kumar, S.K. Kataria	9789350142
2	Heat and mass transfer	Prof. R. K. Rajput., S Chand ,	9789385401
3	Heat and mass transfer	Arora and Domkundwar,	9788177000
4	Heat and mass transfer	S. P. Sukhatme, Melisende UK	9788173715

❖ **E-REFERENCES:**

- nptel.ac.in/courses/112101097/, accessed on 23rd August, 2022
- <https://www.youtube.com/watch?v=qa-PQOjS3zA>, accessed on 4th August, 2022

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Apparatus to determine thermal conductivity of metal rod, insulating powder and composite wall
2. Stefan Boltzmann apparatus
3. Pin fin apparatus
4. Solar flat plate collector
5. Shell and tube type, parallel flow, counter flow heat exchanger

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rehad	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	M.T. Gajbhiye	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	S.B. Bambole	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri G.H. Dahole	MSBTE Representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME208G^{\$}
COURSE TITLE	: RENEWABLE ENERGY SOURCES^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

Energy has become an important and one of the basic infrastructures for economic development of a country. Energy security is, therefore, imperative for sustained growth of economy. The oil crisis and concern for environment due to excessive use of fossil fuels have led to remarkable global efforts in harnessing alternative energy resources. World is emphasizing on the power generated by Renewable energy sources. India has set high targets of employing in renewable sources, which increases the demand of trained manpower. This course will give the knowledge of technologies related to renewable energy where Mechanical Engineering principles and products will be applicable.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Implement the technologies that are used to harness the power of solar energy
2. Recommend suitable wind mill for given location
3. Prepare the layout of Micro- hydel and tidal power systems.
4. Identify the various route to generate energy from biomass
5. Apply emerging technologies in renewable Energy to improve the energy security
6. Justify the need of Hybrid systems.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Solar Energy	1a. Justify the need of renewable energy. 1b. State the importance of solar radiation geometry in solar radiation. 1c. Describe the construction of given solar energy collectors. 1d. Justify, the selection different solar collectors for specific application. 1e. Justify, the selection PV panels .	1.1 Scenario of Renewable Energy Sources- Needs of renewable energy, advantages and limitations of renewable energy, present scenario of conventional and renewable sources. 1.2 Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry. Classification of Solar Thermal Systems 1.3 Solar Thermal Systems – Classification of Solar collectors, Flat plate collectors, Parabolic collectors, parabolic dish collector, Solar Tower, comparison between Non- Concentrating (flat plate) and concentrating collector. 1.4 Solar Applications – Solar Dryers, Solar Furnaces, Solar Distillation (Solar Still), Solar Pond and electric power plant operated by solar pond. 1.5 Photo Voltaic(PV) -Phenomenon, classification of solar Photovoltaic systems- Grid connected, Off-grid, Stand-alone systems, types of PV cells, merits and demerits and Applications of PV systems.	10
2. Wind Energy	2a. Apply various terms related to wind power to Wind turbines. 2b. Classify Wind power plant. 2c. Describe the given types of WPP. 2d. Justify the controls of WPP.	2.1 Wind Energy Basic - Power in wind- effect of wind density, angle of attack and wind speed, Betz's Law, Principle of wind energy conversion- Drag and Lift principle 2.2 Wind Power Plant (WPP) - Site selection criteria, Classification of WPP, Wind Energy conversion systems. 2.3 Wind Turbines –Types -Horizontal axis machines (HAWTs) & Vertical axis machines (VAWTs), (Construction and Working) ,	09

		concept of upwind and downwind machines. 2.4 Necessity of speed control of wind turbine, Methods of control of WPP- Yaw control, pitch control.	
3 Hydel and Tidal Power Systems	3a. Classify Hydro-Power Plants. 3b. Describe Micro Hydroelectric power plant. 3c. Draw Layout of Tidal Power plant. 3d. Analyze the prospects of Tidal Energy in India.	3.1 Classification of hydro power plants, based on head and capacity 3.2 Micro-hydro Power Plant - Layout, construction & working, site selection 3.3 Tidal Power - Principles of tidal power, components of tidal power plant, layout construction and working of single and double basin Tidal Plant 3.2 Prospects of Tidal energy power plants in INDIA	06
4. Energy From Biomass	4a. Apply basic principle of Biomass conversion to Bio-fuels. 4b. Compare Floating dome and fixed dome type of Biogas Plant. 4c. Describe construction and working of a given biogas plants. 4d. Justify the selection of biogas as a fuel in rural area.	4.1 Basic principles of Biomass conversion , Photosynthesis, Classification of Bio-Fuels- Biogas, Biodiesel, biogas generation, factors affecting bio-generation of gas. 4.2 Classification of biogas plants , advantages & disadvantages of floating dome and fixed dome type plant. 4.3 Types of biogas plants - Layout, construction and working of Gobar gas generator, Janta biogas plant, and community biogas plants 4.4 Application of Biogas in domestic, industry and vehicles	09
5. Other Forms of Renewable Energy Sources	5a. Describe the given fuel cell. 5b. Justify, the hydrogen as green fuel. 5c. Describe the given methods of hydrogen production. 5d. Justify the necessity of Hydrogen Storage.	5.1 Fuel Cells – Classification Fuels for Fuel Cells, Principle of operation of a H ₂ -O ₂ fuel cell, ion exchange membrane cell, fossil fuel cell, molten carbonate cell, Advantages and disadvantages of fuel cells, applications of fuel cells. 5.2 Hydrogen Energy Hydrogen energy-Merits of hydrogen over other fuels, Comparison of hydrogen properties with Petrol Gasoline, Methane, Methanol 5.3 Different methods of hydrogen production, Electrolysis of water-Fundamentals of Electrolysis, chemical reaction, Electrolysis	08

		Methods- Tank type Electrolizer, Bipolar Electrolyzer - description, advantages and limitations. 5.4 Hydrogen storage- Necessity and methods, their description, advantages and limitations.	
6. Renewable Energy Hybrid System	6a. Justify the need of Hybrid systems. 6b. Describe the given hybrid system with its layout. 6c. Analyze the prospects of renewable energy hybrid systems in India.	6.1 Concept and need of Hybrid Systems 6.2 Types of Hybrid System : Construction and Working of Wind – Solar, Wind- Biogas, Wind- Fuel Cell, Solar – Biogas, Solar- Fuel Cell. 6.3 Prospects of Renewable Energy Hybrid Systems in INDIA	06
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Calculate the capacity requirement for solar water heater for given application and select the solar water heater. Write report on its selection and installation.	1. Solar Energy	04
2	Assemble a solar PV system with and without battery connection		04
3	Measure wind velocity and select suitable wind mill.	2. Wind Energy	02
4	Prepare a visit report on wind power plant or Prepare a report on Wind Power Plant by observing video CD.		04
5	Prepare a visit report on Micro Hydro- electric power plants in India or Prepare a report on Micro Hydro -electric power plants by observing video CD.	3. Hydel and Tidal Power Systems	04
6	Gather information about Tidal power plants in India		02
7	Dismantle and assemble Janta bio gas plant model and state precautions for use. OR Prepare a visit report on biogas plant or Prepare a report on biogas Plant by observing video CD.	4. Energy From Biomass	04
8	Prepare detail report and give presentation in the class on any one of the following topics , i) H ₂ -O ₂ fuel cell ii) ion exchange membrane cell	5. Other forms of Renewable Energy sources	04

	iii) fossil fuel cell iv) molten carbonate cell, v) Different methods of hydrogen production vi) Hydrogen storage vii) Applications of Fuel cells.		
9	Prepare layout of Wind-Solar hybrid power systems and write a report on installation-procedure, operating procedure, power output and precautions.	6.Renewable Energy Hybrid System	04
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Solar Energy	02(02)	06(03)	06(03)	14(08)
2	Wind Energy	02(00)	03(00)	06(06)	11(06)
3	Hydel and Tidal Power Systems	02(00)	03(03)	03(03)	08(06)
4	Energy From Biomass	02(00)	06(03)	06(03)	14(06)
5	Other forms of Renewable Energy sources	02(02)	03(03)	00(00)	05(05)
6	Renewable Energy Hybrid System	02(02)	03(00)	03(03)	08(05)
	Total	12(06)	24(12)	24(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	5	R	2	6	R	2										
2	1	U	3	1	U	3	2	U	3	1	U	3	1	A	3				3/5
3	2	A	3	2	A	3	3	U	3	3	U	3	3	A	3				3/5
4	4	U	3	4	U	3	5	U	3	4	U	3	4	A	3				3/5
5	5	U	3	6	U	3	6	A	3	5	U	3	6	A	3				3/5
6	1	A	6	4	A	6	2	A	6										2/3

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3,4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Market Survey, collection of information of energy efficient equipment / luminaries. etc.	10
2	Performance	20
3	Skills and Results	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	3	3	3	3	-	3	3	-
2	3	3	3	3	3	-	3	3	-
3	3	-	-	-	3	-	-	3	-
4	3	3	3	-	3	-	-	3	-
5	3	-	-	-	3	-	-	3	-
6	3	3	3	-	3	-	-	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Non-conventional energy sources	G.D. Rai, Standard Publishers Distributors.	8186308296
2	Power Plant Engineering	Arora and Domkundwar. Dhanpat Rai & co.	0-07-084175-6
3	Solar Energy	S.P. Sukhatme. Tata McGraw-Hill Education, 1996.	0074624539
4	Fundamentals and Applications of Renewable Energy	Mehmet Kanoglu, Yunus A. Cengel & John M. Cimbala, McGraw-Hill	978-1-260-45530-4
5	Introduction to Renewable Energy	Subbiah Muthuraman, LAP Lambert Academic Publishing	9783659753510, 3659753513
6	Non-Conventional Energy Sources and Utilisation (Energy Engineering)	Er. R K Rajput, S. Chand Publishing	9788121939713

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/112105050/rn1111.pdf> accessed on 28 Feb 2022
- <http://nptel.ac.in/courses/108105058/15> accessed on 28 Feb 2022
- <https://www.youtube.com/watch?v=rnpHZWYpKDJg> accessed on 28 Feb 2022
- <https://www.energy.gov/energysaver/buying-and-making-electricity/small-wind-electric-systems>
- <http://syncrgyfiles.com/2015/04/small-scale-vs-large-scale-wind-turbines/>
- <https://www.nrel.gov/workingwithus/re-wind.html>
- <https://www.youtube.com/watch?v=JJDylOtr5yA>
- <https://www.youtube.com/watch?v=NbZepCQUQTg>
- http://nptel.ac.in/courses/108108078/pdf/chap6/teach_slides06.pdf
- [https://www.youtube.com/watch?v=JbrdUoU2j\[E](https://www.youtube.com/watch?v=JbrdUoU2j[E)
- <https://www.youtube.com/watch?v=i9yCpuIMzeO>
- <https://www.youtube.com/watch?v=DKvzVIN-sOQ>
- <https://www.bioenergyconsult.com/biomass-energy-systems/>
- <https://mnre.gov.in/bio-energy>
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- <https://www.youtube.com/watch?v=EyxWu2RVQYo>
- <https://www.youtube.com/watch?v=1gta2ICarDw>
- <https://www.youtube.com/watch?v=umvd4183vZE>
- https://www.youtube.com/watch?v=nabM5MGq_NY
- <https://www.youtube.com/watch?v=umvd4183vZE>
- https://www.youtube.com/watch?v=lB1fc_hVYwg
- <https://www.youtube.com/watch?v=28b5JrWvftg>
- <https://www.youtube.com/watch?v=NYJK9NhSSCA>
- <https://www.youtube.com/watch?v=JO0rl-MoSf8>
- <https://www.youtube.com/watch?v=PKXn5xFFpB4>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

- 1.Solar Photovoltaic Training Kit prepared by IIT, Mumbai
- 2.Mono-crystalline Solar PV module, 50Wp
- 3.Poly- crystalline Solar PV module, 50Wp
- 4.Wind Turbine 1 Kw with all accessories
- 5.Wind turbine models
- 6.Solar water heating system models
- 7.Biogas Models

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	Course Expert & HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	K.S. Thekedar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
6	Shri. G.H. Dahole	MSBTE Representative Lecturer in Mechanical Engg	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVES COURSE
COURSE CODE	: ME209G^{\$}
COURSE TITLE	: INDUSTRIAL AUTOMATION ^{\$}
TEACHING SCHEME	: TH: 03;TU:00;PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

This course is classified under Professional Electives. This course describes the basic components & principles of automation. Concept of control and production system which are commonly used in automated industry.

Automation is need of industry which leads to fulfill the changing demand of customer. Hence, this course will develop various ideas related to automation system and diagnose various real time problems in automation industry. It is very useful course for understanding the higher level knowledge in the field of Mechanical engineering.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify potential areas of industrial automation.
2. Understand the various control systems used in Automation.
3. Select suitable major control components and Material Handling system required to automate a process or an activity.
4. Diagnose the various Automatic data capture system and faults in automation.
5. Recognize various automated processes, material handling equipment and Inspection techniques during Industrial visit.

6. Select and Apply suitable automatic Inspection technique and hardware for the given application.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Automation	1a. Apply the basic concept of Automation. 1b. Select the type of automation. 1c. Obtain the basic elements. of automated system. 1d. Identify the use of various safety monitoring functions. 1e. Diagnose the various faults in automated system.	1.1 Basic Concept of Automation, Need for Automation, 1.2 Types of Automated Manufacturing systems a. Fixed, Programmable, Flexible Automation, b. Advantages and Limitations of Automation 1.3 Basic Elements of an Automated system a. Power to accomplish the Automated Process b. Program of Instructions c. Introduction to Control systems Advanced Automation Functions 1.4 Safety Monitoring 1.5 Maintenance and repair diagnostics and Error Detection and recovery	08
2. Control Technologies in Automation	2a. Select and Apply the various Types of Control Systems. 2b. Choose between time & event driven control system. 2c. Compare various computer process control system. 2d. Identify control system for particular Applications.	2.1 Continuous control system – regulatory control, feed forward control, adaptive control 2.2 Discrete Control system – event driven, time driven 2.3 Forms of Computer process control – computer process monitoring, 2.4 Direct digital control, supervisory control, distributed control system	08
3 Automation in Material Handling System	3a. Identify role of various material handling systems in automation. 3b. Describe the technology used in AGV. 3c. Select the types of monorail and type of	3.1 Types of material handling system in Automation 3.2 Automated guided vehicle systems a. Types of vehicles and AGVs applications b. Vehicle guidance technology c. Vehicle Management and safety 3.3 Monorails and Cranes 3.4 Conveyor system	08

	crane. 3d. Select the Conveyors for particular automation system.	a. Types of conveyors b. Conveyor operations and features	
4. Automatic Data Capture	4a. Select the various Automatic Identification methods. 4b. Describe the concept of the various Automatic Identification methods. 4c. Select and apply the data capture system for particular Application.	4.1 Overview of Automatic Identification methods 4.2 Bar Code Technology a. Linear bar codes(one dimensional) b. Two-Dimensional bar codes 4.3 Other Automatic data capture technologies a. Magnetic strips b. Optical character recognition	07
5. Automated Production Systems	5a. Select the various system configurations used in automated production lines. 5b. Describe the mechanism of linear transfer and rotary Indexing. 5c. Identify the applications of automated production line & assembly system. 5d. Select and Apply the types of assembly systems used in Automation and automobile industry.	5.1 Fundamentals of automated – production lines & System configurations In-line & rotary configurations. 5.2 Work part Transfer Mechanisms like Linear transfer, Rotary indexing. 5.3 Application of automated production lines 5.4 Automated assembly systems a. Type of assembly systems b. Applications(Automobile Industry)	09
6. Automation in Inspection	6a. Select and Apply between off-line and on-line inspection. 6b. Distinguish between Product inspection and Process monitoring. 6c. Select and Apply the inspection techniques for particular application. 6d. Sect and Apply of Coordinate	6.1 Introduction to off-line and on-line inspection 6.2 Product inspection and process monitoring 6.3 Distributed inspection and final Inspection, Contact and noncontact inspection techniques 6.4 Introduction to Coordinate Measuring machine , Machine Vision	08

	Measuring machine & Machine Vision.		
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Diagnose the faults in any one automated system.	1. Introduction to Industrial Automation	04
2	Identify any Discrete control system used in Automated system.	2. Control Tech. in Automation	04
3	Identify any Continuous control system used in Automated system	3. Automation in material handling system	04
4	Conduct case study on any of the data capturing technique	4. Automatic data capture	04
5	Calculate the time required to manufacture a part on transfer line in automation industry.	5. Automated Production systems	04
6	Calculate the time required to manufacture a / assembly job in automation industry.	5. Automated Production Systems	04
7	Prepare a visit report on function various automated material handling equipments in industry	6. Automated material Handling systems	04
8	Measure various dimensions of given job using CMM or any other automated gauging system	6. Automated inspection system	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Automation	04(02)	06(03)	00(00)	10(05)
2	Control Technologies In Automation	02(00)	03(05)	03(00)	08(05)
3	Automation in Material Handling	00(00)	03(03)	06(06)	09(09)
4	Automatic data capture	02(00)	03(03)	06(00)	11(03)
5	Automated Production systems	00(02)	05(00)	06(03)	11(05)
6	Automation in inspection	00(00)	05(06)	06(03)	11(09)
	Total	08(04)	25(20)	27(12)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	1	R	2	2	R	2	4	R	2	5	U	2	6	U	2	6/9
	1	R	2	5	R	2	2	U	2										
2	1	U	3	2	U	3	3	U	3	1	U	3	3	U	3				3/5
3	1	U	3	4	U	3	5	U	3	2	U	3	4	U	3				3/5
4	6	U	3	3	A	3	6	A	3	6	U	3	5	A	3				3/5
5	3	A	3	2	A	3	6	A	3	6	U	3	6	A	3				3/5
6	4	A	6	5	A	6	6	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3,4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	-	-	-	-	-	3	-
2	3	3	-	2	-	-	-	3	-
3	3	3	-	3	-	-	-	3	-
4	3	3	2	3	3	-	2	3	2
5	3	3	2	3	3	-	2	3	2
6	3	3	2	3	3	-	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Automation, Production Systems and Computer Integrated Manufacturing	M.P. Groover, Pearson Education, 3rd Edition, 2007	100132393212
2	Industrial Automation	David W. Pessen, John Wiley and Sons, edition 1989	9780471600718
3	Computer Based Industrial Control	Krishna Kant, PHI Learning Pvt. Ltd. 2nd Edition, 2010	9788120339880
4	Performance Modeling of Automated Manufacturing Systems	Viswanandham N, PHI Learning Pvt. Ltd. International Edition. 2009	9788120308701

❖ **E-REFERENCES:**

- [http://nptel.ac.in/courses/108105063/pdf/L-01\(SM\)\(IA&C\)%20\(\(EE\)NPTEL\).pdf](http://nptel.ac.in/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf), accessed on 4th July, 2021
- <http://nptel.ac.in/downloads/108105063/>, accessed on 4th July, 2021
- <https://nptel.ac.in/courses/112/102/112102011/> accessed on 15th July 2021
- <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-me39/> accessed on 15th July 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Model of Automated processing plant
2. Process Control system Kit- Water level PLC control system kit
3. Demo kit of sensors, Electrical And Pneumatic Actuators
4. Data capturing machine - bar code/optical character recognition
5. Model of Automated guided vehicle – Automatic load transfer, wire guided/laser guide, Load capacity at least 5kg, height at least 2ft, speed at least 5mm/sec, Voltmeter MI 0-150-300 V
6. Model of Coordinate measurement machine- Measuring Volume at least 500mm x 400mm x 440mm, accuracy – 0.1µm, PC control, bench top/portable, Probe/Sensors – Touch type

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rehadre	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr. V U Datir	Course Expert & Lecturer Mech. Engg	Government Polytechnic, Nagpur.
4	Mr. A. S Bahendwar	Course Expert & Lecturer Mech. Engg	Government Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE Representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ME/ PK/ MC
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME210G^{\$}
COURSE TITLE	: THEORY OF MACHINES^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

