

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 calliper, outside micro-meter 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 Semiconductors	2a. Apply Coulomb's inverse square law for determining the force between different 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.	2.1 Concept of charge, Coulomb's inverse square law, Electric field, Electric field intensity, potential and potential difference. 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.	08
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, Charle's 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	4.1 Definition of wave motion, amplitude, period, frequency & wavelength, relation between velocity, frequency & wavelength. Progressive wave, Stationary waves, longitudinal and transverse wave.	08

	data. 4c. Find given terms related to Acoustics. 4d. Calculate half-life period of given radioactive substance.	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 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 NDT.	04
		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(6)	30(18)	18(12)	60(36)

U – Understand

R – Remember U – Understand A – Analyze / Apply

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

L- Level of Question

T- Unit/Topic Number	L- Level of Question	M- Marks
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U-Understand

R-Remember U-Understand 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 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	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 slider 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)



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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 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
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>, Assessed on 25th July, 2021
- www.talkenglish.com-grammar , Assessed on 12th July, 2021
- www.perfect-english-grammar.com , Assessed on 18th March, 2021

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

S.N.	Name	Designation	Institute / Industry
1	Dr.RupaliLondhe	Lecturer in English & Coordinator	Government Polytechnic, Nagpur.
2	Prof NitinPote	Expert, Lecturer in English	Government Polytechnic, Bramhapuri
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.
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/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,	12

		Varignon's theorem of moment and its application. 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	08

		parallel to the plane. (Excluding ladder friction).	
Total Hrs.			48

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 13:978-938159558
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 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 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, Kapalbhathi, 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 Assignment s		Assignment s		--	Assignmen t 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		Assignment s	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	Prof. 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	--	--		Grades A,B, C
	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	--	--		Grades A, B, C.
	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 EE/EC/MC
COURSE CATEGORY:	BASIC SCIENCE COURSE
COURSE CODE	: MH 103G
COURSE TITLE	: APPLIED MATHEMATICS
TEACHING SCHEME:	TH: 03 ;TU:01 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT=1 CLOCK HR.)
TH. TEE EXAM.	: 03 HRs
PR. TEE EXAM	: --
PT. EXAM	: 01 HR

❖ **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, Complex Number and Laplace Transform. 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 function 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 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 ,properties and methods to solve indefinite and definite integral problems
5. Apply the concept of differential equation which helps to solve engineering problems.
6. Express the complex number in Polar and Exponential form, Apply Laplace Transform to solve the engineering problems.

❖ 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 the 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 limits of the given logarithmic functions.	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.	
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. 3e. Differentiate the given function w.r.t. another function. 3f. Find the second order	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

	derivatives of the given function.		
4. Indefinite and Definite Integration	4a. Integrate the give 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 function by, Integration by Parts or Partial Fraction. 4f. 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. Laplace Transform and Complex Number	6a. Find the Laplace transform the given function by using standard formulae or by properties. 6b. Find the Laplace transform the given function by using Laplace Transform of Derivatives. 6c. Express the given complex number in the form of $a+ib$, separate it	6.1 Concept of Laplace Transform, standard formulae And Properties. - Linearity property. - First And Second shifting property. - Change of scale property. 6.2 Laplace Transform of Derivatives. - Multiplication by t^n . - Division by t 6.3 Concept of complex number, Algebra of complex number, Equality of complex number. 6.4 Power of i , Argand's Diagram,	08

	into real and imaginary parts. 6d. Find the modulus and amplitude of the given complex number. . 6e. Express the given complex number into Polar form. 6f. Find the root of the given complex number. 6g. Verify the given relation by using Euler's Theorem and DeMoiver's theorem.	Modulus and Amplitude of complex number. 6.5 Polar form of complex number. 6.6 Roots of complex number. 6.7 Power of complex Number (DeMoiver's Theorem) and EULER's Theorem.	
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Assign ment	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 Applications of derivative	01
5	To find dy/dx of implicit functions.		01
6	To find dy/dx of parametric functions and inverse inverse trigonometric functions.		01
7	To find the Higher order Derivatives		01
8	Solve examples using rules of integration and substitution method.	4. Integration, Definite integration and Applications	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	Evaluate definite integral simple examples.		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 modulus and amplitude of the complex number.	6. Complex Number and Laplace Transform	01
16	Solve examples of Laplace Transform.		01

❖ SPECIFICATION TABLE FOR THEORY PAPER:

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(02)	06(00)	00(03)	08(05)
3	Derivatives, Second Order Derivative	02(00)	03(03)	06(03)	11(06)
4	Integration, and Definite Integration	02(02)	9(00)	03(06)	14(06)
5	Differential Equations	04(00)	06(03)	00(03)	10(06)
6	Complex Number and Laplace Transform	00(02)	00(06)	12(00)	12(08)
	Total	12(06)	24(15)	24(15)	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			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	2	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 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 Assignm ents		Tutorial Assignme nts	15	--	Assignment Book	1, 2, 3, 4,5,6
	TEE (Term End Examination)	End Exam	Stude nts	End of the Course	60	24	Theory Answer Scripts	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Continu ous Assessm ent of Practical	Students	End of Every Practical	--	--	--	--
		Journal Writing		Assignme nts	--	--	--	--
				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 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.Gaikawad, 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/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	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	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.ausetute.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 ELECTRICAL ENGINEERING
COURSE CATEGORY: PROGRAMME CORE COURSE
COURSE CODE : EE102G
COURSE TITLE : ELEMENTS OF ELECTRICAL 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:**

Electrical engineering students should know the facts, concepts, principles and procedures in electrical engineering. The basic aim of this course is that student must learn the basic concepts, rules and laws of electric and magnetic circuits and practical's thereof. It is very useful course for understanding the higher level knowledge in the field of electrical engineering.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply electrical safety concept.
2. Utilize different terms related with fundamentals of electricity.
3. Analyze DC circuit by using various theorems and prove it experimentally.
4. Identify different electrical symbols, components, measurement instruments and connect them in a circuit.
5. Make use of different laws and concepts in magnetism and electrostatics.
6. Operate electrical equipments.

❖ **COURSE DETAILS:**
A. THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Electrical Safety	1a. Apply electrical safety rules while working. 1b. Describe the procedure to remove the electrocuted person from live conductor. 1c. Interpret electrical safety signs and symbols. 1d. Apply different methods of artificial respiration on electrocuted person. 1e. Describe the procedure to operate fire-fighting equipment on different types of fires.	1.1 Electrical Safety, Causes of accidents, General safety rules, Concept of electrical shock, Effect of electric shock, Method of removing electrocuted person, Safety signs and symbols. 1.2 Artificial respiration-Schaefer's method, Silvester's method, mouth to mouth respiration. 1.3 First Aid. Electric Fire, Causes of Fire, Basic ways of extinguishing the fire Classification of fire, Class A, B, C, D, Firefighting equipment fire extinguishers, and their types.	06
2. Fundamentals of Electricity	2a. Define the various Electrical Parameters. 2b. State different effects of electric Current. 2c. Define the terms work, power and energy. 2d. State Ohm's Law and laws of resistance and its applications. 2e. Calculate the temperature coefficient of resistance. 2f. State types of sources and loads. 2g. Solve the numerical based on work, power energy.	2.1 Concept of electric charge, current, voltage drop, EMF, potential difference, Direction of current and their SI units. 2.2 Different effects of electric current. 2.3 Resistance, unit of resistance, Law of resistance (Factors affecting resistance), Effect of temperature on resistance, temperature coefficient of resistance, Ohms law. (Numerical problems based on 2.3) 2.4 Concept of Conductors, insulators, semiconductors with examples. 2.5 Work, power, energy and their SI units, Joule's law, Relation between H.P and watts, Kwh and Kcal, cost of electrical energy. (No derivations, Numerical problems based on 2.5) 2.6 Types of sources and loads.	14
3. DC Circuits	3a. State properties of series, parallel and series- parallel resistive circuits. 3b. Solve series, parallel and	3.1 Concept of DC voltage & current. 3.2 Resistance in series, properties of series circuit, voltage	10

	series- parallel resistive circuits. 3c. Perform source Transformation. 3d. Describe open circuit and short circuit. 3e. Describe the concept of Ideal voltage source and Practical Voltage Source. 3f. Describe the concept of Ideal current source, Practical current Source.	distribution in series circuit, equivalent resistance of series circuit, Applications of series circuits. 3.3 Resistance in parallel, properties of parallel circuit, current distribution in parallel circuit, equivalent resistance of parallel circuit, Applications of parallel circuits. 3.4 Series-parallel combination, Equivalent resistance of series-parallel combination. Application of Ohm's law for simple DC circuits (Numerical problems based on 3.4) 3.5 Types Of DC Electric Current source, Ideal voltage source, Practical Voltage Source, Ideal current source, Practical current Source, Source transformation. Concept of Open circuit and short circuit.	
4. Electrostatics	4a. Define terms related to Electrostatics. 4b. Describe parallel plate Capacitor. 4c. Describe charging and discharging of capacitor. 4d. Solve series, parallel capacitor circuits. 4e. State types of capacitors.	4.1 Concept of electric field, electric flux, electric intensity, electric flux density, electric potential, potential gradient, dielectric strength. 4.2 Capacitance, dielectric constant, capacitance of parallel plate capacitor 4.3 Capacitance in series and parallel and source of capacitance in electrical systems. Charging & discharging of capacitor, Dielectric loss. (Numerical problems based on 4.3) Types of capacitor and their application.	10
5. Magnetism and Electromagnetism	5a. Define terms related to magnetism and electromagnetism. 5b. State laws related to magnetism and electromagnetism. 5c. Describe B-H curve. 5d. Solve problems related to magnetism and	5.1 Laws of magnetic force, magnetic field, Absolute and relative permeability of a medium, concept of lines of force, Magnetic flux and magnetic flux density and field intensity. Relation between B and H. 5.2 Concept of MMF, Reluctance,	12

	electromagnetism. 5e. Describe Inductances in series and parallel. 5f. Apply Fleming's right hand rule and Lenz's law to determine direction of induced EMF in a given circuit. 5g. Identify the similarities and dissimilarities magnetic and electric.	Magnetic circuits, Comparison between electric and magnetic circuits, concept of leakage flux and leakage coefficient, calculation of ampere-turns for simple series magnetic circuit, B-H curve, hysteresis loop & hysteresis loss. (Simple numerical) 5.3 Magnetic effect of electric current, Right hand thumb rule, Interaction between magnetic fields, force on current carrying conductors, Fleming's left hand rule. 5.4 Faraday's Laws of electromagnetic induction. 5.5 Direction of induced EMF and current, Lenz's Law, Fleming's right hand rule, Induced EMF, Dynamically induced EMF, statically induced EMF, self Inductance (L), Mutual Inductance, co-efficient of coupling. (Numerical on 5.4 & 5.5) 5.6 Inductances in series and parallel, rise and decay of current in an inductive circuit, Behavior of inductor on AC & DC	
6. AC Fundamentals	6a. Define terms related to AC fundamentals. 6b. Compare terms time period and frequency, angular velocity and frequency, frequency and speed. 6c. Perform addition and subtraction of alternating quantities. 6d. Solve problems related to pure resistive, inductive and capacitive circuit.	6.1 Generation of alternating voltage- single phase and three-phase. 6.2 Equation of sinusoidal alternating voltage and current, important terminology such as- waveform, instantaneous value, cycle, time period, frequency, amplitude, Relation between time period and frequency, angular velocity and frequency, frequency and speed. 6.3 Maximum, average and R.M.S. value of sinusoidal waveform, form factor and peak factor. (Numerical based on 6.2& 6.3). 6.4 Phase and phase difference, phasor representation of sinusoidal voltage and current,	12

		addition and subtraction of alternating quantities.A.C. Voltage applied to pure resistor, pure inductor, and pure capacitor. Concept of reactance, and power factor, power in single- phase circuits. (Simple Numerical)	
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❖ **LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify electrical measuring instruments, sources, ICDP/ITDP, switches, loads, wires and execute safety precautions in laboratory.	1. Electrical Safety	04
2	Connect voltmeter, ammeter and wattmeter in electrical circuit.	2. Fundamentals of Electricity	02
3	Measure the current, voltage and resistance with the help of multi-meter or tong tester.		02
4	Find unknown resistance in an electric circuit using Ohms law.		02
5	Find temperature coefficient of materials.		02
6	Calculate equivalent resistance of series circuit.	3.DC Circuits	02
7	Calculate equivalent resistance of parallel circuit.		02
8	Plot charging and discharging curves of capacitor.	4. Electrostatics	04
9	Measure capacitance of capacitor using LCR meter and Calculate equivalent capacitance in series and parallel circuit.		02
10	Plot the B-H loop of a Ferro-magnetic core material.	5.Magnetism and Electromagnetism	02
11	Measure the inductance of a given coil.		02
12	Operate CRO to measure amplitude, time period, frequency, phase difference for sinusoidal wave forms.	6. AC Fundamentals	02
13	Find current response of pure resistive circuit.		02
14	Find current response of pure Inductive/capacitive circuit.		02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Electrical Safety	02(00)	03(03)	00(00)	05(03)
2	Fundamentals of Electricity	05(02)	03(06)	06(00)	14(08)
3	DC Circuits	04(02)	06(03)	00(00)	10(05)
4	Electrostatics	02(00)	06(03)	00(00)	08(03)
5	Magnetism and Electromagnetism	05(00)	06(03)	00(06)	11(09)
6	AC Fundamentals	00 (02)	06(06)	06(00)	12(08)
	Total	18(09)	30(21)	12(06)	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
	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	5	R	2	6/9
	6	R	2	2	R	2	3	R	2										
2	1	U	3	2	R	3	3	U	3	1	U	3	2	U	3				3/5
3	2	U	3	3	U	3	5	U	3	3	U	3	2	U	3				3/5
4	4	U	3	6	U	3	5	U	3	5	U	3	6	U	3				3/5
5	4	U	3	6	U	3	5	R	3	6	U	3	4	U	3				3/5
6	2	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		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	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 equipments. 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	-	-	-	2	-	-	2	2
2	3	3	2	2	-	-	3	-	-
3	3	3	-	-	-	-	2	2	-
4	3	-	2	3	2	-	2	3	2
5	3	3	2	3	2	-	2	3	2
6	3	2	2	3	2	-	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	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
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❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , accessed on 21st 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