This course is classified under professional courses. Mechanical engineering technicians primarily work as production, maintenance and design supervisors. In order to perform such jobs they should have ability to analyze, identify and interpret various mechanisms and the machines. Operation and 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 mechanisms, cams, power transmission device, flywheel and governor, brake and 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.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Recognize various links/kinematic pairs of popular mechanism and understand the Inversions of different kinematic chain
2. Calculate velocity and acceleration in mechanism by graphical and Analytical method
3. Construct displacement diagram and cam profile for given type of follower
4. Identify various parts and terms related to governor , flywheel and find the counter balance mass graphically and analytically
5. Select the types of drives for particular application and Calculate various

terms Related to open belt drive

6. Describe the design of Brakes, Dynamometers, Bearings and Clutches and their Function and working

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Kinematics and Mechanisms.	1a. Define various definitions related to kinematics and Mechanisms. 1b. List types of terms related to kinematic chain and mechanisms. 1c. State types of inversions of Four bar kinematic chain. 1d. State types of inversions of Single slider kinematic chain. 1e. State types of inversions of Double slider Kinematic chain.	1.1 Kinematics of Machines: Definitions of Kinematics, Dynamics, Statics, Kinetics. 1.2 Kinematic link, Kinematic pairs with its types, Constrained motion and its type, Kinematic chain with classification, mechanism, Gruebler's criterion, Inversion, Machine and Structure. 1.3 Inversions of Kinematic Chain: Inversion of four bar chain: Coupled wheels of Locomotive and Pantograph. 1.4 Inversion of Single Slider Crank Kinematic Chain: Rotary I.C. Engines mechanism, Whitworth quick return and Crank and slotted lever quick return mechanism. 1.5 Inversion of Double Slider Crank Kinematic Chain: Scotch Yoke Mechanism and Oldham's Coupling.	15
2. Velocity and Acceleration in Mechanisms	2a. Define terms related to velocity and Acceleration. 2b. State the concept of relative velocity and acceleration. 2c. Calculate velocity and acceleration for given mechanism. 2d. Draw velocity and acceleration diagram for single slider mechanism.	2.1 Definition of Linear displacement, Angular displacement. 2.2 Concept of relative velocity and relative acceleration of a point on link, Angular velocity and angular acceleration, Inter relation between linear and angular velocity and acceleration. 2.3 Drawing of velocity and acceleration diagrams of given configuration. Numerical on determination of velocity and acceleration of a point on link by relative velocity method (excluding Coriolis component of acceleration).	08

		2.4 Determine velocity and acceleration of different links in reciprocating engine mechanism by Analytical method (No derivation) and Klein's construction.	
3. Cams and Followers	3a. Define terms related to cam and Classify cams and follower. 3b. Construct displacement diagram for different motion of follower. 3c. Construct cam profiles for the given type of follower motion with and without offset.	3.1 Definition of Cams and followers with their detailed classification and applications, Cam terminology. 3.2 Displacement diagram when the follower moves with – (i) Uniform Velocity (ii) S.H.M. (iii) Uniform acceleration and retardation. 3.3 Simple numerical on construction of Radial cam profiles with Knife-edge and Roller followers with and without offset. (Graphical Method)	08
4. Flywheel & Governors Balancing & Vibration	4a. Concept of Flywheel and governor. 4b. Draw Turning moment diagram. 4c. State terms related to the governor. 4d. Describe with neat sketch types of Governors. 4e. State concept of Balancing. 4f. Find balancing mass and Position of plane. 4g. Terminology of vibration.	4.1 Flywheel: Definition, Function and Applications of flywheel, 4.2 Turning moment diagram for four stroke single cylinder I.C. Engine. (No numerical), Define Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance. (No numerical). 4.3 Governors: Definition, Function and applications, its comparison flywheel. Governor terminology. 4.4 Types of governor: i. Inertia governors. ii. Centrifugal governors. iii. Porter governor iv. Proell governor v. Hartnell governor vi. Hartung governor vii. Wilson-Hartnell governor. (No numerical). 4.5 Balancing: Concept of balancing, It's causes and remedies 4.6 Balancing of single rotating mass, Balancing of several masses rotating in the same plane, Analytical and graphical Methods. (Simple numerical.) 4.7 Vibrations: Concept, terminology, Causes and remedies	07

5. Power Transmission	5a. Classify power transmission drives and Select suitable power transmission drive . 5b. Select suitable belt Drive. 5c. Estimate various parameters related to design of flat belt drive . 5d. Describe gear terminology . 5e. Select suitable gear drive and gear train and chain drive for particular application.	5.1 Power transmission: Types of Drives – Belt, Chain, Rope, Gear drives and their comparison. 5.2 Belt Drives: Flat belt, V– belt and their applications, material for Flat and V-belt. 5.3 Terms used for belt drive : Angle of lap, Belt length, Slip and creep, velocity ratio, ratio of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission. (No derivation), (Simple numerical). 5.4 Gear Drives : Advantages and disadvantages, classification of Gear Drive, Gear terminology, types of gears and gear trains, and their selection for different Applications. Train value for simple, Compound and epicyclic Gear train. (No numerical.) 5.5 Chain and Rope Drives: Types, applications, advantages and Limitations.	08
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6. Clutches, Bearings, Brakes & Dynamometer	6a. Describe concept of clutches and its applications. 6b. Describe construction and working of various types of clutch. 6c. Calculate torque required to overcome the friction and power lost in friction in clutch. 6d. Select the type of bearing. 6e. Estimate torque required to overcome the friction and power lost in friction in Bearing. 6f. Identify the types of brake and its Applications. 6g. Describe construction and working of various Types of brakes. 6h. Calculate braking force braking torque and power for shoe & band brakes 6i. Describe construction and working of various types of dynamometer.	6.1 Clutches: Definition, classification and applications of clutch, 6.2 Power transmission through friction by uniform pressure and uniform wear theories. Construction and working of Single plate, Multi plate, Centrifugal and Cone clutch. 6.3 Calculate torque required to overcome the friction and power lost in friction in clutch (No derivation, simple numerical on Single and Multi plate clutch.) 6.4 Bearings: Definition, Details of Simple pivot, Collar and Conical pivot bearing. (No derivation). 6.5 Calculation of torque and power lost in friction. in bearing 6.6 Brakes: Definition, Classification of Brakes, Construction and working of- (i) shoe brake, (ii) Band Brake, (iii) Internal expanding shoe brake (iv) Disc Brake; Concept of Self Locking & Self Energizing brakes. 6.7 Numerical on calculation of braking force , braking torque and power for shoe & band brakes; (No derivation,) 6.8 Dynamometer: Definition, Construction and working of (i) Prony brake dynamometer. (ii) Rope brake dynamometer. (iii) Hydraulic dynamometer. (iv) Eddy current Dynamometer (No numerical)	09
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify links, types of links, kinematic chain, in following mechanisms. 1) Elliptical Trammel. 2) Water hand pumps mechanism. 3) Quick Return Mechanism used in shaper Machine Prepare proportionate sketches for above mechanisms.	1. Introduction to Kinematics and Mechanism	02
2	Identify links, types of links, kinematic chain, in following mechanisms. 1) Ackerman's steering mechanism 2) Geneva mechanism 3) Differential Mechanism Prepare proportionate sketches for above mechanisms	1. Introduction To Kinematics and Mechanism	02
3	Determine velocity and acceleration of various links of the given two mechanisms, by relative velocity method for analysis of motion of links. (Two Problems on A2 size sheet).	2. Velocity and Acceleration In Mechanisms	04
4	Determine velocity and acceleration in an I.C. engine's slider crank mechanism by Klein's construction. and analytical method(One Problem with varying crank angle on A2 size sheet).	2. Velocity and Acceleration in Mechanisms	04
5	Construct Displacement diagram Cam profile of aradial cam for the given follower type and given motion of follower with offset and without offset. (Four Problems on A2 size sheet).	3. Cams and Follower	04
6	Identify and locate various components of Centrifugal Governor.	4. Flywheel and Governors	02
7	Estimate slip, length of belt, angle of contact in an open belt drive	5. Power Transmission	04
8	Determine graphically and analytically counterbalance mass and its direction for complete balancing of a system of several masses rotating in a single plane.(Two problems on A2 size sheet).	4. Balancing	04
9	Calculate the Braking torque in different type of brakes(Exercise on Block and band Brake 2 Problems)	6. Brakes	02
10	Assemble and dismantle different type of clutch(Multi plate clutch used in two wheeler)	6. Clutch	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction To Kinematics and Mechanism	02(00)	06(00)	02(06)	10(06)
2	Velocity and Acceleration In Mechanisms	02(02)	02(02)	03(03)	07(07)
3	Cams and Follower	03(00)	03(00)	06(06)	12(06)
4	Flywheel and Governors and Balancing	00(02)	06(03)	03(00)	09(05)
5	Power Transmission	00(00)	04(06)	06(00)	10(06)
6	Clutches, Bearings, Brakes and Dynamometers.	03(03)	03(03)	06(00)	12(06)
Total		10(07)	24(14)	26(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	5	U	2	1	A	2	2	U	2	5	U	2	6/9
	2	U	2	2	R	2	4	R	2										
2	1	U	3	3	R	3	6	R	3	4	U	3	5	U	3				3/5
3	1	U	3	3	U	3	4	U	3	2	A	3	6	R	3				3/5
4	4	U	3	5	A	3	6	U	3	1	A	3	6	U	3				3/5
5	2	A	3	4	A	3	5	A	3	1	A	3	5	U	3				3/5
6	3	A	6	6	A	6	3	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assign-ments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assign-ments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagrams of mechanisms, governors , cam profile , selection of equipments. writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawings (if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	3	-	-	-	-	-	3	-
2	3	3	-	3	-	-	-	3	-
3	3	3	3	3	-	-	-	3	-
4	3	3	-	3	3	-	3	3	-
5	3	3	3	3	3	-	3	3	-
6	3	3	3	3	3	-	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Theory of Machines and Mechanism.	Shigley, Joseph E., Uicker, John Joseph, McGraw-Hill Companies, 2nd Edition 1994	13: 9780070569300
2	Theory of Machines.	R.S. Khurmi and J.K. Gupta, S Chand and company ltd.14th Edition, 2005	10:812192524X
3	Theory of Machines.	S.S. Ratan , Tata McGraw-Hill Education Pvt. Ltd. 3rd Edition, 2009	13: 9780070144774

❖ **E-REFERENCES:**

- [https://en.wikipedia.org/wiki/Mechanism_\(engineering\)](https://en.wikipedia.org/wiki/Mechanism_(engineering)) , accessed on 10th July, 2021
- <http://royalmechanicalbuzz.blogspot.in/2015/04/theory-of-machines-by-rs-khurmi-ebook-pdf.html> accessed on 12th July, 2021
- <http://nptel.ac.in/video.php?subjectId=112104121> accessed on 10th July, 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Model of
 - i) Ackerman's steering mechanism
 - ii) Coupling rod of locomotive.
 - iii) Oldham's coupling.
 - iv) Elliptical Trammel.
 - v) Geneva mechanism
 - vi) Water hand pumps mechanism.
 - vii) Scotch Yoke Mechanism
 - viii) Withworth ,Crank and slotted Quick return Mechanism
 - ix) Differential Mechanism
2. Models of Different types cam and Followers- eccentric cams, tangent cams, roller and knife edge followers.
3. Models of Mechanically operated two braking mechanism for wheelers.
 - i) Shoe brake
 - ii) Band Brake
 - iii) Internal expanding shoe brake
 - iv) Disc Brake
4. Balancing of several masses rotating in a single plane Test rig.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr. V U Datir	Course Expert & Lecturer in Mechanical Engineering	Govt. Polytechnic, Nagpur
4	Mr. T K Ghormade	Course Expert & Lecturer in Mechanical Engineering	Govt. Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE Representative Lecturer in Mechanical Engg	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME211G
COURSE TITLE	: PRODUCTION TECHNOLOGY AND QUALITY CONTROL**
TEACHING SCHEME	: TH: 03; TU: 00; PR: 00 (CLOCK Hrs.)
TOTAL CREDITS	: 03 (1 TH/TU CREDIT = 1 CLOCK Hr., 1 PR CREDIT = 2 CLOCK Hr.)
TH. TEE EXAM	: 01 Hr. ** (Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 30 MINUTES (Objective Type Examination)

❖ **RATIONALE:**

Production Technology integrates men, machines, materials and method of production, information and energy to make a product and hence enhance productivity by eliminating wastefulness in production processes. Mechanical engineering technologists needs to determine the standardized process, planning, scheduling, time for its completion known as work and time study, plant layout, plant location, advancements in manufacturing processes to increase the output, measuring the output in terms of productivity, evaluation of jobs, measurement of quality of product. Total Quality Control is an effective system of integrating quality development, quality maintenance and quality improvement efforts of the various groups in industry, so as to enable production and services at most economical level which tends towards full customer satisfaction. Understanding of fundamental principles of Production Technology and quality control helps a technologist in maximizing efficiency within a company by finding the best use of people, equipment, and facilities.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to—

1. Select the various techniques to improve productivity and product design.
2. Interpret the suitability and application of plant layout.
3. Prepare the detailed sequence of operations for manufacturing of components.

4. Recognize the objectives, functions, techniques, applications of Production Planning and control.
5. Apply method study and work measurement techniques to optimize manufacturing processes.
6. Interpret the data obtained from the different quality control processes.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Production System and Product Design	1a. Classify the Production System 1b. Estimate the requirement of proper production system. 1c. Identify the techniques for improving productivity. 1d. Compare Production and Productivity. 1e. Describe approach and concept of product development.	1.1 Introduction to production system. 1.2 Types of production system and applications. 1.3 Requirements and Factors of good production system. 1.4 Productivity, Importance, types, measurement of productivity, techniques to improvement of productivity. 1.5 Product development approaches, Product development process and Related Concepts-Simplification, Standardization, Specialization.	05
2. Plant Location and Layout	2a. Identify factors affecting site selection. 2b. Identify Govt. Policies / relaxation related to plant location in backward area. 2c. Classify plant layout. 2d. Compare different type of plant layout. 2e. Draw layouts for manufacturing units. 2f. Describe design principle of plant layout.	2.1 Importance of site selection, factors affecting site selection and governing factors. 2.2 Govt. policies, Relaxation for backward areas 2.3 Definition, objectives and types of plant layout. 2.4 Characteristics of good plant layout 2.5 Symptoms of bad plant layout. 2.6 Design principle of plant layout.	06
3. Process Planning	3a. Plan appropriate manufacturing processes for manufacturing of	3.1 Process planning from raw material to finish product. 3.2 Factors affecting the process planning. 3.3 Sequence of operations, operation	07

	the given simple job/ component. 3b. Identify factors affecting process planning. 3c. Select sequence of operations for a process. 3d. Prepare operation sheet for a component. 3e. Select machine tool for given manufacturing process. 3f. Describe stages of inspection during production. 3g. Identify techniques of assembly planning.	sheet, and combined operation. 3.4 Determination of inspection stages, types of inspection. 3.5 Selection of machine 3.6 Techniques of assembly planning, types of assembly. 3.7 Plant capacity, machine capacity and plant efficiency.	
4. Production Planning and Control	4a. Select the functions of Production planning and control. 4b. Select the sequencing of job. 4c. Identify the factors affecting scheduling. 4d. Compare Scheduling and Routing. 4e. Classify dispatching. 4f. Identify the techniques of production control. 4g. Construct a Gantt chart for a given Sample data. 4h. Describe need of line balancing.	4.1 Production Planning and Control (PPC), introduction, objectives, functions of production planning and control. 4.2 Routing, concept and route sheet. 4.3 Sequencing N jobs on 2 machines. 4.4 Scheduling, definition, objectives, devices, factors affecting scheduling. 4.5 Dispatching, functions, types and common forms used in Dispatching. 4.6 Production Control and the “Expediting”, Progressive control of production and its steps. 4.7 Concept of line balancing. 4.8 Gantt chart, as control tool and method of construction, advantages of Gantt chart.	10
5. Industrial Engineering	5a. Apply method study and time study for manufacturing of the given job. 5b. Select relevant recording techniques for the given process with justification. 5c. Prepare relevant types of charts for the given process using the given	5.1 Method study: Definition, objectives, steps in method study and method improvement, selection of work. 5.2 Recording techniques: Outline process chart, flow process charts, multiple activity chart, two handed process chart/ SIMO chart, flow diagram, string diagram, travel chart and therbligs. 5.3 Principles of motion economy, concept of ergonomics and workplace layout. 5.4 Work Measurement: Definition,	08

	recording techniques. 5d. Apply principle of motion economy. 5e. Calculate standard time for the given activity using work measurement.	objectives, procedure, Time study, Time study equipment. 5.5 Normal time, standard time, allowances, Merit rating, calculation of standard time.	
6. Quality Control	6a. Prepare quality characteristics chart which contribute to fitness for use of the given job/component. 6b. Select steps to solve the given problem in the industry using quality circle concept with justification. 6c. Identify key six sigma roles, six sigma strategic group, Six sigma Black Belt, KAIZEN, POKA-YOKE, 5S Techniques, ISO9000, ISO-14000. 6d. Calculate mean, mode, median, standard deviation, range, variance for the given sample including the frequency. 6e. Interpret the control charts (X and R-bar, P-chart and C-chart) for measured data of the given sample (s). 6f. Prepare Single / Double sampling plan for the given Lot size (N), Sample size (n), acceptance number (c).	6.1 Meaning of quality control, Quality objectives, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Quality assurance, Quality Circle. 6.2 Total Quality Management, Six sigma, Statistical meaning and methodology, Six sigma Black Belt concept, KAIZEN, POKA-YOKE, 5S Techniques, Introduction of ISO9000, ISO-14000. 6.3 Quality Economics: Cost of quality, Value of quality, Economics of quality confirmation, Cost of quality appraisal, prevention, external and internal failure cost, Cost of rework and repair, Quality function deployment: Basic concept and areas of application. 6.4 Basics of Statistical concepts, Meaning and importance of SQC, frequency distribution, mean, mode, median, standard deviation, range, variance, variable measurement and attribute measurement. 6.5 Construction of frequency distribution curve, normal distribution curve, area under the curve and its interpretation, Control charts for variables -X and R charts, control charts for attribute sp, np, C charts. 6.6 Process capability of machine concept, determination of statistical limits and comparison with tolerance limits to determine capable or incapable process. 6.7 Acceptance Sampling Concept, Comparison with 100% inspection, different types of sampling plans,	12

	6g. Interpret control charts for the given variable and attribute data.	merits and demerits of acceptance sampling. O.C. curve- significance and importance, producer's risk, AQL, AOQL, IQL.	
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
	NIL		

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Production System and Product Design	02(00)	02(02)	02(00)	06(02)
2	Plant Location and Layout	02(00)	02(02)	04(00)	08(02)
3	Process planning	02(00)	04(00)	02(02)	08(02)
4	Production Planning and Control	02(00)	06(00)	04(00)	12(00)
5	Industrial Engineering	02(00)	04(00)	04(02)	10(02)
6	Quality Control	02(00)	04(02)	10(00)	16(02)
	Total	12(00)	22(06)	26(04)	60(10)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Options
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01 To 35	1	R	2	1	U	2	1	A	2	1	U	2	2	R	2	30/35
	2	U	2	2	A	2	2	A	2	2	U	2	3	R	2	
	3	U	2	3	U	2	3	A	2	3	A	2	4	R	2	
	4	U	2	4	U	2	4	U	2	4	A	2	4	A	2	
	5	R	2	5	U	2	5	U	2	5	A	2	5	A	2	
	5	A	2	6	R	2	6	U	2	6	U	2	6	A	2	
	6	A	2	6	A	2	6	A	2	6	A	2	6	U	2	

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	--	--	--	--
		Journal Writing		Assignments	--	--	--	--
				Total	--	--	--	--
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
	Nil	

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	-	3	-	3	-	3	3	3
2	3	-	-	-	3	3	3	3	3
3	3	3	-	-	3	3	3	3	3
4	3	3	-	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	A Textbook of Production Engineering	P. C. Sharma, S. Chand and Co. Ltd, Delhi, 1 st Edition, 1982	978-81-219-0111-6
2	Industrial Engineering and Production Management	Martand T Telsang, S. Chand and Co. Ltd, Delhi, 3 rd Revised Edition, 2018.	978-93-525-3379-4
3	Industrial Engineering and Management	O. P. Khanna, Dhanpat Rai Publication, Date of Publication 1January 2018	978-8189928353
4	Industrial Engineering and Production Management	M. Mahajan, Dhanpat Rai and Co. (P) Ltd, 1 st Edition, 2014.	978-00-2009-200-9, 020102014
5	Industrial Engineering and Management	T. R. Banga and S. C. Sharma, Khanna Publishers, Edition 12, 2017.	978-81-9332-846-0, 8193328469
6	Statistical Quality Control	M. S. Mahajan, Dhanpat Rai and Sons, New Delhi, (2006)	ISBN-10:817700039X
7	Total Quality Management	Besterfield, Dale, H., Pearson New Delhi, (2011)	ISBN-13:9780130993069

❖ **E-REFERENCES:**

- <http://link.springer.com/book/10.1007%2F978-3-319-12304-2>, accessed on 19th March, 2022.
- <https://nptel.ac.in/courses/112107143>, accessed on 19th March, 2022.
- <https://nptel.ac.in/courses/110105088>, accessed on 19th March, 2022.
- <http://ebookinga.com/pdf/a-textbook-of-production-engineering-by-pc-sharma-pdf-free-download>, accessed on 19th March, 2022
- <http://pec.ac.in/~pecac/new/wp-content/uploads/2015/01/Production-Industrial-engineering.pdf> accessed on 19th March, 2022.
- <http://joteringstu.esy.es/advances-in-production-technology-lecture-notes-in-production-engineering.pdf>, accessed on 19th March, 2022.
- <https://www.youtube.com/watch?v=2mAeggAH28E>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

NIL

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr. P. V. Rekhade	Head of Mechanical Engineering	Government Polytechnic, Nagpur.
2	Dr. R. G. Chaudhari	Head of Mechanical Engineering	Government Polytechnic, Nagpur.
3	Mr. Y. B. Dupare	Course Expert & Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr. S. R. Kaduskar	Course Expert & Lecturer, Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Mr. G. F. Potbhare	PBOS Member & Principal	NIT Polytechnic, Nagpur
7	Mr. G. H. Dahole	MSBTE Representative & Lecturer, Mechanical Engineering	Government Polytechnic, Gondia.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY:	PROGRAMME CORE COURSE
COURSE CODE	: MT215G
COURSE TITLE	: MECHANICAL ENGINEERING MATERIALS
TEACHING SCHEME:	TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR.,1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 02 HRs
PR. TEE	: 02 HRs
PT.	: 30 Min.