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

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

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

S.N.	Name	Designation	Institute / Industry
1	Mr. A. M. Arekar	Chairman ,PBOS &, HOD Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Mrs.A.A.Alegaonkar	CDC Coordinator & Lecturer , Electrical Engg. Deptt.	Government Polytechnic, Nagpur
3	Ms.P. S.Rithe	Expert & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur.
4	Shri.M.C.Musale	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
5	Shri.M.N.Gawande	Expert & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
6	Mrs.A.P.Gandhi	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
7	Mrs.P.M.Sonwane	Expert & Lecturer in Electrical 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 ELECTRICAL ENGINEERING
COURSE CATEGORY:	ENGINEERING SCIENCE COURSE
COURSE CODE	: EC103G
COURSE TITLE	: FUNDAMENTALS OF ELECTRONICS
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:

Diploma engineers have to deal with the various electronic components while maintaining various electrical systems. This course gives the students an idea of basic operating principles and handling of various electronic components and devices. This course will enable the students to apply the knowledge to solve broad electronics engineering application problems in electrical engineering field.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify and test different electronic components and devices.
2. Select appropriate electronic circuit for particular application.
3. Assemble a given analog/digital circuit.
4. Design a digital circuit using Boolean expression.
5. Design a regulated power supply as per requirement.
6. Interpret the characteristics and waveforms of electronic circuits.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. PN junction Diode	1a. Define various terms related to semiconductor. 1b. Describe the Formation of PN junction. 1c. Draw & describe the Forward and reverse V-I characteristic of PN junction diode 1d. Describe the working Principle of PN junction diodes. 1e. State Specification of Diodes.	1.1 Importance of Electronics 1.2 Commonly used semiconductors: Germanium and Silicon 1.3 Intrinsic Semiconductor, Extrinsic Semiconductor 1.4 Formation of PN junction, Depletion region 1.5 PN junction diode - Symbol, Terminal identification, Forward and reverse biasing, V-I characteristics, Avalanche breakdown	06
2. Diode Applications	2a. Interpret the need of following types of circuits. • Rectifiers • Filters. 2b. Describe circuit diagram and operation of rectifiers and filters. 2c. Describe circuit diagram and operation of integrator and differentiator. 2d. Select a particular circuit as per the requirement. 2e. Describe the following types of diodes. i) LED ii) Photodiode	2.1 Circuit Diagram, Working, Waveforms, Advantages, Disadvantages and applications of – Diode Rectifiers i) Half Wave Rectifier, ii) Full wave centre tap rectifier iii) Full wave Bridge rectifier. 2.2 Filters- π – filter 2.3 Integrator 2.4 Differentiator 2.5 Special purpose Diodes – LED, Photodiode (only Symbol, working and applications)	08
3. Bipolar Junction Transistor (BJT)	3a. Identify the terminals related to following transistors. i) PNP ii) NPN 3b. Draw the symbols of PNP and NPN transistor. 3c. Describe the constructional details	3.1 PNP and NPN transistor - Symbol, terminal identification, Working principle 3.2 Input and output characteristics of transistor in CE configuration 3.3 Advantages of CE configuration 3.4 Applications of Transistor as a switch and Transistor as an amplifier 3.5 Frequency response of transistor	08

	of Transistor 3d. Describe the operating regions of transistor. 3e. Enlist the application of transistor 3f. Select a transistor as per application.	amplifier	
4. Electronic Components	4a. Define the following components: Passive component Active components. 4b. List the examples of the materials used for carbon composition resistor. 4c. Compare wire wound resistor and carbon composition resistor. 4d. Classify switches. 4e. Classify relays. 4f. Enlist the applications of relays. 4g. Select a particular component as per application. 4h. Compare between LED and LCD. 4i. Classify the different types of display. 4j. Describe constructional details of toggle switch.	4.1 Definition – Active components, Passive components 4.2 Resistors - Classification – Fixed, Variable, Types – Carbon Composition, wire-wound (Construction) 4.3 Colour coding of resistors 4.4 Potentiometer – Working principle, construction 4.5 Capacitors - Classification – Fixed, Variable, Types – Ceramic, Electrolytic (Construction) 4.6 Colour coding of capacitors 4.7 Microphones - Working principle, construction, applications of Carbon microphone, Condenser microphone 4.8 Speakers - Working principle, construction, applications of Horn loudspeaker 4.9 Relays - Working principle, construction, applications of Electromagnetic relay 4.10 Switches – Types – SPST, SPDT, DPST, DPDT, toggle, push button, micro switch 4.11 Displays – Working principle, construction of 7 segment LED display	12
5. Digital Electronics	5a. Convert a decimal number to binary, octal, hexadecimal number. 5b. Draw symbols and state truth table of different gates and flip-flops. 5c. Realize a Boolean expression using gates. 5d. Construct basic gates using universal gates 5e. Realize a combinational circuit	5.1 Number system – Types 5.2 Decimal to Binary conversion, Binary to Decimal Conversion 5.3 Logic Gates – Logic symbol and truth table of – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR 5.4 Realization of Boolean Expression using Basic Gates 5.5 Combinational Circuits – Half Adder, Full Adder 5.6 Sequential Circuits – Symbol, Truth table and Working of JK Flip-flop, D flip flop and T flip	08

	using gates. 5f. Describe working of different flip flops.	flop.	
6. Regulated Power Supplies	6a. Identify the blocks of a regulated power supply. 6b. Select a particular configuration as per requirement. 6c. Illustrate the Zener breakdown in Zener diode. 6d. Describe Zener Diode as a voltage Regulator.	6.1 Zener diode Symbol, terminal identification, VI characteristics, Zener voltage regulator 6.2 Block diagram of regulated power supply 6.3 Block diagram of SMPS 6.4 IC based regulators - 78xx series regulators, 79xx series regulators, LM723 variable regulator	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	i) Set the proper voltage & current limits with controls in regulated power supply. ii) Measure voltage & currents using multimeter.	-	02
2	Use the different front panel controls of CRO for measurement.	-	02
3	Measure Vp-p & frequency for different waveforms generated from function generator on CRO.	-	02
4	A) Test the PN junction diode using a multimeter B) Plot the V-I characteristic of PN junction diode	PN junction Diode	02
5	Connect Half-wave rectifier and Full wave center tap rectifier with CRO and draw the input and output waveforms	Diode Applications	04
6	Measure and compare the ripple voltage from the output waveform of Bridge rectifier without capacitor filter and with capacitor filter.	Diode Applications	02
7	Plot the frequency response of single stage CE amplifier. Measure the bandwidth	Bipolar Junction Transistor	02
8	Calculate the value of resistor using colour coding. Measure the value using a multimeter. Compare both results.	Electronic components	02
9	A) Calculate the value of capacitor using colour coding. B) Calculate the value of ceramic capacitor using numeric code.	Electronic components	04
10	Verify the truth table of AND, OR, NOT, NAND, NOR and EX-OR gates.	Digital Electronics	02
11	A) Verify the truth table of Half and Full Adder. B) Verify the truth table of Half and Full Subtractor.	Digital Electronics	04
12	Experiment to be carried out in different groups:	Regulated Power	04

	A) Build a +12V regulator using IC7812. B) Build a -12V regulator using IC7912. C) Build a variable voltage regulator using IC LM723.	Supplies	
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	PN junction Diode	00(04)	06(00)	00(00)	06(04)
2	Diode Applications	04(03)	06(03)	00(00)	10(06)
3	Bipolar Junction Transistor (BJT)	06(00)	06(06)	00(00)	12(06)
4	Electronic Components	04(00)	03(05)	03(03)	10(08)
5	Digital Electronics	02(00)	03(03)	09(03)	14(06)
6	Regulated Power Supplies	02(00)	06(06)	00(00)	08(06)
	Total	18(07)	30(23)	12 (06)	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	2	R	2	2	R	2	4	R	2	4	R	2	5	R	2	6	R	2	6/9
	1	R	2	1	R	2	4	U	2										
2	1	U	3	2	U	3	3	U	3	2	R	3	2	U	3				3/5
3	1	U	3	2	U	3	3	U	3	4	U	3	5	U	3				3/5
4	4	U	3	5	U	3	4	A	3	3	U	3	4	A	3				3/5
5	3	R	3	3	R	3	5	A	3	3	U	3	5	A	3				3/5
6	6	U	6	5	A	6	6	U	6										2/3

❖ **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	--	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
1	3	3	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	-
3	3	3	-	-	-	-	-	2	-
4	3	3	3	3	-	-	2		-
5	3	3	3	3	-	-	2	2	-
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	Electronic Devices and Circuit Theory	Boylestead, Robert, Pearson Education, New Delhi, 2014	
2	Electronic Devices and Circuit Theory : An Introduction	Mottershed, Allen, Goodyear Publishing Co. New Delhi	9780876202654
3	The Art of Electronics	Horowitz, Paul Hill, Winfield, Cambridge University Press, New Delhi 2015	9780521689175
4	Fundamentals of Electronic Devices and Circuits	Bell, David Oxford University Press, New Delhi 2015	9780195425239
5	Electronic Devices and Circuit	Maini, Anil K Wiley India, New Delhi	9788126518951

❖ **E-REFERENCES:**

- www.nptel.iitm.ac.in
- www.datasheetcafe.com
- www.williamson-labs.com
- www.futurelec.com
- www.bis.org.in
- www.learnerstv.com
- www.cadsoft.io
- www.khanacademy.com

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

1. Variable DC power supply 0-30V, 2A, SC Protection
2. Cathode Ray Oscilloscope – Dual trace 20MHz, 1M Ω , Input Impedance
3. Function Generator 0-2MHz, sine, square and triangular output
4. Digital Multi-meter 3 ½ digit display
5. Electronics Workbench
6. Universal IC Tester

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

S.N.	Name	Designation	Institute / Industry
1	Dr. R.V. Yenkar	HOD (EC-Second Shift)	Government Polytechnic, Nagpur.
2	Dr. V.H. Mankar	HOD (EC- First Shift)	Government Polytechnic, Nagpur
3	Prof. Mrs. P.A.Meshram	Lecturer In Electronics	Government Polytechnic, Nagpur
4	Prof. Ms. J.A.Raut	Lecturer In Electronics	Government Polytechnic, Nagpur
5	Shri. Sandip V. Darwhekar	Director	Beta Computer Pvt. Ltd. Nagpur
6	Mrs. Gazala Ali	HOD, Electronics	Anjuman Polytechnic, Nagpur
7	Prof. Kapil Pachpor	Lecturer in Electronics	Govt.Polytechnic, Amravati

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN MECHATRONICS/ ELECTRICAL ENGG.
COURSE CATEGORY:	ENGINEERING SCIENCES COURSE
COURSE CODE	: ME102G /ME103G
COURSE TITLE	: ELEMENTS OF MECHANICAL 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:

This course is classified under basic technology courses. This course describes the basic facts, concepts & principles for the understanding of basic elementary knowledge related to mechanical engineering, which are commonly used in any discipline of Engineering & Technology. This course introduces basic terminology of oil hydraulics and pneumatics as well as Industrial Robotics with NC/ CNC machine to realize needs of electronics sensor & PLC for automation in Industry.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select proper mechanical parts/ accessories of machines & IC Engines.
2. Identify power transmission system.
3. Identify Engine parts.
4. Use proper maintenance tools.
5. Assemble & dismantle engines.
6. Identify the parts in Refrigeration and air conditioning system.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Maintenance Tools	1a. Identify basic mechanical tools. 1b. State types of maintenance tools. 1c. Draw the sketches of tools. 1d. Describe different maintenance tools. 1e. Use cutting tools, hammering tools and maintenance tools.	1.1 Cutting tools- files, drills, chisels, hacksaws- their types, specifications, applications & precautions while handling 1.2 Hammering tools- hammers, mallets- their types, specifications, applications & precautions while handling. 1.3 Maintenance tools- screw drivers, pliers, spanners, wrenches- their types, specifications, applications & precautions while handling.	06
2. Transmission of Power	2a. Define various power transmitting devices. e.g. shaft, bearing, belts, gears, cam. 2b. Compare power transmitting drives. 2c. Draw and describe various types of drives. 2d. Select proper drives for particular application.	2.1 Shafts- Function & its types, Couplings-Function, classification, election of coupling for particular application, Bearings- Function, classification, selection of bearing for particular application 2.2 Cam & Follower-Meaning, Types of Cam & Follower, Terminology. 2.3 Belt drive & Chain Drive – Open and cross belt drive, sleep and creep in belts, comparison between belt and chain drive 2.4 Gear Drives-Types of Gears, Speed of gear, gear terminology, advantages of gear drive.	08
3. IC Engines	3a. State need of IC Engine & classify it. 3b. Describe SI/CI engines, its part and operation with neat sketch. 3c. Interpret two stroke-four stroke engine and comparison between SI and CI engines.	3.1 Internal combustion engine: Necessity, Classification & Fuels used for I.C. Engines. 3.2 Construction, working principle & applications of-- Two stroke & four stroke engines. (Petrol & Diesel) 3.3 Comparison between : i) Two stroke & Four stroke engine, ii) S.I. Engine & C.I. Engine	08
4. Turbines	4a. Draw layout of Thermal and hydro power plant. 4b. State function of turbine. 4c. Classify hydro-turbines.	4.1 Steam turbines- Layout of thermal power plant. 4.2 Impulse and reaction Steam turbine. 4.3 Hydro turbines- Layout of hydro power plant, classification. 4.4 Factors to be considered while selecting hydro turbine.	08