❖ **RATIONALE:**

Mechanical engineering students should have a good knowledge of composition, properties, and applications of engineering materials used in various field. In order to inculcate the same, this course is designed. Ferrous & Non ferrous metals and alloys find major applications. Amongst these, steels and cast iron are the main alloys with major applications in engineering practices. He should be able to identify steels and cast irons by their specifications and be able to select them for proper applications.. Powder metallurgy process also finds applications in manufacturing of special parts with typical properties. This course describes the composition, properties and applications of materials which is very useful for identifying and selecting the proper material in the field of mechanical engineering.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Classify engineering materials, materials.
2. Draw and interpret Iron-Carbon diagram
3. Select appropriate steels and cast irons for engineering applications
4. Recommend different heat treatment processes.
5. Select proper non ferrous alloys for given applications
6. Describe process flow sheet for manufacturing powder metallurgy product.

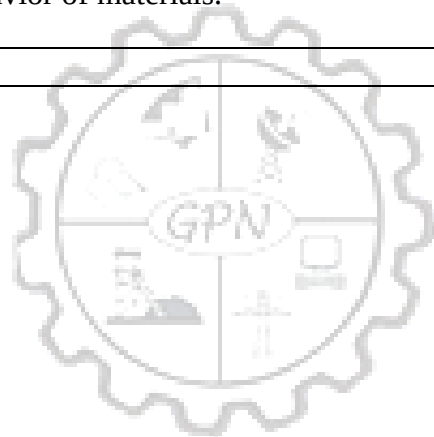
❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Engineering Materials - Structure and Properties	1a. Classify engineering materials 1b. Differentiate amorphous and crystalline solid 1c. Describe various properties of material for engineering use. 1d. Calculate atomic packing efficiency of different crystal structures.	1.1 Classification of engineering materials with examples 1.2 Composite and foam- characteristics and applications 1.3 Amorphous solid and crystalline solid 1.4 Ferrous metals- Characteristics & applications. 1.5 Non-Ferrous metals- Characteristics & applications. 1.6 Crystal structure (BCC, FCC & HCP only), Unit cell and space lattice, concept of atomic packing efficiency 1.7 Physical Properties & Mechanical Properties of metals	06
2. Equilibrium Diagrams	2a. Compare different solid solutions. 2b. Draw and interpret Iron-Carbon diagram. 2c. Appraise phases and composition of steels. 2d. Appreciate Use of critical temperatures of steel. 2e. Identify and Draw various micro structures of cast iron and steel.	2.1 Concepts of phase equilibrium or constitution diagram, pure metal, alloy and solid solutions. 2.2 Types of solid solutions –substitution and interstitial 2.3 Solidification of pure metal and alloy with Cooling curves. 2.4 Iron - Carbon Equilibrium diagram, Microstructures of carbon steel and cast iron, Critical temperatures & its significance.	10
3. Ferrous Metals and Alloys	3a. Classify cast iron. 3b. Identify Cast Iron and steels from I.S. designation. 3c. Compare cast iron with Steel. 3d. Classify steel. 3e. Analyze effect of alloying element on properties of steel. 3f. Select appropriate steels, alloy steels and cast irons for engineering applications.	3.1 Cast Iron: Classification, composition, characteristics and uses of different types of Cast Iron and alloy cast iron. I.S. Specifications of Cast Iron 3.2 Steel: Definition & Properties, classification of steels on various basis as low , medium, high carbon steels, Hypo, Hyper eutectoid steels 3.3 Chemical composition, properties and applications of Low Carbon Steel, Medium carbon steel, High Carbon Steel. 3.4 Alloy Steels: Definition & Classification of alloy steel. 3.5 Effects of alloying elements on	12

		mechanical properties of steels such as Cr, Ni, Mo, W and V 3.6 Composition and application of:- i) Tool steels: High speed steels (HSS), HCHC; ii) OHNS iii) Stainless Steels. 3.7 I.S. specifications of steels. 3.8 Selection of appropriate steels and cast irons for engineering applications	
4. Heat Treatment of Steels	4a. Locate phases on TTT diagram. 4b. Describe different types of heat treatment processes. 4c. Determine temperature range for various heat treatment processes. 4d. Analyze the effect of cooling rate on properties. 4e. Justify need of surface treatment processes. 4f. Recommend proper heat treatment process.	4.1 Time Temperature Transformation diagram for eutectoid steel only 4.2 Heat Treatment Processes: Purposes, temperature ranges, types and applications of: a. Annealing b. Normalizing c. Hardening d. Tempering 4.3 Surface Heat Treatment processes: Need of Surface heat treatment, Types of Surface hardening methods like Flame Hardening, Induction Hardening, Carburizing, and Nitriding.	12
5. Non ferrous Alloys	5a. Compare brass with bronze. 5b. Justify applications of non ferrous alloys. 5c. Select proper non ferrous alloys for given applications.	5.1 Chemical compositions, properties and applications of : a. Copper alloy: brasses and bronzes. b. Aluminium alloys : Y-alloy, Hindalium, duralium, Magnesium. c. Bearing materials: Lead based and Tin based.	04
6. Powder Metallurgy	6a. Elaborate terms related to powder metallurgy. 6b. Describe given powder manufacturing processes. 6c. Describe process flow sheet for manufacturing powder metallurgy product.	6.1 Advantages, limitations and applications of Powder Metallurgy for Engineering products. 6.2 Brief Description of Powder product manufacturing. e.g. powder making, blending, compacting, sintering, infiltration & impregnation.	04
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw crystal structure of different engineering materials.	Engineering Materials - Structure and Properties	04
2	Draw, locate and interpret various phases from Iron-Carbon equilibrium diagram.	Equilibrium diagram	06
3	Prepare Sample for microscopic examination of Cast Iron/ steel.		06
4	Carry out any one process of heat treatment on plain carbon steel.	Heat Treatment Of Steels	06
5	Prepare powder metallurgical component (any one).	Powder Metallurgy	04
6	Perform test such as tensile test, hardness, impact test, spark test.(any one) and Predict mechanical behavior of materials.	Engineering Materials - Structure and Properties	06
Total:			32



❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

R – Remember

U – Understand

A – Analyze / Apply

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Engineering Materials - Structure and Properties	02(00)	03(00)	00(00)	05(00)
2	Equilibrium diagram	02(02)	03(00)	00(03)	05(05)
3	Ferrous metals and alloys	02(02)	00(03)	03(00)	05(05)
4	Heat Treatment Of Steels	02(02)	00(00)	03(03)	05(05)
5	Non ferrous Alloys	02(00)	03(00)	00(00)	05(00)
6	Powder Metallurgy	02(00)	03(00)	00(00)	05(00)
	Total	12(06)	12(03)	06(06)	30(15)

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	2	R	2	3	R	2	4	R	2										
2	1	U	3	2	U	3	2	A	3										2/3
3	3	U	3	3	A	3	4	A	3										2/3
4	4	A	3	5	U	3	6	U	3										2/3

T- Unit/Topic Number

L- Level of Question M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	15	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	05	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	30	12	Theory Answer Scripts	1, 2, 3,4,5,6
				Total	50	20		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	25	10	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	--	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	1, 2, 3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:Nil**❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3			3	3	3	3		
2	3		3	3	3	3	3		
3	3	3		3	3	3	3		
4	3	3	3	3	3	3	3		
5	3		3	3	3	3	3		
6	3	3		3	3	3	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Material science & Metallurgy for engineers	V.D.Kodgire, S.V.Kodgire, Everest Publishing House, first edition, 2011	10:8186314008 13:9788186314005
2	Engineering Materials & Metallurgy	R. Srinivasan, Tata McGraw Hill Education Pvt. Ltd, first edition 1994	13- 978-0-07-067281-9
3	Heat Treatment: Principles and Techniques	T.V.Rajan, C.P.Sharma, Ashok Kumar Sharma, Prentice Hall Of India. 2nd edition, 1994	978-81-203-4095-4
4	Powder Metallurgy	Anil Kumar Sinha, Dhanpat Rai Publications, 1st Edition, 1981	4567144058

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=98lh5Q0M0cg>, accessed on 3th March 2021
- https://www.youtube.com/watch?v=3_BH6HqpPtk, accessed on 3th March 2022
- <https://www.youtube.com/watch?v=eHFI-xuZliQ>, accessed 2th March 2022
- <http://www.engmatl.com/index.php?start=6>, accessed on 2th March 2022
- <http://downloadingisnotsin.net/material-science-and-metallurgy-by-kodgire-pdf-free-download/>, accessed on 22nd March 2022

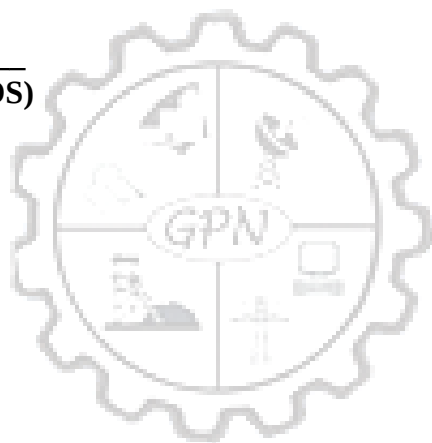
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Models of crystal structure-(FCC,BCC,HCP)
2. Standard Fe-Fe₃C equilibrium diagram
3. Microscope- magnification 100X
4. Grinder- Double ended
5. Polishing machine- cloth polished, rotating disc type
6. Muffle furnace- max temperature 1000⁰c
7. Hardness tester- Rockwell c scale
8. Different Metallurgical products

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Mr.K.L.Meshram	HOD, Metallurgical Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME252G
COURSE TITLE	: CNC TECHNOLOGY AND ROBOTICS
TEACHING SCHEME	: TH: 01; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TE EXAM	: --
PR. TE EXAM	: 02 HRs
PT. EXAM	: --

❖ RATIONALE:

This is Technology course which has relevance with the courses taught earlier namely Manufacturing Processes and advanced manufacturing processes. After getting conversant with the basic manufacturing processes and production processes, it is necessary for a technician to know about the advancements in the area of manufacturing and production processes. The subject will impart knowledge & skills necessary for working in modern manufacturing environment.

This course will help the student to get familiarized with working principles and operations performed on CNC machining centers, generation of part program and study tooling of CNC machine.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select CNC machine for given type of work.
2. Identify the parts of CNC Machines
3. Apply G code and M code for specific machining process and create part programme.
4. Use computer aided part programming languages
5. Prepare tools for use in CNC and observe safety and precautions while using

CNC machine.

6. Demonstrate use of automation elements used in CNC

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to CNC Machines.	1a. Classify CNC Machines. 1b. Difference between NC, CNC and DNC 1c. Describe principle axes of CNC Machine	1.1 NC (Numeric control), CNC (Computer numeric control), DNC (Direct Numeric control) definition, Classification of CNC machines. 1.2 Difference between CNC and NC, relative advantages and disadvantages. 1.3 Cartesian Co-ordinate system and right hand rule for identification of axes.	02
2. Construction and Working Principle of CNC Machine.	2a. Describe construction and working of the different components, subassemblies, and assembly's and peripherals of CNC machines. 2b. Distinguish CNC machine on the basis of constructional features – Turning Centre, Vertical and Horizontal milling machine. 2c. Describe features Multi-axis CNC machine 2d. Draw circuit diagram of pneumatic and Hydraulic system used in CNC Machine 2e. Describe working principle of Automatic tool changer, Pallet changer	2.1 Construction and working of CNC turning, CNC milling machine – Bed and machine frame construction, drives, ball screw, guide ways, machine control unit, lubrication systems etc 2.2 Vertical and Horizontal machining centers. (VMC and HMC) 2.3 Construction and working of Multi-axis CNC machines 2.4 Working of hydraulic and pneumatic systems used for chuck and other parts. 2.5 Working of Automatic Tool Changing (ATC) device, working of Automatic Pallet Changing	03

3. Computer Aided Part Programming	3a. Use various statements of comp aided part programming languages 3b. Develop program for given drawing 3c. Justify use of Computer aided Part Programming	3.1 Introduction to various languages – APT, COMPACT II etc and statements-geometry, Motion, post processor, auxiliary statements 3.2 Programming using statements, 3.3 Advantages and disadvantages of Computer aided Part Programming	02
4. Manual Part Programmin g	4a. Describe function of Codes used in manual part programming. 4b. Develop CNC part programming according to the drawing of the component. 4c. Use various CNC cycles	4.1 NC words, G codes, M codes, Programming formats. 4.2 Lathe co-ordinate system. Tool path co-ordinates. Interpolation functions, Facing and turning program. Linear, Circular interpolation Using Tool nose radius compensation, Tool offset 4.3 Part programming for lathe, milling, drilling etc., Introduction to Canned cycles, List and Application of canned cycles	05
5. Tooling for CNC machines.	5a. Identify types of cutting tools for CNC and VMC / HMC. 5b. Describe construction and working of tool holding assembly. 5c. Apply tool presetting procedure.	5.1 Types of CNC Cutting tools, index able inserts with its geometry 5.2 Construction of tool holding assembly, and types of tool magazine 5.3 Tool presetting procedure	02
6. Robotics	6a. Explain with sketches the function of different elements of Robot. 6b. Select suitable robot considering the configuration 6c. Justify the use of Robot in given application.	6.1 Introduction to Robotics, basic components, joints, degree of freedom, actuators, sensors, end effectors. 6.2 Basic configuration of Robot- Cartesian, polar, spherical etc. 6.3 Applications of Robot in loading, unloading, material handling, processing, assembly inspection etc.	02
Total Hrs.			16

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Unit	Hrs.
1	Prepare report on control systems employed in the CNC machine centre observed during visit to industry-1.	1. Introduction to CNC machines.	02
2	Prepare report on constructional feature of CNC machine centre observed during visit to industry-2.	2. Construction and working principle of CNC machine.	03
3	Prepare report on special features of CNC Machine centre observed during visit to industry-2.	2. Construction and working principle of CNC machine.	04
4	Write a part programme for the given job using computer aided part programming language	3. Computer aided part programming	04
5	Prepare One job on CNC lathe having plain turning, taper turning, step turning, threading, boring and grooving (Batch of 4- 5 students).	4. Manual Part Programming for CNC Lathe centre.	06
6	Prepare One job on CNC milling having following operations–face milling, slotting, contour machining (Batch of 4-5 students)	4. Manual Part Programming for CNC VMC/ HMC (Vertical/ Horizontal Milling Centre)	06
7	Prepare report on selection of cutting tools used for CNC lathe and milling during Practical no.4 &5.	5. Tooling for CNC machines.	03
8	Prepare a report on Robot applications using magazines , videos, online data available	6. Robotics	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
Nil					

❖ QUESTION PAPER PROFILE FOR THEORY PAPER

Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	Test Answer Scripts	--
		Class Room Assignments		Assignments	--	--	Assignment Book	--
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Theory Answer Scripts	--
				Total	--	--		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Description of observed features of CNC Machine in the report.	10
2	Development of manual part program.	15
3	Execution of developed program on CNC machine	15
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	--	3	--	3	3	3	3
2	3	3	3	--	3	--	3	3	3
3	3	3	--	--	3	3	3	3	3
4	3	3	3	3	3	--	3	3	3
5	3	3	3	3	--	3	3	3	3
6	3	3	3	3	--	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	CNC Machines	Adithan M, Pabla B.S.; NewAge Publications.	9780071623018
2	CNC Machine Hand Book	Alan Overby, Mc Graw Hill	9788122834262
3	CAD/CAM/CAE	Chougule N.K., Scitech Publication Pvt Ltd	9788183711753
4	CNC Programming Made Easy	Binit Kumar Jha, Vikas Publication House Pvt. Ltd.	9788125911807
5	CAD/CAM	M.P. Groover, E.W. Zimmers, Prentice Hall India Pvt. Ltd	9788177584165

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/112103174/37>, accessed on 29th October, 2021
- <http://www.egr.msu.edu/~pkwon/me478/operations.pdf>, accessed on 29th October, 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. CNC Turning Machine Center.
2. CNC Vertical/ Horizontal Machine Center.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur.
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur.
3	Mr. A. S. Bahendwar	Course expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr. Y. B. Dupare	Course expert Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A. M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G. F. Potbhare	PBOS Member & Principal	NIT Polytechnic, Nagpur
7	Mr. G. H. Dahole	MSBTE representative & Lecturer in Mechanical Engg	Government Polytechnic, Gondia.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME301G
COURSE TITLE	: MACHINE DESIGN^{\$}
TEACHING SCHEME	: TH: 03; TU: 00;PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 04 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

Machine design is a professional course for mechanical engineer requiring prior knowledge of Strength of materials, Theory of machine, Engineering materials, Manufacturing processes, Mechanical engineering drawing. This course aims to provide fundamental knowledge for material selection, analysis of different types of machine elements subjected to various types of stresses, design of simple machine elements like shaft, keys, coupling, spring, levers, screw, joints and ergonomic concepts.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select suitable materials for designing machine elements by considering stresses on it.
2. Design joints and levers for various applications.
3. Design the power transmission elements like shafts, keys and couplings.
4. Recommend the power screws and suitable fasteners for different applications.
5. Choose springs for various applications.
6. Select standard components with their specifications from manufacturer's catalogue / IS codes.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Design	1a. Write general design procedure for the given component under static loading 1b. Identify the specified loads and stresses for the given component. 1c. Analyse the given component for stress concentration and find out its remedies. 1d. Select the suitable material for the given component and use relevant standard and codes for the same 1e. Apply the theories of failure to design a machine components	1.1 Introduction - Machine Design philosophy and Procedures; General Considerations in Machine Design 1.2 Fundamentals – Types of Loads, Concepts of stress, strain, stress-strain Diagram for ductile and Brittle Materials, Types of Stresses; Bearing Pressure Intensity; Crushing; Bending and torsion; Principal Stresses; simple Numerical. 1.3 Creep and Creep Curve, Fatigue, S-N curve, Endurance limit, Factor of Safety and factors governing its selection, Stress Concentration - Causes & Remedies, Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety and service factor 1.4 Engineering materials: Properties and designation of materials, Use of design data book, Use of standards in design 1.5 Theories of Elastic Failures – principal normal stress theory; Maximum shear stress theory	06
2. Design of Simple Machine Parts	2a. Calculate dimensions and stresses for a given joint. 2b. Calculate dimensions and stresses for the given application of the lever. 2c. Identify possible failures of C-Clamp and Off set link.	2.1 Design of Cotter Joint, Knuckle Joint and Turnbuckle 2.2 Design of Levers-Hand/Foot Lever & Bell Crank Lever, 2.3 Design of C-Clamp, Off set links	08
3. Shaft, Key and Coupling	3a. Design a shaft for a given condition 3b. Identify modes of failures of key and state its effect on strength of shaft.	3.1 Shafts: Types, standard sizes, Design of Shafts (Hollow and Solid) using strength and rigidity equation, ASME code of design for line shafts supported between bearings with one or two pulleys in between or one	10

	3c. Calculate dimensions and stresses for the given Couplings	overhang pulley. 3.2 Key: Classification of Keys, Design of sunk keys, Effect of keyways on strength of shaft 3.3 Coupling - Classification, Design of muff coupling, flange coupling, bush-pin type flexible coupling.	
4. Design of Power Screw and Fasteners	4a. Define the given nomenclature term related to Power Screws 4b. Calculate the torque required for the given conditions and check the Self- Locking and Overhauling properties 4c. Identify the stresses induced in Power Screws 4d. Calculate dimensions and stresses for a given Screw/ Toggle Jack 4e. Identify stresses in bolted joints. 4f. Calculate various parameters in bolted joints as per requirement. 4g. Calculate fillet welding parameters under different Conditions	Power Screws 4.1 Nomenclature of Screws, Thread Profiles used for Power Screws, relative merits and demerits of each. 4.2 Torque required to overcome thread friction, Self-locking and overhauling property, 4.3 Efficiency of power screws & Types of stresses induced, 4.4 Design of Screw Jack, Toggle Jack (only Screw , Nut and Handle Design) Screw Fasteners 4.5 Stresses in Screwed fasteners, Bolts of Uniform Strength 4.6 Design of Bolted Joints subjected to eccentric load acting (i) Parallel and (ii) Perpendicular to the plane of the Bolts. Welded Joints 4.7 Design of parallel and transverse fillet welds, axially loaded symmetrical section; merits and demerits of Screwed and welded joints	12
5 Design of Spring.	5a. Identify the type of spring used in the given application 5b. Define the given spring terminology 5c. Describe various stresses induced in springs for the given application. 5d. Find dimensions of spring for the given application.	5.1 Classification and Application of springs. 5.2 Spring – terminology, materials and specifications 5.3 Stresses in springs, Wahl's correction factor, Deflection and Energy stored in springs 5.4 Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves and Railway buffers	07
6. Antifriction Bearings and Ergonomics	6a. Identify the given type of Bearing 6b. Describe the procedure for designing and selecting the bearing	Antifriction Bearings 6.1 Bearings -Classification of Bearings – Sliding contact & rolling contact 6.2 Terminology of Ball bearings – life load relationship, basic static load	05

& Aesthetic in Design	from manufacturer's catalogue 6c. Apply Ergonomics to the given component 6d. Describe various aspects of Aesthetic	rating and basic dynamic load rating. Selection of ball bearing using manufacturer's catalogue Ergonomic & Aesthetic 6.3 Ergonomic consideration in design, Man machine relationship, Design of equipment for display and control 6.4 Aesthetic considerations regarding shape, size, color & surface finish	
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Survey of different types of Standard components and materials, sample collection and writing a report on Standardization material designation, Properties and uses (Mention IS Code)	1.Introduction to Design	04
2	Design Cotter joint, Knuckle joint or Turn buckle (Any two) 1. Apply various stress considerations. 2. Formulate various resisting areas. 3. Apply appropriate formulae. 4. Calculate various parameters. 5. Draw assembly and detail drawings as per calculated dimensions.	2.Design of simple machine parts	04
3	Design one Lever used in different mechanisms like – Levers used in Bicycle/ 2-wheelers/ 4 Wheelers, Levers used in lathe machines, etc. 1. Apply various stress considerations. 2. Formulate various resisting areas. 3. Use appropriate formulae. 4. Calculate various parameters. 5. Draw assembly and detail drawings as per calculated dimensions.	2.Design of simple machine parts	04
4	Design of Line shaft as per ASME code supported in bearings with two or more pulleys with inclined load on one pulley. 1. Calculate torque and max. Bending moment. 2. Select appropriate failure theories compensating factors to suit conditions. 3. Select appropriate formulae. 4. Calculate various parameters. 5. Draw the concept drawing depicting conditions.	3.Shaft, Keys and Coupling	04

5	Design of coupling – (Any One) (i) Rigid flange coupling (ii) Flexible coupling. Use Design data Book. List the assumptions made 1. Calculate torque. 2. Select empirical relations from design data book. 3. Calculate various parameters. 4. Verify these dimensions under possible failures using formulated resisting areas. 5. Draw assembly and detail drawings as per calculated dimensions.	3. Shaft, Keys and Coupling	04
6	Design a Screw jack or Toggle Jack used for heavy vehicles, cars or other similar applications 1. Apply various stress considerations. 2. Formulate various resisting areas. 3. Select appropriate formulae. 4. Calculate various parameters. 5. Verify these dimensions under possible failures using formulated resisting areas. 6. Verify the calculated dimensions with actual dimensions. 7. Draw assembly and detail drawings as per calculated dimensions.	4. Design of Power Screw and Fasteners	04
7	Design the bolts used in a brackets of any machine or other applications available in the laboratories (eccentric loading) 1. Confirm appropriate loading condition. 2. Calculate load per bolts. 3. Apply various stress considerations. 4. Calculate bolt parameters. 5. Verify the calculated dimensions with actual dimensions 6. Draw Drawing on AutoCAD	4. Design of Power Screw and Fasteners	02
8	Design of the Helical spring used in pen, Shock absorber or similar application. Use Design data Book. List the assumptions made 1. Calculate torque. 2. Select appropriate formulae. 3. Calculate wire diameter. 4. Select standard wire diameter. 5. Calculate various parameters 6. Verify the calculated dimensions with actual dimensions 7. Draw the concept drawing	5. Design of springs	02

9	Select a Bearing for the shaft designed in practical no 4. 1 Take the loads from practical no. 4 2 Calculate Life of bearing 3 Calculate basic dynamic equivalent radial load 4 calculate basic dynamic load rating 5 Select bearing from manufacturer's catalogue.	6.Antifriction Bearings and Ergonomics & Aesthetic in design	02
10	Prepare one assembly and detailed drawings on auto-cad from drawings covered in above practical. i. Select appropriate CAD commands. ii. Draw the assembly drawing.	All Topics	02
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to design	02(02)	03(00)	03(03)	08(05)
2	Design of simple machine parts	02(00)	03(00)	06(06)	11(06)
3	Shaft, Key and Coupling	02(00)	03(03)	09(06)	14(09)
4	Design of Power Screw and fasteners.	02(00)	06(03)	06(03)	14(06)
5	Design of spring.	02(02)	03(00)	03(03)	08(05)
6	Antifriction Bearings and Ergonomics & Aesthetic in design	02(02)	03(03)	00(00)	05(05)
	Total	12(06)	21(09)	27(21)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	5	R	2	6	R	2										
2	1	U	3	2	U	3	1	A	3	1	A	3	3	A	3				3/5
3	2	A	3	2	A	3	3	U	3	3	A	3	3	U	3				3/5
4	3	A	3	4	U	3	4	U	3	4	U	3	4	A	3				3/5
5	5	U	3	5	A	3	6	U	3	3	A	3	3	U	3				3/5
6	3	A	6	4	A	6	2	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Market Survey, collection of information of energy efficient equipment / luminaries. etc.	10
2	Performance	20
3	Skills and Results	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	3	3	-	1	-	-	3	-
2	3	3	3	-	-	-	3	3	-
3	3	3	3	-	-	3	-	3	-
4	3	3	3	-	-	3	3	3	-
5	3	3	3	1	-	-	3	3	-
6	3	3	3	1	1	-	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **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, DhanpatRai& 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 Data for Machine Elements	Abdulla Shariff, DhanpatRai& Sons.2001	9780210223680

7	Theory and Problems of Machine Design	Hall, Holowenko, Laughlin, McGraw Hill.1980	007084352X
8	IS Codes: IS 4218: 1967 ISO Metric Threads IS 2693: 1964 Cast Iron Flexible Couplings IS 2292: 1963 Taper keys and Keyways IS 2293: 1963 Gib Head Keys and Keyways IS 2389: 1963 Bolts, Screws, Nuts and Lock Nuts IS 4694: 1968 Square threads IS 808: 1967 Structural Steel SKF/NBC Catalogue for Bearings	ISO	Indian Standard Bureau New Delhi

❖ **E-REFERENCES:**

- www.youtube.com/watch?v=CLLeLFUvvO2g
- <http://nptelac.in/courses/112105124/>
- www.machinedesignonline.com
- <http://www.uni.edu/~rao/Md-17%20Shaft%20Design.pdf>
- www.youtube.com/watch?v=Wyv7WFaSzc
- www.youtube.com/watch?v=CLLeLFUvvO2g
- <https://engineeringexcellence.files.wordpress.com/2011/10/screw-jack-design.pdf>
- <http://blog.mechguru.com/machine-design/how-to-design-a-helical-compression-spring/>
- <https://www.youtube.com/watch?v=PKXn5xFFpB4>
- <http://www.youtube.com/flangedcoupling>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

- 1 Working models /Acrylic/ Aluminum /Cast/ Scrap/Used components of –
 - i. Cotter joint
 - ii. Knuckle joint
 - iii. Turn-Buckle
 - iv. Foot/Hand lever
 - v. Pulley, Shaft, Keys and couplings
 - vi. Lead screw of lathe
 - vii. Toggle jack /screw jack
 - viii. Ball bearing-single, double row, angular contact and thrust, rolling contact bearings

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P. V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	Course Expert & HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Dr. S. S. Baraskar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
4	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
5	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
6	Shri. G.H. Dahole	MSBTE Representative Lecturer in Mechanical Engg	Govt. Polytechnic, Gondia

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: ME308G ^{\$}
COURSE TITLE	: AUTOMOBILE ENGINEERING ^{\$}
TEACHING SCHEME	: TH:03;TU:00;PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

Automobiles now a day become integral part of modern life. Automobiles are the principal mode of transport system. The diploma engineers must know about the principles of working, construction and preventive maintenance of automobiles. Different types of vehicles and various automobile systems such as transmission, vehicle control, suspension systems, automobile service, management and safety etc. are introduced in this course, so as to get an idea about field of scope of automobiles. Many entrepreneur pass outs go for servicing of automobiles or trading / manufacturing of auto components. Good knowledge of automobile engineering will definitely help to increase employment potential of diploma students.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify categories, drives of vehicles.
2. Analyze factors affecting performance of transmission and control system.
3. Interpret various functions of components of steering and breaking system.
4. Execute dismantle and assemble the various automobile suspension and tyres.
5. Identify, locate and draw various electrical components of automobile systems
6. Evaluate the need of recent trends in automobiles, safety and its service management.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Automobiles	1a. Classify automobile vehicles. 1b. Describe the types of automobile chassis. 1c. Draw vehicle layouts and body. 1d. Describe various layouts of vehicles 1e. Compare various wheel drives.	1.1 Classification of automobile vehicles. 1.2 Types of automobile chassis 1.3 Two and Four wheeler chassis layout, automobile body types. 1.4 Layout of vehicle such as Front Engine rear wheel drive, Front Engine front wheel drive, rear engine rear wheel drive, 1.5 Comparisons of wheel drives with their advantages, disadvantages.	05
2. Transmission System	2a. Identify the major components of transmission system. 2b. Find an appropriate type of transmission system for a given application. 2c. Draw layout of transmission system. 2d. Explain construction and working of components used in transmission systems by taking suitable examples. 2e. Find an appropriate type of rear axle for given application.	2.1 Functions and Need of Transmission System. 2.2 Various components of transmission system and its functions. 2.3 Clutches – types, construction and working of coil spring type and diaphragm type clutch. 2.4 Gear Box – Working principle of Gear box, classification of gear box. 2.5 Construction and working of Constant mesh and synchromesh gear box, Overdrive and transfer case, Fluid Flywheel, Torque convertor and Epicyclic gear box. 2.6 Types, functions, construction and working of Propeller shaft, differential, front and rear Axle.	10
3. Control System	3a. Identify various terms related to steering geometry of vehicle. 3b. Obtain basic terms related to braking system. 3c. Find types of control system. 3d. Interpret basic terms related to steering system. 3e. Find the different components of steering linkages with	3.1 Steering Geometry- Necessity of steering Geometry, significance and ranges of Caster, Camber, King Pin Inclination, Toe In and Toe Out, Steering Axis Inclination. 3.2 Basic terms related to Braking (Stopping Disc, Braking efficiency, fading of brakes) 3.3 List of control system 3.4 Basic terms related to steering system (steering ratio, turning radius, under steering and over steering), components of steering linkages. 3.5 Purpose of steering system,	10

	their function. 3f. Justify the need of power steering. 3g. Describe Control systems of automobiles.	construction and working of – (i) Recirculating ball type (ii) Rack and pinion. 3.6 Power steering: Construction and working of Hydraulic and Electronic power steering. 3.7 Classification of Automotive Brakes. Construction, working and layout of Drum type, Disc type, Hydraulic and Air braking system, Antilock braking system (ABS), Pressure modulation, types of ABS	
4. Suspension System, Wheels and Tyres	4a. Find the types of suspension system. 4b. Identify the basic terminology of suspension system. 4c. Describe construction and working of different types of suspension system. 4d. Classify the wheels and tyres with justification. 4e. Identify the specifications of tyres. 4f. Obtain the Factors affecting tyre life. 4g. Find the factors causing unbalancing in wheels.	4.1 Need and Classification of suspension system. 4.2 Basic terms related with suspension system (Jounce, Rebound, Spring and unsprung weight, spring rate, elasticity) 4.3 Construction and working of following types of suspension systems- (i) Front and rear suspension type (ii) Wishbone type, (iii) Mac Pherson type, (iv) Trailing link type Construction, use and importance of coiled springs, leaf spring and telescopic shock absorbers in suspension system. 4.4 Wheels and tyres Wheel types-spoke, disc and, light alloy cast. Types of Rims. 4.5 Types of Tyres- radial ply, cross ply, tubeless. Tyre specifications / Designation. 4.6 Factors affecting tyre life, tyre Retarding. 4.7 Wheel alignment and balancing - Purpose and procedure of wheel alignment, Purpose of wheel balancing, significance of static and dynamic balancing, procedure for static and dynamic balancing	13
5. Automobile Electrical and Electronics Systems	5a. Identify various parameters related to battery. 5b. Describe operation of starting system. 5c. Describe operation of charging system.	5.1 Battery Battery-types, function, construction and operation Battery capacity, Battery ratings, Battery tests 5.2 Starting System Function of starting system, Construction and working of Standard	06

	5d. Draw layout of lighting system. 5e. Identify the use of color coding's in cables. 5f. Identify basic components of Electric vehicles (EVs). 5g. Describe benefits of EVs. 5h. Describe EVs charging stations.	Bendix Drive. 5.3 Charging System Need, Construction and operation of charging system. Principle ,construction and working of Alternator 5.4 Layout of lighting system. 5.5 Cable color codes, Wiring harness 5.6 Battery, charging port , DC/DC converter, Electric traction motor, onboard charger, power electronics controller, traction battery pack, Transmission, cooling. 5.7 Benefits of EVs. 5.8 Public, workspace charging stations, charging at home.	
6. Automobile Management, Safety and Service	6a. Collect information of Automobile dealership. 6b. Identify Customer Satisfaction index. 6c. Describe functions of passenger comfort and safety component. 6d. Find service tools for automobile service shop.	6.1 Dealership of automobile organization. Role and Responsibilities of Service Manager, Service supervisor. 6.2 Customer Satisfaction index 6.3 Functions of passenger comfort and safety - Air bags , Seat belts, collapsible steering column. 6.4 Site selection and facilities required for service station.	04
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Observe the chassis of four wheeler vehicle. Draw and describe various components mounted on it.	1. Introduction to automobiles	02
2	Dismantle and assemble single plate coil clutch. Identify its parts and write their functions.	2. Transmission systems	04
3	Dismantle and assemble synchromesh gear box. Identify its parts.	2. Transmission systems	04
4	Dismantle the parts of steering system, assemble it and write the function of each part.	3. Control system	04
5	Dismantle Hydraulic brake system and observe various components of it. Write function of important components	3. Control system	04

6	Identify and draw the various parts of the suspension system and write their functions	4. Suspension system, wheels and tyres	04
7	Prepare a visit report on wheel alignment and balancing unit	4. Suspension system, wheels and tyres	04
8	Inspect various battery parameters and charge status by using hydrometer and voltmeter	5. Electrical and Electronics Systems	02
9	Collect the information on advance systems in automobiles like ABS, safety air bags, power operated mirror / windows, active suspension, navigational aids, the sensors and actuators (any two)	6. Automobile Management, Safety and Service	02
10	Prepare a visit report on dealership organization OR Prepare a visit report on preventive maintenance of an automobile by visiting a workshop.	6. Automobile Management, Safety and Service	02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Automobiles	02(02)	02(00)	00(00)	04(02)
2	Transmission system	02(02)	06(00)	06(06)	14(08)
3	Control System	02(00)	06(05)	00(06)	08(11)
4	Suspension system, wheels and tyres	02(00)	06(03)	06(06)	14(09)
5	Automobile Electrical and Electronics Systems	02(00)	06(03)	06(03)	14(06)
6	Automobile Management, Safety and Service	00(00)	00(00)	06(00)	06(00)
	Total	10(04)	26(11)	24(21)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	1	U	2	6/9
	1	R	2	2	R	2	3	U	2										
2	2	U	3	2	U	3	3	U	3	3	A	3	3	A	3				3/5
3	3	U	3	4	U	3	4	U	3	2	A	3	2	A	3				3/5
4	5	U	3	5	U	3	2	A	3	5	A	3	3	U	3				3/5
5	2	A	3	4	A	3	4	A	3	4	U	3	5	U	3				3/5
6	5	A	6	6	A	6	4	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Who m	Frequenc y	Max Mark s	Min Mark s	Evidence Collected	Course Outcome s
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3,4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing and selection of equipment.	10
2	Writing procedure.	10
3	Working of equipment.	20
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	-	-	2	-	-	-	3
2	3	3	-	-	2	-	-	3	-
3	3	3	-	-	2	-	-	-	3
4	3	3	2	3	2	-	2	3	2
5	3	3	2	3	2	-	2	3	2
6	3	3	2	3	2	-	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Automobile Engineering Vol 1	Kirpal Singh, Standard Publications, Edition -12, 2012	9788180141966, 8180141969
2	Automobile Engineering Vol-2	Kirpal Singh, Standard Publications, Edition -13, 2011	9788180141775, 8180141772
3	Automotive Mechanics	Joseph Heitner, Edition- 2, Wiley 2004	9788123908915, 8123908911
4	Automotive Mechanics (SIE)	William H. Crouse and Donald L. Anglin McGraw-Hill Science Edition -13, 2006	9780070634350
5	Automobile Engineering	D.S. Kumar, S.K. Kataria and sons 2009	13: 9789350145739
6	Automobile Engineering	R.B.Gupta , Satya Prakashan 2015	9788176843799

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses>, accessed on 13th November 2022
- https://www.araiindia.com/Draft_AIS_Standards.asp, accessed on 13th November 2022
- http://www.cirtindia.com/testing_universalTyreTestingMachine.html, accessed on 13th November 2022
- www.pcr.org/pages/view/220, accessed on 13th November 2022
- <https://www.auto.howstuffworks>, accessed on 13th November 2022
- http://www.carbibles.com/transmission_bible_pg3.html, accessed on 13th November 2022

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

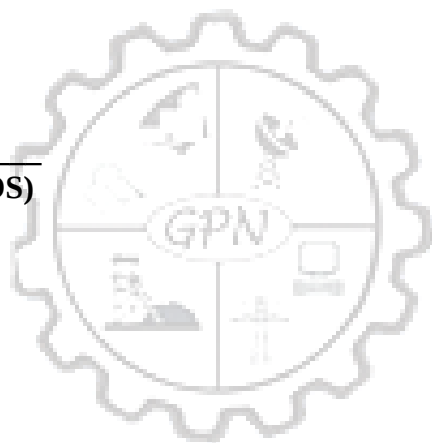
1. Chassis of a car and motor cycle
2. Single plate coil spring clutch, Multi-plate plate clutch, Centrifugal Clutch, Diaphragm spring type clutch
3. Synchromesh Gear Box
4. Constant mesh Gear Box
5. Differential System with Crown and Pinion.
6. Assembly of propeller shaft along with two U-joints and one slip joints
7. Mechanical Steering Gear System, Rack and pinion type with fully manual effort.
8. Recirculating Ball type steering Gear Box
9. Hydraulic Power Steering Gear System of actual power steering gear system with vane pump and other accessories
10. Hydraulic brake system of car with master cylinder, piping, oil tank and brake disc and pad.
11. Air brake system of car with master cylinder, piping, air tank and brake disc and pad.
12. Working model of Auto Electrical System (2/4 wheeler) which consists;
 - (i) Electrical Circuit – Horn, Buzzer, Starting, ignition, Earthing etc.
 - (ii) Lighting circuit – Head, Tail and side lamps, Indicators / Flashers, Parking Light
13. Suspension system of car MacPherson type
14. Battery and charging system multi meter capable of charging 2 – wheeler and 4 – wheeler battery
15. Spanner set (6 to 32 mm) and Adjustable spanner - 5 sets
16. Special tools (Allen key set, Feeler gauges and Pliers etc.) - 2 sets

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, ME (First Shift)	Government Polytechnic, Nagpur.
2	Dr. R.G. Choudhari	HOD, ME (Second Shift)	Government Polytechnic, Nagpur.
3	Shri. N.E. Pise	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Shri. S.R. Kaduskar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M. Onkar	PBOS member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F. Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: WS301G
COURSE TITLE	: MACHINING PROCESSES
TEACHING SCHEME	: TH: 02; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 03 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 02 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