	4d. Select proper turbine as per head. 4e. Compare different turbines.	4.5 Pelton, Francis and Kaplan turbine (only figure & working).	
5. Refrigeration and Air Conditioning	5a. Draw layout and structure of Refrigeration Systems. 5b. Select proper Refrigerants. 5c. Define COP, TR. 5d. Draw layout of Air-conditioning System.	5.1 Refrigeration Systems such as – Vapour Compression Refrigeration System, Vapour; Absorption Refrigeration System 5.2 Refrigerants such as – R12, R22, Ammonia 5.3 Capacity of Refrigeration Plant in TR, Compressor Work, COP 5.4 Air-conditioning System, Cycle of Air-conditioning, Portable AC, Split AC, Ducted AC, COP of Air-conditioner, Capacity of Air-conditioner in TR.	10
6. Boilers	6a. Classify boilers. 6b. Classify Mountings and accessories. 6c. Draw the block diagram of a given Boiler.	6.1 Classification of boilers 6.2 Boiler Mountings and Accessories 6.3 Fire-tube boiler, Water-tube boiler, La-Mount Boiler, Benson Boiler.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify various cutting, hammering & maintenance tools.	1. Maintenance tools	04
2	Use different maintenance tools for maintenance work.	1. Maintenance tools	04
3	Select drives for various applications.	2. Transmission of power	04
4	Dismantle and assemble four stroke diesel engines.	3. IC Engines	04
5	Operate Pelton turbine.	4. Turbines	04
6	Operate Francis turbine.	4. Turbines	04
7	Operate and observe Vapour Compression Refrigeration System.	5. Refrigeration and Air conditioning	04
8	Study the working of water tube boiler .	6. Boilers	04
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Maintenance Tools	02(02)	03(06)	00(00)	05(08)
2	Transmission of Power	02(02)	03(06)	00(00)	05(08)
3	IC Engines	05(00)	06(06)	00(00)	11(06)
4	Turbines	02(02)	06(03)	06(00)	14(05)
5	Refrigeration and Air conditioning	05(02)	06(03)	06(00)	17(05)
6	Boilers	02(02)	06(00)	00(06)	08(08)
	Total	18(10)	30(24)	12(06)	60(40)

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
	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	4	R	2	6	R	2	6/9
	5	R	2	1	U	2	1	U	2										
2	3	R	3	5	R	3	1	U	3	2	U	3	2	U	3				3/5
3	3	U	3	3	U	3	4	U	3	4	U	3	5	U	3				3/5
4	6	U	3	6	U	3	5	U	3	4	A	3	4	A	3				3/5
5	5	A	3	5	A	3	6	A	3	3	U	3	3	U	3				3/5
6	6	A	6	5	U	6	3	U	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	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 diagrams of tools, fasteners, drives, pumps, IC engines and turbines, selection of equipments. 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	2	3	2
2	3	3	3	2	-	3	2	3	2
3	3	3	3	2	-	3	2	3	2
4	3	3	3	2	2	3	2	3	2
5	3	3	3	2	2	3	2	3	2
6	3	3	3	2	2	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 Thermal Engineering	S. Domkundwar., C. P. Kothandaraman and A. V. Domkundwar, Published by Dhanpat Rai& Co. 2004	13: 9788177000214
2	A Textbook Of Thermal Engineering	R.S. Khurmi& J.K. Gupta ; S. Chand & Company Ltd. ; New Delhi.	ISBN: 9788121925730, 9788121925730
3	Elements of Workshop Technology-vol.1	S.K. Hajra Choudhary& A.K. Hajra Choudhary ; Media Promoters & Publishers Pvt. Ltd., Mumbai.	ISBN :9780906216019
4	Mechanisms and Mechanical Devices	Neil Sclater ; Mc-Graw Hill Education.	ISBN: 9780071704427

5	Steam and Gas Turbines and Power Plant Engineering	Dr. R. Yadav ; Central Publishing House, Allahabad.	ISBN: 13-978-8185444352
6	Refrigeration And Air Conditioning	W. F. Stoecker, McGraw Hill India	ISBN:13-978-9332902954
7	I.C. Engines	V. Ganesan	ISBN:13-978-0070648173

❖ **E-REFERENCES:**

1. <https://www.youtube.com/watch?v=BaEHVpKc-1Q>, accessed on 29th March, 2021
2. https://www.youtube.com/watch?v=qbyL--6q7_4, accessed on 29th March, 2021
3. <http://hillagric.ac.in/edu/coa/agengg/lecture/243/Lecture%203%20Engine.pdf> accessed on 29th March, 2021

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

1. Shop Maintenance Tool Kit
2. Single Cylinder Diesel Engine for Assembly and Disassembly
3. Vapour Compression Refrigeration Test Rig
4. Model of La-Mont Boiler

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

S.N.	Name	Designation	Institute / Industry
1	Prof. 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.S. B. Bambole	Course Expert & Lecturer in Mechanical Engg	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 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.

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

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	: ONLINE EXAMINATION
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.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN EE/CM/IT/EC/MT/TX/AI
COURSE CATEGORY	: ENGINEERING SCIENCE COURSE
COURSE CODE	: ME151G
COURSE TITLE	: ENGINEERING GRAPHICS
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 HR
PT. EXAM	: --

❖ **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 blueprints. 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. Apply various drawing codes, conventions and symbols as per IS SP-46 in engineering drawing.
2. Redraw the given drawing by using appropriate geometrical construction.
3. Sketch different types of engineering curve by different methods.
4. Draw isometric projections into orthographic projections.
5. Visualize three dimensional objects and draw isometric projections.
6. Draw freehand sketches of a given engineering element.

❖ **COURSE DETAILS:****A. PRACTICALS :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	PR Hrs
1. Principles of Drawing	1a. Use of instruments for drawing, scales, lines and their applications. 1b. Use of IS:SP-46. 1c. Loci of points from given data.	1.1 Use of different drawing instruments and equipment 1.2 Types of letters and numbers (single stroke vertical and numbers only) 1.3 Conventions of lines, 1.4 Dimensioning technique as per IS:SP-46 1.5 Scales :(reduced, enlarged and full size)-Plain scale, diagonal scale.	06
2. Redraw and Loci of Points	2a. Learn different geometrical construction methods. 2b. Drawing locus of point from given data.	2.1 Different geometrical construction Methods and Redrawing. 2.2 Loci of points	06
3. Engineering Curves.	3a Draw an ellipse by given method 3b Draw parabola by given method 3c Draw hyperbola by given method. 3d Draw involute, and state their applications. 3e Draw a given cycloid and state its applications .	3.1 To draw an ellipse by- i) Arcs of circles method ii) Concentric circles method 3.2 To draw parabola- i) Rectangle method ii) Directrix- focus method 3.3 To draw hyperbola by- i) Passing through a given point With reference to given asymptotes ii) Directrix- focus method 3.4 To draw involutes of circle and Polygon of maximum six sides 3.5 To draw cycloid, epi-cycloid and hypo-cycloid	12
4. Orthographic Projections.	4a. Visualize, interpret and draw orthographic views from given pictorial views. 4b. Difference between first angle and third angle method of projection. 4c. Use of IS:SP-46 for dimensioning technique.	4.1 Introduction to orthographic Projection. 4.2 First angle and Third angle method of projections. 4.3 Conversion of simple pictorial views into orthographic views and dimensioning techniques as per IS. SP-46	14