This is an advanced technology subject which is to be taught, after getting conversant with the basic manufacturing processes. It is necessary for a diploma engineer to know about the advancements in the area of manufacturing processes. This subject will impart knowledge & skills necessary for working in modern manufacturing environment. This subject will help the student to get familiarize with working principles and operations performed on non conventional machines, advanced welding techniques, milling machines, grinding machines, surface finishing machines and maintenance of machine tools.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify traditional machining processes.
2. Perform Milling & Gear Cutting operation.
3. Understand advance welding processes.
4. Perform surface finishing processes.
5. Choose suitable nontraditional material removing process.
6. Understand maintenance of machine tools.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Traditional Machining Methods	1a. Classify Broaching machines. 1b. Describe construction, operation & application of horizontal broaching machine. 1c. Classify Boring machines. 1d. Describe boring tools & operations.	1.1 Broaching machines:- Introduction, classification of Broaching machines. 1.2 Basic parts of horizontal broaching machine & their functions, applications, advantages and limitations of Broaching machine. 1.3 Boring Machines – Necessity, types. 1.4 Boring Tools and operations.	04
2. Milling & Gear Cutting Operation	2a. Identify various terms related to milling operations 2b. Classify Milling machines & milling cutters. 2c. Identify basic parts of Milling machines. 2d. Describe milling operations. 2e. Describe various gear manufacturing operations.	2.1 Milling: Introduction, 2.2 Classification of milling machine, milling cutters 2.3 Basic parts of column & knee type milling machine & their functions 2.4 Different milling operations, like plain milling, side milling, straddle milling, gang milling, face milling - slot milling, slitting. Up milling & down milling operations. 2.5 Gear Cutting: Introduction, gear manufacturing methods	06
3. Advanced Welding Processes	3a. Describe submerged arc welding process. 3b. Describe solid state welding process. 3c. Describe laser beam welding process.	3.1 Introduction of Submerged arc welding process 3.2 Solid state welding process 3.3 Laser beam welding process-basic principle.	06
4. Surface Finishing Processes	4a. Classify grinding machines. 4b. Identify designation and specifications of grinding wheels 4c. Describe wheel dressing, truing & balancing processes. 4d. Describe super finishing processes like honing,	4.1 Grinding Machines: Classification and working of grinding machine - surface, cylindrical, centreless 4.2 Grinding wheel specifications, 4.3 Grinding wheel dressing & truing. Balancing of grinding wheels. 4.4 Super Finishing: Methods of surface finishing like honing, lapping, burnishing, polishing and buffing.	06

	lapping, burnishing, polishing & buffing.		
5. Non-traditional Material Removal Processes	5a. Identify necessity of non-traditional material removal processes. 5b. Classify non-traditional material removal processes. 5c. Describe various non-traditional material removal processes.	5.1 Non-traditional material removal processes- Need, mechanisms & process parameter. 5.2 Classification of non-traditional material removal processes. 5.3 Working of Abrasive jet machining (AJM), Electric discharge machining (EDM), wire cut Electric discharge machining (WEDM), Laser beam machining (LBM), Electro chemical machining (ECM), Ultrasonic machining (USM)	06
6. Maintenance of Machine Tools:	6a. Identify the need of maintenance activity. 6b. Classify maintenance practices 6c. Describe maintenance practices of various machine tools. 6d. Describe the details of maintenance manual	6.1 Need and importance of maintenance activity 6.2 Types of maintenance 6.3 Basic maintenance practices for simple machine elements, Bearing, Coupling, Shaft and pulley, gears, chains, machine belts. Repair cycle analysis, Repair complexity, 6.4 Maintenance manual details.	04
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Prepare report on visit to fabrication shop regarding actual working of Broaching machine, Boring machine and their applications.	1. Traditional Machining Methods	04
2	Perform gear cutting (spur gear /helical gear) operation by using simple indexing method (max. four students per job).	2. Milling & Gear Cutting operation	08
3	Prepare power point presentation on Non-traditional manufacturing process/advanced welding techniques (2students/ group) & present in practical batch.	3. Advanced welding processes.	06

4	Perform surface grinding / cylindrical grinding operation on job for given diagram. (max. four students per job).	4. Surface Finishing processes	04
5	Prepare report on Industrial visit to nontraditional machining process with respect to its working principle & parameters.	5. Non- traditional Material removal processes	06
6	Prepare Maintenance report for any two machines/machine elements with reference to type of faults, causes & remedies. (In a group of 4-5 students)	6. Maintenance of Machine Tools	04
Total Hrs.			32

- Note: - Workshop diary should be maintained by each student duly signed by respective shop instructors.

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Traditional Machining Methods	02(02)	00(00)	00(00)	02(02)
2	Milling & Gear Cutting operation	02(02)	03(03)	00(00)	05(05)
3	Advanced welding processes.	02(02)	03(00)	00(00)	05(02)
4	Surface Finishing processes	00(00)	03(00)	04(04)	07(04)
5	Non- traditional Material removal processes	00(00)	06(03)	00(00)	06(03)
6	Maintenance of Machine Tools	02(00)	03(00)	00(00)	05(00)
	Total	08(06)	18(06)	04(04)	30(16)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	6	R	2	1	R	2	2	R	2	4/7
	3	R	2																
2	2	U	3	2	U	3	3	U	3	4	U	3							3/4
3	5	U	3	5	U	3	6	U	3	5	U	3							3/4
4	4	A	4	4	A	4													1/2

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)		--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	20	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	30	12	Theory Answer Scripts	1,2,3,4,5,6
				Total	50	20		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	40	--	Job / Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	10	--	Journal	1, 2, 3,4,5,6
				Total	50	20		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Job work / Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3,4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Job drawing, selection of equipment, writing procedure, precautions etc.	10
2	Performance	20
3	Skills	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	3	-	-	2	-	-	-	3
2	3	3	-	-	2	-	-	3	-
3	3	3	-	-	2	-	-	-	3
4	3	3	2	3	2	-	2	3	2
5	3	3	2	3	2	-	2	3	2
6	3	3	2	3	2	-	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **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 Volume- II	O. P. Khanna & Lal Dhanpat Rai Publications.	456714404X 13:1234567144042
4	Nonconventional Machining	P.K.Mishra, Narosa Publishing House, 1997	10: 8173191387 13: 978-8173191381
5	Industrial Maintenance	H.P.Garg, S.Chand (G/L) & Company Ltd; 3rd Revised edition, 1987	10: 8121901685 13: 978-8121901680

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=vsNAPRIKAVs> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=PXxkQzKRy3s> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=aeOaAZRwpfY> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=B8w-0Oi0Yf4> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=91BnVAs1dXU> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=ayrvpl2LSwY> Accessed on 24th Dec 2022
- https://www.youtube.com/watch?v=R3Y_lrJJ65c Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=qaRyeTPxtvs> Accessed on 24th Dec 2022
- <https://www.youtube.com/watch?v=cxU1zUOpGLk> Accessed on 24th Dec 2022

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Lathe Machine with all accessories
2. Cylindrical grinding machine with all accessories
3. Milling Machine with all accessories
4. Fitting, welding, tools and equipments as per requirement.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, ME (First Shift)	Government Polytechnic, Nagpur.
2	Dr. R.G. Choudhari	HOD, ME (Second Shift)	Government Polytechnic, Nagpur.
3	Shri. N.E. Pise	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Shri. N.S. Pawar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M. Onkar	PBOS member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F. Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engg	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/ME/PK/EC/MC/CM/IT/AI/MT/TX/EE
COURSE CATEGORY:	HUMANITIES AND SOCIAL SCIENCE COURSE
COURSE CODE	: AE213G
COURSE TITLE	: INDUSTRIAL MANAGEMENT **
TEACHING SCHEME:	TH:03; TU:00;PR:00(CLOCK Hrs.)
TOTAL CREDITS	: 03 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEEXAM	: 01 Hr.(Online Examination)
PR. TEEEXAM	: --
PT. EXAM	: 30 Minutes (MCQ)

❖ **RATIONALE:**

Diploma graduate works at middle management level in the industries / engineering organizations. Therefore he has to be proficient in planning, organizing & coordinating various activities of industries s/ organizations or when he is required to work in different types of projects.

They are also expected to deal with workforce and management problems. In the present era of competition, optimum utilization of the resources with achieving higher productivity is essential for any industry to survive. Quality and cost controls are also other important factors which contribute to the day to day supervision issues. This course aims to deal effectively with such issues along with familiarization of acts and laws applied to industries.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to

1. Use basic management principles to explore financial resources and management.
2. Use basic management principles to execute daily activities.
3. Use principles of planning and organizing for accomplishment of task .
4. Use principles of directing and controlling for implementing the plans.
5. Apply principles of safety management in all activities.
6. Apply various provisions of Industrial Acts.

❖ **COURSE DETAILS:****A. THEORY :**

Unit	Specific Learning Outcome(SLO) (Cognitive domain)	Topics and Sub-Topics	Hrs
1. Financial Management	1a. Describe given types of Ownership. 1b. Select suitable forms of ownership for given situations. 1c. Select suitable finance mode for a given venture. 1d. Compare share and debentures on given factors.	1.1 Forms of ownership Proprietorship, Partnership, Joint Stock. 1.2 Co-operative sector public sector, Govt. Undertaking Advantages Limitations & Application of each type comparison between different forms 1.3 Need of finance & sources of finance 1.4 Shares, debentures, types of shares, & comparison between shares & debentures, Break even analysis.	10
2. Introduction to Management Concepts and Managerial Skills	2a. Differentiate the concept and principles of management for the given situation. 2b. Describe functions of management for given situation. 2c. Compare the features of the given types of planning 2d. Suggest the steps in organizing in the given situation. 2e. Suggest suitable type of organization for the given example. 2f. Identify the functional areas of management for the given situation. 2g. Suggest suitable managerial skills for given situation with justification .	2.1 Definitions of management, role and importance of management. 2.2 Management characteristics and principles, levels of management and their functions; management, administration and organization, relation between management and administration. 2.3 Functions of management; planning, organizing, leading/directing, staffing and controlling. 2.4 Types of planning and steps in planning 2.5 Types of organization, Steps in organizing 2.6 Functional areas of management. 2.7 Managerial skill : Planning, decision making, problem solving and delegation	10
3. Planning & Organising	3a. Differentiate the nature of planning and planning activities for the given situation. 3b. Suggest the step wise procedure to complete the given activity in the shop floor. 3c. Select suitable forms for given activities. 3d. Prepare materials and	Planning at supervisory level 3.1 Planning by supervisor. 3.2 Planning activities, detailing and following of each step. 3.3 Prescribing standard forms for various activities. 3.4 Budgeting for materials and manpower Organizing at supervisory level 3.5 Organizing the physical resources.	08

	manpower budget for the given production activity. 3e. Describe with block diagrams the organization of the physical resources required for the given situation. 3f. Describe the human needs to satisfy the job needs for the given situation. 3g. Explain various tasks to be done by the concerned individuals for completing the given activity .	3.6 Matching human need with job needs 3.7 Allotment of tasks to individuals and establishing relationship among persons working in a group	
4. Directing and Controlling	4a. Justify the chosen need of directions and instructions to the subordinates to complete the given task. 4b. Select the feasible of instructions. to complete the given simple task, with justification 4c. Predict the possible mistakes for completing the given simple activity. 4d. Describe the managerial control actions and remedial measures required to be taken for completing the given task successfully with justification. 4e. Describe suitable control methods for given factor.	Directing at supervisory level 4.1 Needs for directions and instructions to subordinates; Completeness and feasibilities of instructions. 4.2 Personal counseling advanced predictions of possible mistakes. 4.3 Elaborating decisions, laying disciplinary standards in overall working. Controlling at supervisory level 4.4 Managerial control; understanding team and link between various departments in respect of process and quality standards; Steps in control process. 4.5 Controlling methods; Control over the performance in respect of quality, quantity of production, time and cost. Measuring performance, comparing with standards, correcting unfavorable deviations.	06
5. Safety Management	5a. Describe the general safety norms required to be taken in the given case. 5b. Suggest preventive measures of plant activities in the given situation. 5c. Describe the safe procedural steps required to be taken to prevent the given the type of accident. 5d. Prepare a work permit in to conduct the given maintenance activity.	5.1 Need for safety management measures 5.2 General safety norms for an industrial unit; Preventive measures. 5.3 Definition of accident, types of industrial accident, Causes of accidents 5.4 Fire hazards; Fire drill: Procedure and frequency 5.5 Safety procedure: Hazard occupational movement related to process, equipment	08

	5e. Describe the causes of the specified type of accident in the given situation. 5f. Prepare the specification of the firefighting equipment required for the given type of fire.	5.6 Work permits: Source countries migrants eligibility, age, maximum period of employment	
6. Legislative Acts	6a. Describe the purpose of the act . 6b. Describe the main provisions of the given acts and important definition.	6.1 Necessity of acts, Important definition and Main provisions of acts. 6.2 Industrial Acts : a. Indian Factory Act b. Industrial Dispute Act c. Workman Compensation Act d. Minimum Wages Act	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
NIL			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Financial Management	02(00)	06(00)	04(02)	12(02)
2	Introduction to Management Concepts and Managerial Skills	02(00)	04(00)	04(02)	10(02)
3	Planning & Organising	02(00)	02(02)	06(00)	10(02)
4	Directing and Controlling	02(00)	04(02)	04(00)	10(02)
5	Safety Management	02(00)	04(00)	04(00)	10(00)
6	Legislative Acts	02(00)	02(02)	04(00)	08(02)
	Total	12(00)	22(06)	26(04)	60(10)

R–Remember U–Understand A–Analyze/Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Options
Q 01 To Q 35	1	R	2	1	U	2	1	U	2	1	U	2	1	A	2	30/35
	1	A	2	1	A	2	2	R	2	2	U	2	2	U	2	
	2	A	2	2	A	2	2	A	2	3	R	2	3	U	2	
	3	U	2	3	A	2	3	A	2	3	A	2	4	R	2	
	4	U	2	4	U	2	4	U	2	4	A	2	4	A	2	
	5	R	2	5	U	2	5	U	2	5	A	2	5	A	2	
	6	R	2	6	U	2	6	U	2	6	A	2	6	A	2	

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Cours e Outco mes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3, 4, 5, 6
		Class Room Assignments		Assignments	15	--	Assignment book	1, 2, 3, 4, 5, 6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4, 5, 6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous assessment of practical	Students	End of every practical	--	--	Journal	1, 2, 3, 4, 5, 6
		Journal Writing		Assignment	--	--	Journal	1, 2, 3, 4, 5, 6
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	1, 2, 3, 4, 5, 6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4, 5, 6
	End of Course Survey			End of The Course	Questionnaires			

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	--	--	--	--	3	3	--	--
2	3	--	--	--	--	3	3	--	--
3	3	--	--	--	--	3	3	--	--
4	3	--	--	--	--	3	3	--	--
5	3	--	--	--	--	3	3	--	--
6	3	--	--	--	--	3	3	--	--

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

❖ **REFERENCE & TEXTBOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Engineering & Management	T.R.Banga & S.C.Sharma, Khanna Publishers, Edition-25, 2014	10:81-7409-078-9 13:978-81-7409-078-9
2	Industrial Engineering And Management	O.P.Khanna, Dhanpat Rai, New Delhi, 1980	81-885-9777-5
3	Industrial Organization and Management	Lawrence L Bethel & James L Riggs, New York, McGraw-Hill [1971], 6 th , 1979	09-322-3849-1
4	Industrial Management	I.K.Chopde & A.M.Sheikh, S.Chand & Co. Ltd, Delhi, 2 nd , 1999	81-219-1480-9
5	Industrial Engineering: Organization and Management	Tara Chand, Publisher: Nem Chand, 5 th , 1982	B0007BSSB0
6	Engineering Economics	Tara Chand, Publisher: Nem Chand, 14 th , 2014	81-85240-82-5
7	Entrepreneurial Development	S.S. Khanna, S. Chand & Co. Ltd, Delhi, 1 st , 1999, reprint 2006	81-219-1801-4

❖ **E-REFERENCES:**

- <http://www.free-management-ebooks.com/index.htm>, accessed on 18th Feb 2022
- https://www.youtube.com/watch?v=3VReVbsmjKI&ab_channel=NPTEL-NOCIITM accessed on 18th Feb 2022
- [https://www.youtube.com/watch?v=2Ie9uH9ySpo&ab_channel=Management study Guide](https://www.youtube.com/watch?v=2Ie9uH9ySpo&ab_channel=Management%20study%20Guide) accessed on 18th Feb 2022
- [youtube.com/watch?v=9QM-3LMeBQA](https://www.youtube.com/watch?v=9QM-3LMeBQA) accessed on 18th Feb 2022

❖ **LIST OF MAJOR EQUIPMENTS WITH SPECIFICATION:**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute/Industry
1	Dr.G.K.Awari	Head of the Department, Automobile Engineering Deptt.	Government Polytechnic, Nagpur.
2	Dr.R.G.Choudhary	Head of the Department, Mechanical Engineering Deptt.	Government Polytechnic, Nagpur.
3	Dr.K.S.Dixit	Sr.Lecturer in Automobile Engineering Deptt.	Government Polytechnic, Nagpur.
4	Dr.S.A.Telang	Sr.Lecturer in Automobile Engineering Deptt.	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME302G^{\$}
COURSE TITLE	: INDUSTRIAL FLUID POWER^{\$}
TEACHING SCHEME	: TH:03; TU: 00;PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

Industrial Fluid Power deals with the power transmitting system, employing pressurized oil or air to transmit energy from an energy generating source to an energy utilization area. This is sub-categorized as oil hydraulics and pneumatics. The concepts of hydraulics and pneumatics are important and indispensable tools being used in the innovations, circuit design and improvement of engineering processes and devices. Different types of power sources, valves and actuators are essential elements in the power transferring systems in most of the manufacturing industries, specially where automation and control is required.

This course is designed to develop basic knowledge of hydraulic and pneumatic systems which are widely used for automatic control and other purposes in Industry as machine tools, material handling, etc. This course will give the students, the basic skills and knowledge of oil hydraulics and pneumatics which will be directly needed in the industrial environment.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify various components of hydraulic and pneumatic systems.
2. Apply principle of various components used in hydraulic and pneumatic systems.
3. Interpret hydraulic and pneumatic circuits for various applications.
4. Design the hydraulic and pneumatic circuits.
5. Develop hydraulic and pneumatic circuits for various applications.
6. Operate the hydraulic and pneumatic circuits.

❖ COURSE DETAILS:

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Basics of Oil Hydraulic Systems.	1a. Illustrate the various merits and limitations of oil Hydraulic systems. 1b. Analyze the various properties of hydraulic oils. 1c. Illustrate the various properties of hydraulic oil. 1d. Illustrate the construction, working principle and applications of various hydraulic pumps.	1.1 General layout, Practical Applications, Merits and limitations of oil hydraulic systems 1.2 Pascal's Law and Force Multiplication, Properties of hydraulic oil - Compressibility, Viscosity, Demulsibility, Lubricity, Resistance to Oxidation (aging), Air separating ability, Fire Resistance and Flash point. 1.3 Requirements of good hydraulic fluid. 1.4 Hydraulic Pumps- Construction, working principle, applications and symbols of gear pump, Gerotor pump, Vane pump, screw pump, Piston Pump.	06
2. Components of Oil Hydraulic System.	2a. Illustrate the various hydraulic control valves. 2b. Utilize the various direction control valves. 2c. Utilize the various flow control valves. 2d. Utilize the various servo valves. 2e. Select a suitable type of actuator. 2f. Select a suitable type of hydraulic motor. 2g. Select a suitable type of instrument for Angular measurement on given situation. 2h. Illustrate the various types of accessories and accumulators for hydraulic circuit.	2.1 Hydraulic control valves :-Necessity of fluid control system, Construction, working principle and symbols of Pressure control valves - pressure relief valve - direct, pilot operated, pressure reducing, pressure unloading, Sequence valves and counter balancing. 2.2 Direction control valves - Poppet valve, spool valve, 2/2, 3/2, 4/2, 4/3, methods of actuation. Types of different center positions. Check valves, pilot operated check valves. 2.3 Flow control valves – pressure compensated, non pressure compensated flow control valve. 2.4 Servo Valves: - Two-stage servo valve, Jet pipe servo valve, Flapper jet servo valve. 2.5 Actuators:- Classification of actuators Construction, working principle and symbols of Rotary Actuators –Semi-Rotary, Vane type and Dual piston type Semi- rotary. 2.6 Hydraulic motors: - gear type, Vane	10

		type and Piston type Motor. Linear Actuators - single acting cylinder, double acting cylinder. 2.7 Accessories- Construction, working principle and symbols of Pipes, Hoses, Fittings, Oil filters, Seals and gaskets. 2.8 Accumulators and pressure Intensifier or Booster.	
3. Oil Hydraulic Circuits.	3a. Illustrate the linear circuit, regenerative circuit, speed control circuit 3b. Illustrate the various sequence control circuits. 3c. Illustrate the various synchronizing circuits. 3d. Illustrate the various hydraulic motor control circuits. 3e. Illustrate the various industrial hydraulic circuits. 3f. Illustrate the hydraulic circuit for shaping.	3.1 Linear circuit, Re-generative circuit. 3.2 Speed control circuit ; - Meter-in, Meter-out, Bleed-off Circuit. 3.3 Sequence control circuits: - Travel dependent and Pressure dependent. 3.4 Synchronizing circuits: - Synchronizing circuit with mechanical coupling, synchronizing with flowing valves. 3.5 Hydraulic Motor Control circuits: - Speed control of a bi-directional motor, Free-running off and blocked off hydraulic motor circuits. 3.6 Industrial hydraulic circuits:- Hydraulic circuits for Shaping machine, grinding.	08
4. Introduction to Pneumatic Systems.	4a. Draw the general layout of hydraulic & pneumatic systems. 4b. Illustrate the construction and working of various types of air-compressors. 4c. Select a suitable type of air-compressor for the pneumatic circuit.	4.1 Applications of pneumatic systems General layout, merits and demerits of pneumatic systems, Comparison of Hydraulic and pneumatic system. 4.2 Air compressors: - Double stage Single Acting reciprocating, double stage Double Acting reciprocating and Screw type air compressor. 4.3 Selection of air compressors for pneumatic circuits.	04
5. Components of Pneumatic Systems.	5a. Select a suitable type of pressure regulating valve & direction control valve. 5b. Select a suitable type of actuator. 5c. Illustrate the various air-preparation devices. 5d. Select a suitable type of accessory for the pneumatic circuit.	5.1 Valves:-Construction, principle of working and symbols of - i) Pressure regulating valves: - spool type and Seat type valve. ii) Direction control valves:-2/2, 3/2, 4/2, 5/2 and 5/3 direction control valve. iii) Valve Actuation Mechanisms with symbol: - Mechanical actuation, Electrical actuation, Pneumatic actuation and Electro-pneumatic actuation.	10

		iv) Impulse valve (5/2 pilot operated) v) Flow control valves: - Fixed and variable type flow control valves, Check valve (directly and pilot operated), Shuttle valve and Quick exhaust valve. Time delay valve. 5.2 Actuators - Construction, working and symbols of - i) Rotary Actuators – Pneumatic Motors ii) Semi-rotary Actuators (single vane type & double vane type). iii) Linear Actuators – Cylinders - single acting, double acting. 5.3 Air preparation elements: - FRL unit, Dryers and mufflers. 5.4 Accessories- Construction, working and Symbols of Pipes, Hoses, fittings.	
6. Pneumatic Circuits	6a. Compose the circuit for actuation of single acting and double acting cylinder. 6b. Compose the Impulse operating circuits. 6c. Compose the Speed control circuit. 6d. Design the Position based sequencing circuit. 6e. Design the Time delay circuit.	6.1 Circuit for actuation of single acting and double acting cylinder. 6.2 Impulse operating circuits. 6.3 Speed control circuit: - Speed control circuits for double acting cylinder and bidirectional air motor 6.4 Sequencing circuits - Position based sequencing circuit. 6.5 Time delay circuit.	10
Total Hrs			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify components and draw ISO symbols used in hydraulic and pneumatic system.	1. Basics of Oil Hydraulic Systems.	04
2	Identify various types of pump, actuators and control valves in Hydraulic and Pneumatic Systems and analyze its performance.	2. Components of oil Hydraulic system	04
3	Construct and actuate meter in and meter out circuit on hydraulic circuit.	3. Oil Hydraulic Circuits	04
4	Construct and actuate hydraulic circuit for Single acting cylinder and double acting cylinder.	3. Oil Hydraulic Circuits	04

5	Construct and actuate hydraulic circuit of the given sequencing of operations.	3. Oil Hydraulic Circuits	04
6	Construct and actuate speed control pneumatic circuits.	5. Components of Pneumatic Systems.	02
7	Construct and actuate indirect (pilot) control pneumatic circuits.	5. Componentsof Pneumatic Systems.	02
8	Construct and actuate pneumatic circuits for the sequencing of operations.	6. Pneumatic Circuits.	02
9	Construct and actuate pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY)	6. Pneumatic Circuits.	02
10	Prepare maintenance schedule for hydraulic and pneumatic system.	Hydraulic and Pneumatic Circuits.(Unit 5 & 6)	04
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Basics of Oil Hydraulic Systems	02(02)	03(00)	00(00)	05(02)
2	Components of Hydraulic system	02(02)	06(06)	06(00)	14(08)
3	Oil Hydraulic Circuits	02(00)	06(00)	03(06)	11(06)
4	Introduction to Pneumatic Systems	00(00)	06(09)	06(00)	12(09)
5	Components of Pneumatic Systems	02(00)	03(00)	03(03)	08(03)
6	Pneumatic Circuits	04(02)	00(00)	06(06)	10(08)
	Total	12(06)	24(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	5	R	2	6	R	2	1	R	2	6/9
	1	R	2	2	R	2	6	R	2										
2	1	U	3	2	U	3	2	U	3	2	U	3	2	U	3				3/5
3	2	A	3	2	A	3	3	U	3	3	A	3	3	A	3				3/5
4	3	U	3	3	A	3	4	A	3	4	U	3	4	U	3				3/5
5	4	A	3	5	U	3	5	A	3	4	U	3	5	A	3				3/5
6	4	U	6	6	A	6	6	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing the figure of equipment, selection of equipment, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	3	3
2	3	3	3	-	3	-	-	3	-
3	3	3	3	2	-	-	-	-	3
4	3	3	3	2	3	-	2	3	3
5	3	3	-	-	3	1	-	3	3
6	3	-	-	-	3	-	2	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE AND TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Oil Hydraulic system- Principles and maintenance	S.R .Majumdar, Tata McGraw Hill Education Pvt. Lid, New Delhi.,16 November 2002.	ISBN : 0071204059
2	Pneumatic System- Principles and Maintenance	S.R .Majumdar, Tata McGraw Hill education Pvt. Lid, New Delhi.23 rd reprint edition , 01 July 2017.	ISBN: 0074602314
3	Treatise on Hydraulics and Pneumatics Fluid Power	Sameer Vazir Shaikh, Iliyas Rasul Khan, R. K. Publications, Kolhapur.	-----
4	Industrial Hydraulics	John J Pippenger, Tyler cregory Hicks, Gregg Division ,Mc- Graw Hill, 01 January 1980.	ISBN 10: 0070664773 ISBN 13: 9780070664777

5	Pneumatics and Hydraulics	Andrew Parr, Butterworth – Heinemann, 3 rd Edition, 28 January 2011.	ISBN: 9780080966755
6	Hydraulic and Pneumatics	Andrew Parr, Jaico publishing house, New Delhi, 2005.	ISBN 13: 9788172241896
7	Audel Pumps and Hydraulics	Rex Miller, Mark Richard Miller, Harry L Steward, Audel, 6th Edition, October, 2004.	ISBN: 9780764571169
8	Hydraulic and Pneumatic A Technician's and Engineer's Guide	Andrew Parr, Butterworth Heinemann 3rd Edition, March, 2011.	ISBN10:0080966748 ISBN13:978-0080966748

❖ **E-REFERENCES:**

- <https://searchworks.stanford.edu/> searched on 16th Feb. 2022
- <http://www.energiazero.org/meccatronica/mechatronics/> searched on 16th Feb. 2022
- <https://d6s74no67skb0.cloudfront.net/course-material/> searched on 16th Feb. 2022
- <https://www.e4training.com/hyd02/> searched on 16th Feb. 2022
- <https://www.teachengineering.org/lessons/> searched on 16th Feb. 2022

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Pressure control valve for Hydraulic circuit.
2. Flow control valve for Hydraulic circuit.
3. Direction control valve for Hydraulic circuit.
4. FRL – unit for Pneumatic circuit.
5. Rotary Actuator, Semi-rotary Actuator & Linear Actuator for Pneumatic circuit.
6. Screw type Air-compressor

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr.Y.K. Gaiky	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Mr.A.S. Bahendwar	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. Mr. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engg.	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME303G ^{\$}
COURSE TITLE	: POWER PLANT ENGINEERING ^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

The electric power generation and distribution industry has evolved during almost exactly one century into its present form. This development has been driven by economics, technological advancements, and government regulations. Because the need for electricity is pervasive in our society, there is a continuing interest in the technology of electric power production and distribution. Power Plant Engineering, however, offers a unified treatment of power system economics, planning, design, and operation that includes consideration of all of the forces which have shaped the industry. Electricity in bulk quantities is produced in power plants, which can be of -Thermal, Nuclear, Hydraulic, Gas turbine and Geothermal. Most of the power plants use mechanical engineering equipment and components. Hence, this course attempts to provide the basic knowledge of the components, operation and maintenance of power plants to the students and would also acquaint them with the latest technological advances taking place in this sector.

❖ COURSE OUTCOMES:

After completing this course students will be able to—

1. Understand the present scenario of power in India.
2. Estimate the parameters related to economics of power plants.
3. Understand the working of Hydro-electric power plant.

4. Identify the various components of steam power plant.
5. Understand the working principle of Nuclear and Gas turbine powerplant.
6. Analyse the environmental issues of Power Plant and its impact on Environment.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Power Plant	1a. Classify Power plants and suggest suitable location. 1b. Explain energy scenario in India. 1c. Describe future planning for power generation in India.	1.1 Introduction –Concept of Power Plant; classification of Power Plant; Location of power plant; 1.2 World and National scenario of demand and supply of energy; Indian Energy scenario in India; 1.3 Present power position in India; future planning for power generation; power corporations in India	04
2. Economics of Power Plant	2a. Define terminologies used in Power Plant. 2b. Explain performance and operating characteristics of Power Plant. 2c. Estimate the performance parameters of Power Plant.	2.1 Terminology used in Power Plant – Peak Load, Base Load, Load Factor, utility factor; Demand Factor; 2.2 Factors affecting the operation of power plant, Methods of meeting fluctuating load in power plant; Load-sharing – cost of power – tariff methods; performance and operating characteristics of power plant 2.3 Estimation of production cost of electrical energy in various types of power plants; estimation of various performance parameters. (Simple Numerical)	08
3. Hydro Power Plant	3a. Apply the terms related to Hydroelectric power plant for power generation. 3b. Explain site selection parameters of Hydroelectric power plant. 3c. Classify hydroelectric power plant.	3.1 Introduction to Hydroelectric power plant, rainfall, runoff and its measurement, Hydrograph, flow duration curve 3.2 Selection of sites for hydroelectric power plant; General layout and its working 3.3 Classification – Run off river plant, storage river plant, pumped storage plant; advantages and disadvantages	08
4. Steam Power Plant	4a. Draw general layout of Steam Power Plant. 4b. Explain Coal handling	4.1 Introduction of Steam Power Plant; General Layout and Working of Power plant; advantages and	12

	and coal storage system of steam power plant. 4c. Explain given type of Fuel burner used in steam power plant. 4d. Explain given type of pulverised fuel handling system. 4e. Describe the given type of Ash handling system. 4f. Explain the importance of feed water treatment along with its advantages and limitation.	limitations 4.2 Coal Handling system – steps involved in coal handling and its methods, stages in coal storage 4.3 Fuel burning-Stokerfiring-overfeed stoker –under feed stokers-chain grate stoker, 4.4 Pulverized fuel handling system-unit and central system, Pulverization of coal-Ball mill, 4.5 Ash handling system-Gravity system-electrostatic precipitation (ESP) system- 4.6 Feed water treatment- Mechanical method, Advantages and limitations of Thermal power plant.	
5. Nuclear & Gas turbine Power Plant	5a. Compare nuclear fission and fusion. 5b. Describe the given type of Nuclear reactor. 5c. Explain the given method of waste disposal. 5d. Draw the layout of given gas turbine Power plant. 5e. Identify the components of Gas turbine power plant. 5f. Justify the use of Gas turbine power plants in India.	Nuclear Power Plant 5.1 Introduction of nuclear power plant- nuclear fuels, nuclear fission and fusion, 5.2 Working of a nuclear power plant, types of reactors- pressurized water reactor- boiling water reactor, 5.3 Effects of nuclear radiation, different methods for nuclear waste disposal- low, medium and high level waste disposal, Advantages and limitations of Nuclear Power Plant Gas Turbine Power Plant. 5.4 Schematic diagram & working of open and closed cycle gas turbine power plant, 5.5 Components of Gas turbine—compressor, combustion chamber, gas turbine, vortex blading, 5.6 Gas turbine fuels, Gas turbine power plants in India – Namrup & Uran gas turbine power plants. Advantages and limitations of Gas turbine power Plant	10
6. Environmental Impact of Power Plant	6a. Describe the given social and economical issues of power plants. 6b. Explain measures taken to control Air and Water Pollution.	6.1 Social and Economical issues of power plant- Oxides of sulphur-oxides of carbon-oxides of nitrogen, Acid precipitation-Acid rain- acid snow- Dry deposition-acid fog, greenhouse effect, 6.2 Air and water pollution from thermal power plants and its control, Thermal pollution from thermal	06

		power plants, noise pollution and its control,	
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Survey the demand and supply of Energy in India and write a report on it mentioning the type of plant along with percentage fulfilling the demand.	1. Introduction to Power Plant	04
2	Estimate the production cost of electrical energy of a given power plant by studying various parameters	2. Economics of Power Plant	04
3	Prepare a visit report on Hydro- electric power plants in India or Prepare a report on Hydro - electric power plants by observing video CD.	3. Hydro Power Plant	04
4	Prepare a visit report on Steam power plants or Prepare a report on Hydro -electric power plants by observing video CD.	4. Steam Power Plant	04
5	Prepare detail report and give presentation in the class on any one of the following topics , 1.Coal Handling system in Steam Power plant 2.Fuel burning in Steam Power Plant 3.Pulverized fuel handling system 4.Ash handling system 5.Feed water treatment in Steam Power Plant	4. Steam Power Plant	04
6	Prepare a report on Nuclear power plant to identify various components using models, charts, simulated and real videos.	5. Nuclear & Gas Turbine Power Plant	04
7	Prepare a report on Gas Turbine power plant to identify various components using models, charts, simulated and real videos.	5. Nuclear & Gas Turbine Power Plant	04
8	Write the report on the data collected on various sources of Air, Water and noise pollution created by the given power plant and its impact on Environment; also suggest the steps for its control.	6. Environmental Impact of Power Plant	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Power Plant	02(02)	03(03)	00(00)	05(05)
2	Economics of Power Plant	02(00)	03(00)	06(06)	11(06)
3	Hydro Power Plant	02(00)	06(03)	03(03)	11(06)
4	Steam Power Plant	02(02)	06(03)	09(06)	17(11)
5	Nuclear and Gas Turbine Power Plant	02(02)	03(00)	06(03)	11(05)
6	Environmental Impact of Power Plant	02(00)	03(03)	00(00)	05(03)
	Total	12(06)	24(12)	24(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	4	R	2	5	R	2										
2	1	U	3	2	U	3	2	A	3	1	U	3	3	U	3				3/5
3	2	A	3	3	U	3	3	U	3	3	A	3	4	U	3				3/5
4	3	A	3	4	U	3	4	U	3	4	A	3	4	A	3				3/5
5	4	A	3	5	U	3	6	U	3	5	A	3	6	U	3				3/5
6	4	A	6	5	A	6	2	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1R2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Market Survey, collection of information, drawing the figure of equipment, selection of equipment, writing procedure etc.etc.	10
2	Performance	20
3	Skills and Results	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	3	3	-	3	-	3	3	
2	3	3	3	-	3	-	3	3	3
3	3	-	3	-	3	-	3	3	-
4	3	3	3	-	3	3	3	-	3
5	3	3	3	-	3	3	3	3	-
6	3	3	3	-	3	3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S. N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Power Plant Engineering	Nag,P.K , Tata McGraw Hill India, 2007.	978933920404
2	Power Plant Technology	El-WakilM.M., McGraw Hill Education, India, 2010	9780070702448
3	Power Plant Engineering	Raja,A.K., Prentice Hall,2006	9788122418316
4	A Text Book of Power Plant Engineering	Sharma,P.C. and Nagpal, McGraw Hill Education, (India)	9789350143841
5	Steam and Gas Turbine and Power Plant Engineering	Yadav,R, Central Publication house	9788185444352
6	A Text Book of Power Plant Engineering	R.K. Rajput, Laxmi Publications,	9788131802557, 9788131802557

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=-hooifWJ1jY>
- <https://www.youtube.com/watch?v=Uhjhufhg3Xk>
- <https://www.youtube.com/watch?v=UwexvaCMWA>
- <https://www.youtube.com/watch?v=AdA5d8Hm>
- <https://www.youtube.com/watch?v=ChvI2v85fsU>
- <https://www.youtube.com/watch?v=IdPTuwKEfmA>
- <https://www.youtube.com/watch?v=XjbczcFNrNU>
- <https://www.youtube.com/watch?v=0rsPFdkwR0>
- <https://www.youtube.com/watch?v=gDVukFIOxURc>
- <https://www.youtube.com/watch?v=02p5AKP6W0Q>
- <https://www.youtube.com/watch?v=FXBqvLWxbr0>
- <https://www.youtube.com/watch?v=dCPfHifMbOk>
- <https://www.youtube.com/watch?v=b6-n0pFu5d4>
- <https://www.youtube.com/watch?v=iUXHzYLgrB0>
- <https://www.youtube.com/watch?v=ZssGiY6rfYE>
- <https://www.youtube.com/watch?v=F01AFJe2j2A>
- <https://www.youtube.com/watch?v=c6wDRQMD- YE>
- <https://www.youtube.com/watch?v=ks-G4FYVtg>
- <https://www.youtube.com/watch?v=H6ECIYcfXKw>
- <https://www.youtube.com/watch?v=KmYbupS4u-k>
- <https://www.youtube.com/watch?v=rEJKiUYjWlE>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Model of Hydro-electric power plant
2. Model of Steam Power Plant
3. Model of coal handling system
4. Model of ash handling system
5. Model of Gas Turbine Power Plant
6. Model of nuclear power plant

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	Course Expert & HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
4	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
5	Shri. G.H. Dahole	MSBTE Representative & Lecturer in Mechanical Engg.	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME304G^{\$}
COURSE TITLE	: TOOL ENGINEERING^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

Tools are essential component of machining process. The machining operations quality and efficiency mainly depends upon quality of tools used that depends upon the proper shape, size and material of the tools. Productivity and quality of machining processes may further be enhanced by proper and quick mounting of tools and jobs on machines using suitable Jigs and Fixtures. Therefore, this course attempts to develop abilities in students to select a tool of proper size and shape for required for machining process. This course also dealt with the basic design of cutting tools, jigs and fixtures.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Classify geometries of various cutting tools.
2. Select and apply appropriate cutting tool insert and tool holders for different machining operations.
3. Relate and choose appropriate locating and clamping devices for components.
4. Differentiate and deploy proper Jigs and Fixtures for components and machining operations.
5. Use appropriate press tools and press tools operations.
6. Utilize appropriate dies for bending and forging components.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs .
1. Introduction to Tool Engineering	1a. Classify the given cutting processes. 1b. Estimate cutting force in the given simple numerical problem situation. 1c. Draw cutting tool geometry of single point cutting tool using ASA or ORS system. 1d. State the shear angle required for the given job with justification.	1.1 Tool Engineering : Definition, Principles, Metal cutting Mechanics, 1.2 Cutting Forces: Merchant Circle, types of chips, chip thickness ratio, shear angle. Types of Metal cutting Process: Orthogonal 1.3 Geometry of cutting tool: Single point 1.4 Shear angle: Concept, need and method	06
2. Cutting Tool Materials and Holdings Devices	2a. List the different Properties and composition of the given tool material(s). 2b. Interpret ISO designation of the given tool inserts. 2c. Select tool holders and inserts for the given component ad machining operation and machining operation with justification. 2d. Describe tool holders for milling and CNC machines. 2e. Explain the given tool sharpening method(s).	2.1 Cutting tool Materials – Types, Composition, Properties and Applications 2.2 Carbide Inserts – Types, ISO-Designation and Application 2.3 Other inserts like CBN and PCBN, ISO Designations to Tool holders 2.4 Tool holders for Turning, Milling and CNC Machines. 2.5 Tool Sharpening Method for single Point Cutting Tool.	06
3. Locating and Clamping Devices	3a. Explain principle of location with reference to the given work piece. 3b. Calculate the degree of freedom in the given situation. 3c. Select different types of locators for the given situation with justification. 3d. Select different types of clamping devices for the given situation with	3.1 Concept, definition locating and clamping, Use of locating and clamping principles on shop floor 3.2 Degree of freedom concept and importance 3.3 Locator: Types, Construction, working and applications 3.4 Clamping devices: Types, construction, working and application, fool proofing and ejecting techniques	06

	justification.		
4. Jigs and Fixtures	4a. Differentiate between given types of Jig and Fixture. 4b. Select the relevant Jigs for the given component with justification. 4c. Select the relevant fixtures for the given component with justification. 4d. Explain the design procedure for the given Jig and Fixture.	4.1 Concept, definition of jigs and fixtures. Difference between jigs and fixtures. 4.2 Jigs: Types, Construction, Working and Applications. 4.3 Fixtures: Types, Construction, Working and Applications. 4.4 Design considerations and procedure for Jigs and Fixtures.	08
5. Press Tool Design	5a. Select suitable press tool operation for the given sample press tool component with justification. 5b. Calculate press tonnage and centre of pressure for the given press tool component. 5c. Prepare scrap strip layout for the given press tool component. 5d. Describe stock stop, pilots, strippers and knockouts. 5e. Design progressive cutting die for the given simple press tool component.	5.1 Press working processes: Types, Sketches and Applications. 5.2 Press Tools: Types, Working, component and their functions Concept, Meaning, Definitions and Calculations of press tonnage and shut height of press tool. Shear action in die cutting operation. Centre of Pressure: Concept, Meaning, and Definition, Methods of finding and important. Die Clearance: Concept, Meaning, Definition, Reasons, Effects and Methods of application. Cutting force: Methods to calculate methods of reducing 5.3 Scrap strip layout: Concept, Importance, method to prepare and determining percentage stock utilization. 5.4 Types, Working, and application of stock stop, pilots, strippers and knockouts. 5.5 Cutting dies-types and applications Design of progressive cutting die: a) Sketch the Component b) Prepare scrap strip layout. c) Calculate tonnage. d) Determine centre of pressure	12

		e) Determine dimensions of punches die block and die shoe. f) Prepare sketch of stripper plate. General assembly sketch of punches arrangement, die block, die shoe and stripper plate.	
6. Bending, Drawing and Forging Dies	6a. Calculate band radius, bend allowance and spring back for the given simple part. 6b. Draw labeled sketch of given die(s). 6c. Select die(s) for the given part with justification.	6.1 Bending Dies: i) Types, parts and functions of bending die ii) Definition, calculations and factors affecting bend radii, bend allowance and spring back. iii) Methods to compute bending pressure: Types, sketch, working and applications of bending dies. 6.2 Drawing dies: Types and method to determine blank size for drawing operation, Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging) 6.3 Forging dies: Terminology, types, sketch, working and Application	10
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify the given types of tools; give its uses and mentioned their designation systems.	1. Basics of Tool Engineering	04
2	Sketch the given type of cutting tool with nomenclature taken for re-sharpening by visualizing its angles in ASA system to identify its tool geometry and write a report on it.		02
3	Identify different tool holders and their use for Turning, Milling and CNC machine and write a report on it.	2. Cutting Tool Materials and Holdings Devices	04