5. Isometric Projections	5a. Visualize, interpret and draw Isometric views from given orthographic views.	5.1 Isometric scales 5.2 Isometric views of simple object (plane surfaces, slanting surfaces, and Rectangular, V, Trapezoidal slots)	14
6. Freehand Sketches	6a. Prepare proportionate freehand sketches of given machine elements. 6b. Describe functions and use of machine element.	6.1 Types of screws and threads profile— Vee and square, acme, buttress, seller, BA threads, knuckle threads. 6.2 Bolts—square and hexagonal bolts, eyebolt 6.3 Types of nuts: square, hexagonal, wing 6.4 Foundation bolts: Eye foundation bolt, Rag foundation bolt, Lewis foundation bolt 6.5 Single and double Riveted Lap and Butt joints	12
Total Hrs.			64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Draw types of lines, lettering, numbers and two problem from sub topics 1.5 of Unit 1 (01 Sheet)	1 Principles of drawing	06
2	Draw two problems each from subtopic 2.2 and 2.3 from Unit 2 (01 Sheet)	2 Redraw and Loci of Points	06
3	Draw Engineering Curves, one problem from each sub topic of Unit 2. (01 Sheet)	3 Engineering Curves	12
4	Draw two problem using first angle method of projection (01 Sheet)	4 Orthographic Projections	14
5	Draw one problem with plane surfaces & other with slot, slanting surfaces (using natural scale and isometric scale) (01 Sheet)	5 Isometric Projections	14
6	Draw Free Hand Sketches—any ten sketches covering all the topics under Unit 6 (01 Sheet)	6 Free Hand Sketches	12
Total Hrs.			64

❖ **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		Continuous	-	--	-	-
	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	--	Drawing Sheets	1, 2, 3,4,5,6
		Drawing Portfolio		Assignments	05	--	Drawing Portfolio	1, 2, 3,4,5,6
				Total	25	10		
	TEE (Term End Examination)	End Exam	Students	End of the Course	25@	10	Drawing Answer sheets	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	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 Outcome s (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	-	—
5	3	3	3	-	—	—	2	-	—
6	3	3	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	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.J Shaha, 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=j5nwO-JwVv4&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:**

- 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. Rekhade	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, Nagpur.
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	Govt. Polytechnic, Gondia

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE201G
COURSE TITLE	: ELECTRIC POWER GENERATION^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: NIL
TOTAL CREDITS	: 03 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: -NIL
PT.	: -1 HR

❖ **RATIONALE:**

This course is classified under applied technology courses. Knowledge of various energy sources is essential for the diploma holder for generation of the electrical energy. Also knowledge of constructional features, operations of different machineries and equipments of power generating station is necessary for the electrical engineers so as to enable him to satisfy the increasing demand of electrical energy in industrial complexes.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to—

1. Maintain the optimized working of thermal power station.
2. Identify hydro- Electric Power Station based on head of water.
3. Select the site for Nuclear power plants.
4. Apply the knowledge of functioning of generating equipment for supervision and maintenance in Diesel Power Plant.
5. Analyze the environmental impact of gas power plant.
6. Calculate performance parameters of power plants.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Thermal Power Station	1a. Describe the function of given systems in thermal power plant using block diagram. 1b. Describe the working of given type of turbine. 1c. List location of Thermal power plants in Maharashtra with their capacities.	1.1 Generation of electric energy. Types of coal and their calorific values , Electric energy Sources – conventional & renewable, Advantages & disadvantages of thermal power station , Site selection for thermal power plant, line & Block diagram of the system showing the process of energy conversion. Functions of equipment used in the systems such as, • Coal handling plant • Ash handling plant • Boiler • Economizer • Air pre –heater • Super-heater • ID /FD fans • Condensers • Cooling towers & Cooling systems 1.2 Steam turbine- working principle, type, & specification, Alternator : Special features of turbo alternator , specification , Electrostatic precipitator : definition, Application, use . 1.3 Location of Thermal power plants in Maharashtra and their capacities, Causes of pollution in thermal power plant, environmental impact of thermal power plant	12
2. Hydro- Electric Power Station	2a. Select site for hydroelectric plant , describe working with the line & block diagram of hydro plant . 2b. Classify Hydroelectric power plant on the basis of	2.1 Introduction, Advantages and disadvantages of hydroelectric plants. Site selection for hydroelectric plant, line and block diagram of the system showing the process of energy conversion. 2.2 Classification of hydroelectric power stations: High, medium & low head, functions of catchment	10

	head . 2c. Identify given types of turbine used in hydro plant based on head of water . 2d. Justify the use of Pumped storage plants .	area, dam, spillways, surge tank, reservoir, penstocks and tailrace. 2.3 Classification of turbine based on head of water: Pelton turbine, Francis turbine, Kaplan turbine . Working principle & constructional feature of each type of turbines. 2.4 Pumped storage plants for supplying peak load- description, advantages, location of hydro power plants in Maharashtra and their capacities	
3. Nuclear Power Station	3a. Select site for nuclear plant . 3b. Describe working Principle, function of given system in Nuclear power plant. 3c. Compare the given nuclear reactors on given points . 3d. Classify radiations & describe effects of given radiation on humans.	3.1 Introduction, Advantages disadvantages of nuclear power plant, site selection for nuclear plant, Nuclear power plants in India and their capacities . 3.2 Line and block diagram of the system showing the process of energy conversion. 3.3 Nuclear fission, chain reaction, moderator and coolant, fissile and fertile materials and their properties , Nuclear reactors , classification, Boiling water reactor , Pressurized water reactor, liquid metal fuel reactor, CANDU reactor, Fast breeder reactor. 3.4 Types of radiations, effects of radiation on humans, shielding, types of nuclear wastes and their disposal.	10
4. Diesel Power Plant	4a. Describe the given process of energy conversion in Diesel power station. 4b. Describe the given type of diesel engine with justification.	4.1 Introduction, Advantages and disadvantages of diesel plant, application of diesel plant, line and block diagram of the system showing the process of energy conversion. 4.2 Diesel engine - working principles, components of diesel engine, lubrication and starting method. Causes of pollution	05
5. Gas Power Plant	5a. Describe the given system of Gas power plant with block diagram. 5b. Compare given plant on the basis of given	5.1 Introduction, Block diagram of gas power plant, fuels, important properties while selecting the fuel for gas turbine. 5.2 Advantages and disadvantages of gas power plant, comparison of gas	05