4	Identify different clamping devices and their use available in the workshop and write a report on it.	3. Locating and Clamping Devices	04
5	Draw assembly and detail drawing of the designed Jig and Fixture.	4. Jigs and Fixtures	02
6	Design a progressive cutting die for a simple component.	5. Press Tool Design	02
7	Draw assembly and detail drawing of the designed progressive cutting die.		02
8	Prepare Strip layout of simple component.		02
9	Identify and Use different parts used in Press.		02
10	Design a bending die for given component.	6. Bending, Drawing and Forging Dies	02
11	Draw and describe the bending die indicating all parts and dimensions.		04
12	Estimate blank size for Deep Drawing a simple component.		02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Basics of Tool Engineering	02(02)	03(03)	00(00)	05(05)
2	Cutting Tool Materials and Holding Devices	02(00)	03(00)	06(06)	11(06)
3	Locating and Clamping Devices	02(00)	03(03)	03(03)	08(06)
4	Jigs and Fixtures	02(00)	06(03)	06(03)	14(06)
5	Press Tool Design	02(02)	06(03)	06(03)	14(08)
6	Bending, Drawing and Forging Dies	02(02)	03(00)	03(03)	08(05)
	Total	12(06)	24(12)	24(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	5	R	2	6	R	2										
2	1	U	3	2	U	3	2	A	3	1	U	3	3	U	3				3/5
3	2	A	3	3	U	3	3	A	3	3	A	3	4	U	3				3/5
4	4	U	3	4	U	3	5	U	3	4	A	3	5	A	3				3/5
5	5	U	3	6	U	3	6	A	3	5	U	3	6	A	3				3/5
6	4	A	6	5	A	6	2	A	6										2/3

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagrams of experiment set up, equipments, writing	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO1	PSO2
	1	2	3	4	5	6	7		
1	-	3	-	-	-	-	3	3	-
2	-	3	-	-	-	-	3	3	-
3	-	3	-	-	-	3	-	3	-
4	-	3	2	-	-	3	-	3	-
5	-	3	2	-	-	3	-	3	-
6	-	3	2	-	-	3	-	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Tool Design	Donaldson Cyrll, Mcgraw Hill Education, 2000	9780070153929, 0070153922
2	Fundamental of Tool Engineering Design	Basu, S.K., Oxford Ibh 1979	812040016X, 9788120400160
3	Tool Engineering and Designs	Nagpal G.H. Khanna Publication, 2003	817409203X
4	Tool Engineering, JigsandFixture	Atkins Albert, McGraw-Hill, 1922	1151454966

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=MPxFB6gcJ5M>
- https://www.youtube.com/watch?v=_XFijwC5n3w
- <https://www.youtube.com/watch?v=-uw2Dn9uSrM>
- <https://www.youtube.com/watch?v=eqKa2gv9Kx0>
- <https://www.youtube.com/watch?v=O6ykFfYGPvU>
- <https://www.youtube.com/watch?v=a8WheFQ-fTw>
- <https://www.youtube.com/watch?v=HZ-KHdu7pMs>

- <https://www.youtube.com/watch?v=qpHIlkSF4N4>
- <https://www.youtube.com/watch?v=E7YTiS2bx4w>
- <https://www.youtube.com/watch?v=kI3R08rfpAo>
- https://www.youtube.com/watch?v=8cZHv_szMJE
- <https://www.youtube.com/watch?v=HKKT2I6IY2Q>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Single Point Cutting Tool – 2 Qty.
2. Drill – M12/ M 16/ M 20 size
3. Grinding Machine – Grinder Size 100 mm (minimum)
4. Tool Holders – Milling Cutter mandrill, Drill tool holder, Tool post of lathe machine
(Qty. one each)
5. Clamping devices for drilling machine, Milling machine, Chucks (Qty. one each)
6. Different Press Tools

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Mr.M.T. Gajbhiye	Course Expert & Lecturer in Mechanical	Government Polytechnic, Nagpur
4	Mr.S.B. Bambole	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F. Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME305G^{\$}
COURSE TITLE	: REFRIGARATION AND AIRCONDITIONING^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ 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 types of refrigerants is one of the basic requirements. It is also expected that they are conversant with various refrigerating equipments & controls, basics of cryogenics and psychometric.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Analyze the performance of different refrigeration systems.
2. Appraise of modern trends in the field of refrigeration and air conditioning.
3. Select the proper refrigeration and air Conditioning system.
4. Diagnose faults and suggest remedial measures in refrigeration air conditioning system.
5. Operate test rigs of air-conditioning unit.
6. Calculate COP of various refrigeration systems.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Basics of Refrigeration	1a. Elaborate refrigeration, COP and Refrigeration effect 1b. Describe the concept of heat engine, heat pump and refrigerator 1c. Draw PV and TS diagram of reverse Carnot cycle 1d. Describe the Bell Coleman air refrigerator.	1.1 Introduction: - Describe the refrigeration, Necessity of refrigeration, Concept of heat engine, heat pump and refrigerator. Unit of refrigeration, C.O.P. and refrigerating effect. 1.2 Reversed Carnot Cycle and its representation on PV and TS diagram. (Numerical to find out COP) 1.3 Air Refrigeration Cycles 1.4 Bell Coleman air refrigerator, its representation on PV and TS	08
2. Refrigeration System and Refrigerants	2a. Describe the principle of VCRC 2b. Describe the effect of superheating, under cooling, suction pressure and discharge pressure on performance of VCRC 2c. Calculate the COP of VCRS, State the advantages of VCRC 2d. Describe the working principle and components of Vapour Absorption System 2e. State the desirable properties of refrigerants 2f. Select refrigerant for specific application 2g. Describe the concept of Green House Effect, Ozone depletion, Global warming	2.1 Vapour Compression Refrigeration Cycle (V.C.R.C): Principle, components, Representation on P-H and T-S diagram. 2.2 Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V. C. R. system, 2.3 Calculation of COP, Vapour Compression Refrigeration Cycle (V.C.R.C): 2.4 Describe the working principle of Vapour Absorption System. 2.5 Desirable properties of Refrigerant and absorbent used in Vapour Absorption System 2.6 Refrigerants : Classification of refrigerants, Desirable properties of refrigerants, Nomenclature of refrigerants, 2.7 Selection of refrigerant for specific applications, 2.8 Concept of Green House Effect, Ozone depletion, Global warming, Eco-friendly refrigerants like R-134a, alternate refrigerants etc,	10

3. Components of Vapour Compression Refrigeration System.	3a. Describe the construction and working of compressor, condenser, expansion valve, evaporators and chillers. 3b. State the different components of hermitically sealed compressor. 3c. State the function of expansion devices 3d. Select different controller for particular VCRS application. 3e. Classify evaporator and chiller. 3f. State the functions of other components such as Drier, Solenoid valve, Thermostatic switch, Defrosting device	3.1 Compressors - Classification, Construction and working of open type, hermetic, centrifugal, vane type, axial, screw compressor and their applications. 3.2 Condensers - Classification, description of air cooled and water cooled condensers, comparison and applications. Evaporative condensers 3.3 Expansion devices - Types - Capillary tube, automatic expansion valve, thermostatic expansion valve and their applications 3.4 Controls - High pressure & low pressure cut-outs, high voltage & low voltage control, thermostat & overload protector, relay. Accumulator, strainer, drier, oil separator, their functions & locations 3.5 Evaporators and Chillers - Classification of evaporators ,working principle of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator, Capacity of evaporator and their applications. Classification of chillers, 3.6 Other components- Drier, Solenoid valve, Thermostatic switch, Defrosting device	08
4. Psychrometry	4a. State the necessity of air conditioner 4b. Describe the different Psychrometric processes and show it on Psychrometric chart 4c. Describe the term SHF, RSHF, ERSHF, GSHF 4d. Describe the humidifier, dehumidifier, filter, heating and cooling coils 4e. Draw comfort chart	4.1 Describe the air condition and its necessity, Properties of Air, Dalton law of Partial pressure 4.2 Psychrometric chart, Elaborate all the Psychrometric processes, Bypass Factor, 4.3 Concept of ADP, concept of SHF, RSHF, Adiabatic mixing of Air streams 4.4 Describe the Equipment's used for Air conditioning i.e. humidifier, dehumidifier, filter, heating and cooling coils 4.5 List out the factors affecting human comfort, Effective temperature and comfort chart	10
5. Air	5a. Classify the A.C. systems	5.1 Classification of A.C. systems 5.2 Industrial and commercial A.C.	08

Conditioning System	5b. Distinguish between Industrial and commercial A.C. systems 5c. Select A.C. system for particular working condition 5d. State the application of A.C. system 5e. Describe Automobile Air conditioning	systems 5.3 Summer, winter and year round A.C. systems 5.4 Central and unitary A.C. systems 5.5 Give the application of A.C. systems 5.6 Introduction to automobile air conditioning	
6. Air Distribution Systems	6a. State the various duct material and losses in ducts 6b. Describe the working of fans and blowers 6c. State the types and properties of insulating materials. 6d. How the insulation is applied.	6.1 Duct systems -Closed perimeter system, extended plenum system, radial duct system, duct materials, requirement of duct materials, losses in ducts 6.2 Fans and Blowers -Types, working of fans and blowers , Air distribution outlets: Supply outlets, return outlets, grills, diffusers 6.3 Insulating Materials – Types, Properties & Purpose 6.4 Methods of applying insulation.	04
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Analysis of Bell Coleman air refrigerator system.	1. Basics of Refrigeration	04
2	Calculate the COP of domestic refrigerator/VCRS.	2. Refrigeration System and Refrigerants	04
3	Identify the components and calculate the COP of ice plant test rig.	2. Refrigeration System and Refrigerants	04
4	Identify the components and Calculate the COP of water cooler test rig.	2. Refrigeration System and Refrigerants	04
5	Identify and describe the components of Vapour Compression Refrigeration System.	3. Components of Vapour Compression Refrigeration System.	04
6	Identify and describe the components of hermetically sealed compressor.	4. Psychrometry	04
7	Prepare a report of Visit to cold storage industry/ central A.C. plant in view of ducting system, insulation system and Air distribution system.	5. Air Conditioning System	04

8	Identify the components and Calculate the COP of test rig air Conditioning System.	6. Air Distribution Systems	04
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Basics Of Refrigeration	02(02)	03(03)	06(03)	11(08)
2	Refrigeration System and Refrigerants	02(00)	03(03)	06(03)	11(06)
3	Components Of Vapour Compression Refrigeration System	02(00)	03(00)	06(06)	11(06)
4	Psychrometry	02(02)	06(03)	03(00)	11(05)
5	Air Conditioning System	02(00)	06(03)	03(03)	11(06)
6	Air Distribution Systems	02(02)	03(03)	00(00)	05(05)
Total		12(06)	24(15)	24(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	4	R	2	6	R	2										
2	1	U	3	1	A	3	1	A	3	1	U	3	1	A	3				3/5
3	2	U	3	2	A	3	2	A	3	2	A	3	2	U	3				3/5
4	3	U	3	3	A	3	3	A	3	4	U	3	5	A	3				3/5
5	4	A	3	5	A	3	6	U	3	5	U	3	6	U	3				3/5
6	4	U	6	5	U	6	3	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ **ASSESSMENT AND EVALUATION SCHEME:**

✓ ASSESSMENT AND EVALUATION SCHEME:								
	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3,4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of equipment, Drawing sketch of Apparatus, Writing Procedure, Observation Tables.etc.	10
2	Performance	20
3	Calculation, Result, Drawing Graphs(if any)	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	3	3
2	3	3	3	-	3	-	-	3	-
3	3	3	3	2	-	-	-	-	3
4	3	3	3	2	3	-	3	3	3
5	3	3	-	-	3	2	-	3	3
6	3	3	3	-	3	2	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **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 Publication New Delhi	10:8121927811
2	Refrigeration and Air Conditioning	Arora C.P. Tata Mcgraw Hill publication New Delhi	13-978-07-008390-5
3	Refrigeration and Air Conditioning	Prasad Manohar. New Age International New Delhi	9788120348721
4	Principle of Refrigeration	Dossat R.J. John Wiley and sons Ltd U.K.	978-0130272706

❖ **E-REFERENCE:**

- <https://www.vedantu.com>
- <https://www.iare.ac.in>
- <https://sist.sathyabama.ac.in>
- <https://gmpua.com>
- <https://www.daboosanat.com>
- <https://www.rajagiritech.ac.in>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS :**

- 1) Vapour compression Refrigeration system Test Rig.
- 2) Water cooler Test Rig
- 3) House hold refrigerator test rig
- 4) Window air conditioning test rig
- 5) Split air condition test rig
- 6) Test rig of ice plant
- 7) Analysis of Domestic Refrigerator system

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V.Rekhade	Head, Dept. of Mechanical Engg.	Government Polytechnic Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Shri.N.S. Pawar	Course Expert & Lecturer (Selection Grade), Dept. of Mechanical Engg.	Government Polytechnic Nagpur
4	Shri. K.S. Thekedar	Course Expert & Lecturer , Dept. of Mechanical Engg.	Government Polytechnic Nagpur
5	Er. A.M. Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME306G ^{\$}
COURSE TITLE	: COMPUTER INTEGRATED MANUFACTURING ^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH= 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	: 03 HRs
PR. TE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ **RATIONALE:**

This course is classified under Elective courses. Competition has an important role to survive for manufacturing industries in global economic market. It is more important capability of producing through diverse customer's demand with very short time to the market for manufacturing companies. Computer Integrated Manufacturing (CIM) is the integration of the total manufacturing enterprise through the use of integrated systems and data communications coupled with new managerial philosophies that improve organization and personnel efficiency.

To satisfy industrial need, diploma engineer should be able to cope with CAD/ CAM & CIM. Detailed knowledge of above mentioned aspects with deep insight to the practical applications develop a professional confidence in them to become successful engineers in manufacturing industries.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Recognize various elements of CIM wheel.
2. Choose appropriate automated material handling systems.
3. Calculate system through put for AS/RS system.
4. Apply OPITZ coding system for particular part.

5. Develop Flexible Manufacturing System for particular applications.
6. Inspect components using coordinate measuring machine.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Computer Integrated Manufacturing	1a. Describe components of CIM wheel. 1b. Describe given benefits of CIM using Justification	1.1 Definition, Concept and Evolution of CIM , CIM Wheel 1.2 Benefits of CIM (Tangible and Intangible)	06
2. Automated Material Handling and Storage System	2a. Select vehicle guidance technology for given application of AGV. 2b. Calculate system through put for AS/RS on given data 2c. Justify the application of Robot in Material handling and allied services in manufacturing.	2.1 Automated guided vehicle: Definition, Types of vehicles, Vehicle guidance technology, Vehicle Management: traffic control and vehicle dispatching. 2.2 Automated storage systems: Automated storage/ retrieval Systems: types, applications. Carousel storage systems (Numerical analysis on system throughput for AS/RS system only.) 2.3 Robot Applications in Material handling, machine loading & unloading, processing & assembly application	08
3. Group Technology	3a. Describe part families and Compare process type layout and GT layout. 3b. Interpret the code for given part using OPITZ. Mi class system 3c. Group the machines in machine cell using ROC 3d. State applications of GT.	3.1 Group Technology: Definition, Part families, Process type layout and GT layout, 3.2 Methods of grouping parts into families, Types of parts classification systems, 3.3 Coding system structure, Opitz system, Mi class system. ROC system. 3.4 Benefits and Applications of GT.	08

4. Computer Aided Process Planning	4a. Describe Retrieval type CAPP. 4b. Describe Generative type CAPP. 4c. Differentiate between Retrieval type and Generative type CAPP.	4.1 CAPP- The planning function, Difficulties in traditional process planning, CAPP system, Retrieval type 4.2 Generative and Hybrid type computer aided process planning system, 4.3 Comparison and Benefits of CAPP systems.	08
5. Flexible Manufacturing System	5a. Describe types of FMS and its components. 5b. Draw the FMS system for particular type. 5c. Select type of FMS for particular application. 5d. Derive benefits and applications of FMS	5.1 Definition of flexible manufacturing system, Types of FMS on the basis of number of machines and Flexibility. FMS Components 5.2 Workstations: Load unload stations, Machining stations, other processing stations, assembly 5.3 Material handling and storage System: Functions, Equipment, Layout configurations, Computer Control system, various functions of computer control system. 5.4 Application and benefits of FMS.	10
6. Computer Aided Inspection	6a. Select proper type of structure of CMM for particular application. 6b. Describe the procedure to measure dimensions and geometry of given part using CMM. 6c. Identify the types, applications of CMM structures and their configuration 6d. Describe machine vision	6.1 Introduction to inspection technology 6.2 Coordinate Measuring machine: Definition, CMM construction i) Probe and its types ii) Mechanical Structure and its types. 6.3 CMM applications and benefits. 6.4 Machine Vision: Definition, Operation and application.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw wheel CIM model which represent the concept of CIM.	1. Introduction To CIM	04
2	Identify configuration of given Automated material handling system	2. Automated Material Handling	04
3	Calculate system throughput for AS/RS System. (solve one numerical)	2. Automated Material Handling	04
4	Interpret the code for the given part using OPITZ system.	3. Group Technology	04
5	Interpret the code for the given part using MiClass system.	3. Group Technology & 4 Computer Aided Process Planning	04
6	Identify the components of FMS and Develop Flexible Manufacturing System for particular applications.	5. Flexible Manufacturing System	04
7	Measure dimensions and geometry of given part using CMM machine.	6. Computer Aided Inspection	04
8	Prepare Visit Report on Industrial/institute visit to observe the use of robots and its operations.	ALL units.	04
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction To CIM	02(00)	06(00)	00(00)	08(00)
2	Automated Material Handling	02(00)	03(03)	03(06)	08(09)
3	Group Technology	02(02)	06(03)	06(03)	14(08)
4	Computer Advance Process Planning	02(02)	03(03)	03(00)	08(05)
5	FMS	04(00)	03(06)	03(06)	10(12)
6	Computer Aided Inspection	00(02)	06(00)	06(00)	12(02)
	Total	12(06)	27(15)	21(15)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ QUESTION PAPER PROFILE FOR THEORY PAPER:

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	5	R	2	6/9
	3	R	2	4	R	2	6	R	2										
2	1	U	3	2	U	3	3	U	3	1	U	3	5	A	3				3/5
3	4	U	3	5	U	3	6	U	3	2	U	3	3	U	3				3/5
4	6	U	3	4	U	3	5	U	3	5	A	3	2	A	3				3/5
5	3	A	3	4	A	3	5	A	3	5	U	3	3	U	3				3/5
6	2	A	6	3	A	6	6	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1R2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment	Theory	(Continuous Assessment)	Students	Two PT (average of two tests)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
				Continuous	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1, 2, 3,4,5,6
				Total	100	40		
Direct Assessment	CA (Continuous Assessment)	Continuous Assessments of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assessments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1, 2, 3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form		1, 2, 3, 4,5,6	
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing diagrams of AGV configurations, AS/RS system, CMM machine, writing procedure etc.	10
2	Performance	20
3	Calculation, Result, Drawings (if any)	10
4	Viva voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSOs	
	1	2	3	4	5	6	7	1	2
CO1	3	-	-	1	1	-	3	3	3
CO2	3	3	3	1	-	-	3	3	3
CO3	3	3	-	3	-	-	-	3	3
CO4	3	3	2	3	3	-	3	3	3
CO5	3	3	3	2	2	2	3	3	3
CO6	3	3	-	3	-	2	-	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Principles Of Computer - Integrated Manufacturing	Vajpayee S. Kant, PHI Learning Pvt. Ltd., Ed 2005	10: 812031476X
2	CAD/CAM, Computer – Aided Design and Manufacturing	Mikell P Groover, Emory W Zimmers, Pearson (I) ltd	978-81-7758-416-5
3	Automation, Production Systems, and Computer-integrated Manufacturing	Mikell P Groover, PHI learning private limited, Edition 2008	9780132393218
4	CAD/CAM Concepts and Applications	Chennakesava R. Alavala PHI Learning Pvt Ltd Ed 2009	978-81-203-3340-6

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/112101099/1> accessed on 9th July 2021
- <http://nptel.ac.in/courses/112101099/3> accessed on 9th July, 2021
- <https://www.youtube.com/watch?v=tiaT1YS-IM> accessed on 3rd July, 2021

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Charts for OPITZ parts classification and coding system.
2. Co-ordinate measuring machine:- Measuring volume atleast 500mm x400mm x 440mm, accuracy 0.1 μ m, PC Control, Portable, Probe/Sensor Touch-type.