	points.	turbine and steam power plant , environmental impact of gas power plant.	
6. Performance of Power Station	6a. Compare different power stations on the basis of given points. 6b. Calculate given factors for given load. 6c. Select no. of units based on given load curve.	6.1 Comparison between different generating stations with respect to sources of energy, site, initial cost, and running cost, pollution, efficiency, maintenance and stand by losses. 6.2 Definitions - connected load, maximum demand, average load, installed capacity, load factor, diversity factor, demand factor, plant capacity factor, plant utilization factor, Calculate connected load, maximum demand, average load, installed capacity, load factor, diversity factor, demand factor, plant capacity factor, plant utilization factor. 6.3 Load curve and load duration curve. Concept of generating units. Choice of number and rating of units for a given load curve and operational schedule, calculate no. of unit generated from given load curve ,concept of base load & peak load stations.	06
		Total Hr.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Thermal Power Plant	06(02)	03(06)	06(00)	15(08)
2	Hydro Power Plant	00(00)	03(06)	06(00)	09(06)
3	Nuclear Power Plant	02(00)	03(00)	03(06)	08(06)
4	Diesel Power Plant	02(00)	06(03)	00(00)	08(03)
5	Gas Power Plant	02(02)	06(03)	00(00)	08(05)
6	Performance of Power Station	00(02)	00(00)	12(06)	12(08)
	Total	12(06)	21(18)	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			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	5	R	2	4	R	2	3	R	2	1	R	2	1	R	2	1	R	2	6/9
	6	R	2	5	R	2	1	R	2										
2	5	U	3	4	U	3	3	U	3	2	U	3	1	U	3				3/5
3	5	U	3	3	A	3	2	U	3	4	U	3	2	U	3				3/5
4	4	U	3	2	A	3	1	A	3	5	U	3	3	A	3				3/5
5	2	A	3	1	A	3	1	U	3	3	A	3	1	U	3				3/5
6	6	A	6	6	A	6	6	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)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	25	--	Test Answer Sheets	1, 2, 3, 4,5,6
		Assignments		Continuous	15	--	Assignment Book / Sheet	1, 2, 3, 4,5,6
	TE E (Term End)	End Exam	Students	End of the Course	60	24	Theory Answer Sheets	1, 2, 3, 4,5,6
				Total	100	40		
Direct Assessment Practical	CA (Continuous)		Students	Continuous	--	--	--	--
		Journal Writing		Continuous	--	--	--	--
				Total	--	--		
	TE E (Term End)	End Exam	Students	End of the Course	--	--	--	--
Indirect Assessment	Student Feedback on course		Students	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
Nil		

❖ MAPPING COURSE OUTCOMES WITH PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)							PSOs	
	1	2	3	4	5	6	7	1	2
1	2	-	-	-	3	-	3	-	3
2	2	-	-	-	-	-	3	-	3
3	3	-	-	-	3	-	3	-	3
4	3	-	-	-	3	-	3	-	3
5	3	-	-	-	3	-	3	-	3
6	2	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	Generation Of Electrical Energy	B.R.Gupta, Eurasia Publishing House (Pvt.) Ltd, Third Edition, 1996.	81-219-0102-2
2	Principles Of Power System	V.K. Mehta, S.Chand & Co.Ltd, Reprint, 1996.	81-219-0594-X
3	A Text Book on Power System Engineering	A. Chakrabarti P. V. Gupta M. I. Soni , U.S. Bhatnagar, Dhanpat Rai Publishing Company (P) Ltd., 2008	10: 8177000209 13: 978-8177000207
4	Power Plant Engineering	K.K.Ramalingam, Sciech Publications (India) Pvt. Ltd, Reprint, 2010	81-8732-877-0
5	Elements of Electrical Power Station Design	M.V. Deshpande, Prentice Hall India Learning Private Limited, 2009	10: 812033647X 13: 978-8120336476
6	Power Plant Engineering	G.R. Nagpal, S.C. Sharma, Khanna Publishers-Delhi, 2012	10: 8174093095 13: 978-8174093097

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=-xebh8wU8gY>, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=bCEiOnuODac>, accessed on 27th January, 2022
- <http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of-transformer>, accessed on 27th January, 2022
- <http://nptel.ac.in/courses/108108076/16>, accessed on 27th January, 2022
- <https://youtu.be/AMXxXoHtM-o>, accessed on 27th January, 2022
- <https://youtu.be/usnnKAOvNnM>, accessed on 27th January, 2022

❖ **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.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Mr.A.M.Arekar	I / c. Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mr.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mrs.A.P.Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs.N.J.Suryavanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Ms.P.M Sonwane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Ms.P.S.Rithe	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY:	PROGRAMME CORE COURSE
COURSE CODE	: EE202G
COURSE TITLE	: ELECTRICAL CIRCUIT AND NETWORK
TEACHING SCHEME:	TH: 03; TU: 01; 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:**

This course describes the concepts and principles for solving electrical circuits. The knowledge of this course is useful for developing the concepts of the courses like switchgear and protection, Transmission and distribution, Electrical machines and Project . On the basis of this the drawing and interpretation of phasor diagram / equivalent circuit of any electrical circuit, transformer, machines and switchgear can be made.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply proper techniques of DC network reduction.
2. Apply proper methods of circuit analysis to determine variables of DC circuit.
3. Apply proper network theorems to determine variables of DC circuit.
4. Apply basic concepts of AC to interpret response of circuit elements on application of sine wave AC.
5. Apply concepts of single phase AC to interpret response of series and parallel AC circuit on application of sine wave AC and determine AC circuit variables.
6. Apply concepts of three phase AC to determine line and phase values current, voltage and power in balanced star & delta connection.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. D.C. Circuit & Network Reduction	1a. Define linear and nonlinear circuit, active and passive circuit, bilateral and unilateral circuit. 1b. Compare ideal and practical current and voltage source. 1c. Apply source transformation technique to reduce given network. 1d. Calculate equivalent resistance of series, parallel and series-parallel network. 1e. Transformation of resistances using Delta- star and Star-delta 1f. Calculate equivalent resistance of network by applying star-delta and delta-star transformation.	1.1 Definition - circuit, linear and nonlinear circuit , Bilateral and unilateral circuit, active and passive circuit, Electrical network, Node, Branch, Loop, mesh. 1.2 Concept of voltage source and current source, Ideal and Practical voltage source and its v-i characteristics, Ideal and Practical current source and its v-i characteristics. 1.3 Voltage sources in series , current sources in parallel , Conversion of voltage to current source and vice versa 1.4 Resistances in series, parallel and series- parallel. 1.5 Delta-Star and Star-Delta transformation of resistances. 1.6 D.C. Network reduction using series-parallel, star-delta & source conversion techniques. (Numerical)	08
2. D.C. Circuit Analysis.	2a. State KCL and KVL. 2b. Describe the sign convention for voltage drop and EMF of D.C. source. 2c. Apply KCL /KVL to determine branch current and branch voltage. 2d. Apply Mesh current analysis to solve the given network. 2e. Apply Node voltage analysis to solve the given network. 2f. Describe the procedure to determine the current and voltage in	2.1 Kirchhoff's current and voltage law ,Sign convention. 2.2 Application of Kirchhoff's laws for solving circuits, solve DC Circuits using Kirchhoff's laws. 2.3 Mesh current analysis. Steps to be followed for applying a mesh current analysis, Super mesh technique, solve DC Circuits using mesh analysis. 2.4 Node voltage analysis. Steps to be followed for applying node voltage analysis. Super node technique; solve DC Circuits using node analysis.	06