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
3	Prof. A. S. Bahendwar	Course Expert & Lecturer in Mechanical Engineering	Govt. Polytechnic, Nagpur
4	Prof. V. U. Datir	Course Expert & Lecturer in Mechanical Engineering	Govt. Polytechnic, Nagpur
5	Er. A.M.Onkar	PBOS Member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
6	Shri. G.F.Potbhare	PBOS Member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHANICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: ME307G^{\$}
COURSE TITLE	: PRODUCT DEVELOPMENT^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 03 HRs
PR. TEE EXAM	: 02 HRs
PT. EXAM	: 01 HR

❖ RATIONALE:

This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

❖ COURSE OUTCOMES:

After completing this course student will be able to—

1. Understand the product development process and carry out its market survey.
2. Extract customer need from market survey.
3. Development of conceptual plan for the product as per customer need.
4. Design and testing product using design software.
5. Select suitable manufacturing method .
6. Apply Operation Research Method for manufacturing Technology.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Product Development	1a. Describe the product life cycle. 1b. Describe the product development process 1c. Analyze the market for the potential of a product	1.1 Introduction: Classification/ Specifications of Products, Product life cycle. Product mix. 1.2 Modern product development process, Innovative thinking. 1.3 Market study	06
2. Need Identification of Product Development	2a. Apply various techniques for the collection of consumer need. 2b. Justify the need of a product.	2.1 Identifying customer needs, voice of customer, customer populations-hierarchy of human needs, need gathering methods. 2.2 New product needs, importance, establishing engineering characteristics, competitive benchmarking, quality function deployment, case studies.	06
3 Concept Development of Product	3a. Study the alternate solutions for the development of new product. 3b. Synthesis of various ideas from different views.	3.1 Creative thinking: Creativity and problem solving, creative thinking methods, generating design 3.2 Concepts-systematic methods for designing, functional decomposition, physical decomposition, functional representation, ergonomics / aesthetics of the product.	06
4. Product Design	4a. Apply engineering knowledge for the designing of product. 4b. Analyze the product design from various aspects.	4.1 Industrial design: Human factors design, user friendly design, design for serviceability, design for environment. 4.2 Prototyping and testing, cost evaluation, categories of cost, overhead costs, activity based costing, methods of developing cost estimates, manufacturing cost, value analysis in costing.	08
5. Manufacturing Aspect	5a. Describe the need of manufacturing aspects with justification 5b. Select proper production techniques for the	5.1 Introduction : Need and application 5.2 Lean Manufacturing: Introduction, concept, principles, advantages and limitation 5.3 Agile manufacturing: Introduction, concept, principles, advantages and limitation 5.4 Compare lean manufacturing and agile manufacturing	10

	given product 5c. Compare Lean and Agile manufacturing technology 5d. State Merits and demerits of manufacturing aspects		
6. Operation Research	6a. Formulate the LPP model 6b. Optimize the given objective of LP 6c. Construct the network diagram using project management tool and techniques. 6d. Classify PERT and CPM	6.1 Introduction to Operation Research 6.2 Linear Programming : Graphical and Simplex method 6.3 Project Evaluation and review technique (PERT) 6.4 Critical Path Method (CPM)	12
		Total Hrs	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Use MS Excel to generate comparative statement for selected service industry on the basis of market survey	1. Introduction to Product Development	04
2	Use MS Excel to generate comparative statement for selected manufacturing industry on the basis of market survey		02
3	Collect Data of sales of any service industry.	2. Need Identification of Product Development.	02
4	Collect Data of sales of any manufacturing industry.		02
5	Prepare operation sheet for given service / manufacturing industry		02
6	Prepare design of the product using any software.	3. Concept Development of product	04
7	Prepare design of the product using any software.	4. Product Design	04
8	Use proper software to simulate the given situation.	5. Manufacturing Aspect	04
9	Develop PERT network diagram for maintenance of any situation.	6. Operation Research	04

10	Develop CPM network diagram for maintenance of any situation.		04
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Product	02(02)	03(03)	00(00)	05(05)
2	Need Identification of Product	02(00)	03(03)	03(03)	08(06)
3	Concept Development of product	02(02)	03(00)	03(03)	08(05)
4	Product Design	02(00)	03(00)	06(06)	11(06)
5	Manufacturing Aspect	02(00)	06(03)	06(03)	14(06)
6	Operation Research	02(02)	06(03)	06(03)	14(08)
	Total	12(06)	24(12)	24(18)	60(36)

R – Remember

U – Understand

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Options
1	1	R	2	2	R	2	3	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	3	R	2	6	R	2										
2	1	U	3	2	U	3	3	U	3	1	U	3	2	U	3				3/5
3	2	A	3	3	A	3	4	U	3	2	A	3	3	A	3				3/5
4	4	A	3	4	A	3	5	A	3	5	U	3	5	A	3				3/5
5	5	A	3	6	U	3	6	U	3	6	U	3	6	A	3				3/5
6	5	U	6	6	A	6	4	A	6										2/3

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 2 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 2 Marks

❖ ASSESSMENT AND EVALUATION SCHEME:

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	15	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	60	24	Theory Answer Scripts	1,2,3,4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	50	20	Practical Answer Scripts	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Market Survey, collection of information , compilation of data, results, etc.	20
2	Writing procedure.	10
3	Skills and Results	10
4	Viva voice	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							PSO	PSO
	1	2	3	4	5	6	7	1	2
1	3	3	3	3	3	-	3	3	-
2	3	3	3	3	3	-	3	3	-
3	3	-	-	-	3	-	-	3	-
4	3	3	3	-	3	-	-	3	-
5	3	-	-	-	3	-	-	3	-
6	3	3	3	-	3	-	-	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Product Design and Development	Anita Goyal, Karl T Ulrich, Steven D Eppinger Tata McGraw-Hill Education Edition, 2009	10-007-14679-9
2	Engineering Design: A Project-based Introduction	Clive L.Dym, Patrick Little John Wiley & Sons Edition 2009	978-0-470-22596-7
3	Engineering Design	George E.Dieter, Linda C.Schmidt McGrawHill International Edition, 2009	978-007-127189-9
4	Product Design	Kevin Otto, Kristin Wood Pearson Education	9788177588217
5	Engineering Design Process	Yousef Haik, T. M. M. Shahin Cengage Learning	0495668141
6	Operation Research	P.K. Gupta and D.S. Hira	

❖ **E-REFERENCES:**

- <https://www.productplan.com/learn/what-is-product-development/>
- <https://www.techtarget.com/searchcio/definition/product-development-or-new-product-development-NPD>
- <https://www.shopify.com/in/blog/product-development-process>
- <https://www.youtube.com/watch?v=K1TwNKA0BM>
- <https://www.youtube.com/watch?v=GL2UxjDIUb0>
- https://www.youtube.com/watch?v=k9qOo09KG_I
- <https://www.youtube.com/watch?v=GhJJkEavouA>
- <https://nptel.ac.in/courses/112107217>
- <https://www.basic-concept.com/c/basic-concept-of-product-development>
- <https://www.shopify.com/in/blog/product-development-process>
- <https://sites.tufts.edu/eeseniordesignhandbook/2013/customer-needs-identification-2/>
- <https://www.marketing91.com/concept-development/>
- <https://www.uxpin.com/studio/blog/product-design-trends/>
- <https://marutitech.com/guide-to-new-product-development-process/>

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

1. Computer Laboratory
2. Simulation Software
3. Design software

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Shri. P.V. Rekhade	HOD, ME (First Shift)	Government Polytechnic, Nagpur.
2	Dr. R.G. Choudhari	HOD, ME (Second Shift)	Government Polytechnic, Nagpur.
3	DR. M. M. Pawade	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
4	Shri. M.T. Gajbhiye	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur.
5	Er. A.M. Onkar	PBOS member & Chief Executive Officer	OnkarFurnitures, MIDC, Nagpur
6	Shri. G.F. Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
7	Shri. G.H. Dahole	MSBTE representative & Lecturer in Mechanical Engineering	Govt. Polytechnic, Gondia

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN AE/AI/CM/CE/EC/EE/IT/MC/ME/MT/
PK/TX/TR

COURSE CATEGORY: HUMANITIES AND SOCIAL SCIENCE COURSE

COURSE CODE : ES351G

COURSE TITLE : ENTREPRENEURSHIP AND START UP

TEACHING SCHEME : TH: 02; TU: 00; PR: 02 (CLOCK HRS.)

TOTAL CREDITS : 03 (1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2 CLOCK HR.)

TH. TEE EXAM : --

PR. TEE EXAM : --

PT. EXAM : --

RATIONALE:

Entrepreneurship as a mind set and a way of looking toward opportunity, focus and creativity. It's about creating value for customers, investor, entrepreneur, gaining independent in engineering career. Taking bold risk and solving challenges with undefined solution to be an entrepreneur, you need to have the ability to innovate, to improve the old and invent the new. In recent times, our society is influenced by knowledge creation and technological advancements. Competencies affecting Innovation and creativity have become important in all walks of life, including business context. This makes entrepreneurship education even more important for enhancing quality of life. Entrepreneurship plays an influential role in the economic growth and development of the nation. As the world economy is changing so is the dynamism of the business world. The aim of this course is to instil and kindle the spirit of Entrepreneurship amongst students. The idea of this course is to create job providers rather than job seekers.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to

1. Develop Entrepreneurial mindset.
2. Select self-employment as a viable option for earning dignified career.
3. Adapt the dynamic changes happening in the economy to create employment.
4. Prioritize entrepreneurship as life-skills to improve quality of life and skills of creation to start up.

5. Evaluate opportunities for new creation with overall business Potential and weakness.
6. Develop leadership skill particularly in the area of entrepreneur leadership.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Topics and Subtopics	Hrs.
1. Entrepreneurship Concept and Functions	1.1 Introduction to Entrepreneurship, Entrepreneurship – Concept, Functions and Need 1.2 Entrepreneurship – The Indian Scenario. 1.3 Business Environment and Domain knowledge	04
2. An Entrepreneur & Entrepreneurial Journey	2.1 Development of Entrepreneurial skill and inclination towards entrepreneurship. 2.2 Dimension of Entrepreneurship 2.3 Competencies and characteristics for entrepreneur.	05
3. Entrepreneurs-hip as Innovation and Start up	3.1 Entrepreneurs as problem solvers 3.2 Innovations and Entrepreneurial Ventures – Global and Indian 3.3 Idea generation, Incubation centre.	06
4. Understanding the Market	4.1 Market Concept 4.2 Micro and Macro Market Environment 4.3 Market Research – Concept and Marketing Mix	05
5. Business Finance and Project preparation	5.1 Business plan and project 5.2 Feasibility study of the project 5.3 Project report preparation	06
6. Resource Mobilization	6.1 Institutional Infrastructure to promote entrepreneurship 6.2 Selection and utilization of human resources. 6.3 Business Environment and start up	06

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Outline the success story of any Three entrepreneur from Your Discipline.	1. Entrepreneurship Concept and Functions	02
2	Outline the contribution of SME in GDP of India.	1. Entrepreneurship Concept and Functions	02
3	List out the Barriers faced by entrepreneurship.	1. Entrepreneurship Concept and Functions	02
4	Identify the entrepreneurial traits in students.	1. Entrepreneurship Concept and Functions	04
5	Elaborate the formation of family Business in case study format.	2. An Entrepreneur & Entrepreneurial Journey	02
6	Develop Case study on Technopreneurs like Infosys, UBER, and ZOMATO.	2. An Entrepreneur & Entrepreneurial Journey	06
7	Compose idea generation of new enterprises related to your branch.	3. Entrepreneurship as Innovation and Start up	04
8	Organization of technical feasibility report for the stakeholders and submission for approval.	4. Understanding the Market	04
9	Survey on SSI in your discipline.	5. Business Finance and Project preparation	04
10	List out the facilities and subsidy of SSI unit in your own discipline.	6. Resource Mobilization	02
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Nil❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:-** Nil

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests will be computed)	--	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assignments	--	--	Assignment Book	1, 2, 3,4,5,6
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Theory Answer Scripts	1,2,3,4,5,6
				Total	--	--		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	20	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	05	--	Journal	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course				
Indirect Assessment	Student Feedback on course		Students	After First PT	Student Feedback Form			1, 2, 3, 4,5,6
	End of Course Survey			End of The Course	Questionnaires			

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Practical Content	20
2	Entrepreneur Skills Observed	10
3	Result and Conclusion	10
4	Viva Voce	10
	TOTAL	50

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	1	2	3
1					3	3	3			
2					3	3	3			
3					3	3	3			
4					3	3	3			
5					3	3	3			
6					3	3	3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Entrepreneurship Development and Small Business Management.	Charantimath, P.M.	
2	Entrepreneurship Development in India.	Gupta C.B.	
3	Fundamental of Entrepreneurship and Small Business Management	Himalaya Publishing House.	

❖ **E-REFERENCES:**

1. Harvard Business Review
2. Business India/Business Today/Business World, University News
3. The Journal of Entrepreneurship by SAGE Publisher.
Journals.sagepub.com/home/joe
4. The journal of Entrepreneurship and Innovation in Emerging Economies by SAGE Publisher, journals.sagepub.com/home/eie.
5. International journal of Entrepreneurship and small Business by Inderscience Publisher, www.inderscience.com/ijesb
6. Vikalp Prabandhan

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

Nil

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr.C.P.Kapse	In Charge Head of Deptt, Textile Technology	Government Polytechnic, Nagpur.
2	Dr.G.K.Awari	Head of deptt. , Automobile Engg. Deptt.	Government Polytechnic, Nagpur.
3	Dr.K.S.Dixit	Lecturer, Automobile Engg.Deptt.	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CE/ME/EE/EC/CM/IT/AE/MT/PK/TX/
TR/MC/AIML

COURSE CATEGORY : PROJECT AND INTERNSHIP

COURSE CODE :IN351G

COURSE TITLE :INTERNSHIP

TEACHING SCHEME :TH: 00; TU: 00; PR: 30 (CLOCK Hrs.)

TOTAL CREDITS :15 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCKHR.)

Table: Credit framework for Internship.

Sr. No.	Suggested Schedule	Suggested Duration	Activities	Credits
1.	6 th Semester	16 Weeks	Inter/Intra Institutional activities	15
			Industries/Govt./Non-Govt./NGO/ Rural Internship/Innovation/Entrepreneurship/Research Organizations	
			Seminars/Presentations/Internal Evaluation Work	
			Seminars/Presentations/External Evaluation Work	

TH. TEE : --

PR. TEE : 02 HRs

PT. EXAM : --

❖ **RATIONALE:**

Internship is educational and career development opportunity, providing practical experience in a field or discipline. Industrial training is the demonstration of technical knowledge acquired by the students during their course work. This course provides an opportunity to the students to identify and solve real life problem of the industries / research organizations / society. The main aim of this initiative is enhancement of the employability skills of the students passing out from the institute.

The aim of the polytechnic education is to create a pool of skill based manpower to support shop floor and field operations as a middle level link between technicians and engineers. Diploma pass out plays an important role in managing shop-floor operations. Therefore, it is necessary to the diploma pass out to get acquainted with the actual shop floor operations in the industry. This course has been designed to give actual working environment exposure to the diploma students.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Improve career related skills
2. Adopt industrial safety practices
3. Originate survey, related to industrial processes.
4. Appraise industrial working environment.
5. Elaborate Industrial problems
6. Compile, prepare and present report on activities carried out.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
Nil			

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical No.	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Improve Career related activities • Soft Skills • Presentation skills • Career Guidance • Resume Writing skills • Group Discussion skills • Interview skills • Business Etiquette • Effective Email writing • Telephone etiquette • IT Foundation skills • Do's and Don'ts to be followed in Industry • Safety Practices	Orientation / Training	60
2	Adopt Industrial Safety Practices • Talk to safety officer • Record the safety practices to be followed in industry. • Record Don'ts and Do's. • Follow all instructions.	Safety Practices	60
3	Originate survey, related to the Industrial Process • Collect information regarding various processes carried out in an industry by discussing the allotted supervisor/officer • Note down findings • Prepare brief report	Survey	90
4	Appraise industrial working environment • Follow instructions of supervisor • Observe industrial processes • Record daily work done in diary	Working Experiences	120

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Not Applicable

❖ ASSESSMENT AND EVALUATION SCHEME:

ASSESSMENT AND EVALUATION SCHEME.								
☐	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous)	Progressiv e Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignment s		Continuous	--	--	--	--
	TEE (Term End)	End Exam	Stude nts	End of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessmen t of Practical	Students	End of Every week	40	--	Rubrics, Assessme nt Sheets & Report	1,2,3,4,5,6
		Report Writing		Continuous	10	--	Report	1,2,3,4,5,6
		Presentation and Viva- Voce		End of the Course or last two weeks	50	--	Rubrics, Report & Presentatio n	1,2,3,4,5,6
				Total	100	40		
	TEE	End Exam	Stude nts	End of the Course	100	40	Rubrics, Report & Presentati on	1, 2, 3, 4,5,6
	Indirect Assessment	Student Feedback on course		Stude nts	After First Progressive Test	Student Feedback Form		1, 2, 3, 4,5,6
End of Course		End of The Course	Questionnaires					

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Selection of industry	10
2	Survey	10
3	Work done and Feasibility of work/ problem identified	20
4	Report writing	10
5	Presentation Skills and Viva-Voce	50
Total		100

❖ **MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

Course Outcomes (Cos)	Program Outcomes (POs)							PSOs	
	1	2	3	4	5	6	7	1	2
1	2	-	2	2	3	3	3	3	3
2	2	3	3	3	2	3	3	3	3
3	3	3	3	3	-	2	3	3	3
4	-	2	3	2	-	3	3	3	3
5	2	3	3	2	1	3	3	3	3
6	-	2	2	-	-	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

❖ **REFERENCE & TEXT BOOKS:**

S. N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Industrial Training and Education	Lokesh Choudhary, Mittal Publications, 2007	10: 8183242367 13: 9788183242363
2	Training Practice	Penny Hackett, McGraw-Hill Education, September 2003	10: 0852929803 13: 9780852929803

❖ **E-REFERENCES:**

- <https://learning.tcsionhub.in/courses/career-edge-young-professional/>
- https://www.academia.edu/9360059/INDUSTRIAL_TRAINING_GUIDELINE_BOOK

❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

- DLP Projector
- Computers having latest specification

❖ **LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:**

S.N.	Name	Designation	Institute / Industry
1	Dr. M. V. Sarode	Head of Deptt., Computer Engg. Deptt and TPO	Government Polytechnic, Nagpur.
2	Dr. G. V. Gotmare	Lecturer	Government Polytechnic, Gondia.
3	Mr. Avinash Shende	Managing Director (Operation & Planning)	Virtual Galaxy InfoTech Pvt. Ltd. Nagpur
4	Mr. Sachin Pande	Managing Director (Business Development & Management)	Virtual Galaxy InfoTech Pvt. Ltd. Nagpur
5	Mr. Vijay Thakare	CEO	SimSoft Technologies Nagpur

(Member Secretary PBOS)



(Chairman PBOS)