	the given branch of the given network applying Mesh and Node analysis.		
3. D.C. Network Theorems	3a. State different theorem. 3b. State condition for Maximum power transfer. 3c. Compare Thevenin's and Norton's theorem. 3d. Apply Superposition Theorem to solve the given circuit. 3e. Apply Thevenin's Theorem to solve the given circuit . 3f. Apply Norton's Theorem to solve the given circuit. 3g. Apply Maximum Power Transfer Theorem to solve the given circuit. 3h. Describe step wise procedure to solve the given electric circuit by applying network theorems.	3.1 Superposition theorem, limitations, steps to be followed for applying theorem, solve DC Circuits using Superposition Theorem. 3.2 Thevenin's Theorem, steps to be followed for applying Theorem , solve DC Circuits using Thevenin's Theorem. 3.3 Norton's Theorem, steps to be followed for applying Norton's Theorem, solve DC Circuits using Norton's Theorem. 3.4 Maximum Power Transfer theorem, condition for maximum power transfer , applications , steps to be followed for applying Theorem , solve DC Circuits using maximum power transfer Theorem.	08
4. Basic Concepts of AC	4a. Define cycle, time , period, amplitude, frequency. 4b. Interpret phase relationship between two alternating quantities from waveform as well as from equations. 4c. Determine various values of Alternating voltages and currents from sine waveform & mathematical equations. 4d. State the sinusoidal equation of voltage and current in various forms. 4e. Convert one form of	4.1 Definition of various terms like cycle, time period, frequency, amplitude. 4.2 Sinusoidal voltages and Current equation and their different forms , Phase difference, lagging and leading phase relation. 4.3 Values of an alternating quantity- Peak, Average, RMS, Form and Peak Factor. 4.4 Addition and subtraction of two alternating quantities-by Parallelogram method and method of components. 4.5 Significance of operator j , Rectangular form, Trigonometrically form, Polar form, Exponential form and Conversion from one form to other, Addition, subtraction,	08

	alternating quantity in to other. 4f. Perform addition, subtraction, multiplication & division of phasors. 4g. Define the term impedance, inductive reactance, capacitive 4h. reactance and power factor. 4i. Analyze the response of AC applied to pure R,L,C only .	division and multiplication of phasor. complex conjugate. 4.6 AC applied to pure R,L,C only , Waveforms, equations and phasor diagram, concept of Reactance, Impedance and Power factor .	
5. Single Phase AC Circuits	5a. Define the term impedance, inductive reactance, capacitive reactance and power factor. 5b. Draw the phasor diagram for R-L, R-C,R-L-C series Circuit. 5c. Determine impedance, current, power factor & power in given R-L, R-C,R- L-C series circuit. 5d. Interpret phase relationship for R- L, R-C, R-L-C series circuit 5e. Calculate resonant frequency of series circuit. 5f. State condition of series parallel Resonance. 5g. State the effects of Resonance on voltage, current, impedance of series & parallel circuit. 5h. Calculate R-L-C parallel circuit parameters by impedance and admittance method.	5.1 R-L series circuit.- Phasor diagram and waveforms , Impedance triangle, current & voltage equation ,power factor . 5.2 Power triangle, True power, apparent power, reactive power and their interrelation. 5.3 R-C series circuit- Phasor diagram and waveforms, Impedance triangle, current and voltage equation, power factor, AC power. 5.4 R-L-C series circuit- Phasor diagram for three conditions and waveforms, Impedance triangle, power factor, current and voltage equation, AC power, solve series R-L-C circuit. 5.5 Series Resonance- Definition, condition, resonant frequency, characteristics of series resonance, Q factor, solve series ,R-L-C resonant circuit. 5.6 Impedance and Admittance method of solving R-L-C parallel Circuits, Meaning of admittance, susceptance, conductance, phasor diagram, solves parallel R-L-C circuit. 5.7 Resonance in R-L-C parallel circuit. Condition for resonance, characteristics of parallel resonance, Q factor. 5.8 Application of series and parallel resonant circuit.	10

6. Three Phase Circuits	6a. State the advantages of three phase system. 6b. Define balanced and unbalanced voltage system & load. 6c. Define line and phase values w.r.t. star and delta connection 6d. Interpret the relationship between line and phase values of star and delta connection 6e. Draw the phasor diagram for star and delta connection. 6f. Describe the generation of three phase AC. 6g. Calculate impedance, current, power factor, power of three phase star & delta connected system.	6.1 Advantages of three phase AC over single phase AC. 6.2 Generation of three phase AC, Sinusoidal waveform, sinusoidal equation of AC quantities, phase sequence, Phase relationship. 6.3 Connection of three phases- star and delta connection, meaning of line values, phase values, balanced and unbalanced voltage system and load. 6.4 Star connected system-Phasor diagram, relationship between Line and phase values of voltage and current, three phase power. 6.5 Delta connected system- Phasor diagram, relationship between line and phase values of voltage and current, three phase power . 6.6 Solve three phase balanced star connected & delta connected load circuits.	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Trace the response of sinusoidal voltage and current when AC applied to pure R,L,C only on CRO .	Basic concept of AC	02
2	Determine current, active power & power factor in the given R-L series circuit. Draw phasor diagram.	Single phase AC circuits	02
3	Determine current, active power & power factor in the given R-C series circuit. Draw phasor diagram.		02
4	Determine current, active power & power factor in the given R-L-C series circuit. Draw phasor diagram.		02
5	Using variable inductor and capacitor create resonance in given R-L-C Series circuit.		02

6	Determine current, active power & power factor in the given R-L-C parallel circuit with series connection of R & L in parallel with C. Draw phasor diagram.		02
7	Measure current through any branch of given DC circuit and verify Kirchhoff's current law.	DC Circuit analysis	02
8	Measure voltage across any branch of given DC circuit and verify Kirchhoff's voltage law.		02
9	Determine branch currents of a DC circuit containing two sources by superposition theorem.	DC Network Theorems	02
10	Determine the current through load resistance of a given DC circuit by Thevenin's theorem.		02
11	Determine the current through load resistance of a given DC circuit by Nortan's theorem.		02
12	Determine load resistance for maximum power transfer in a given DC circuit using maximum power transfer theorem.		02
13	Measure the line and phase values of voltage and current of three-phase star connected balanced load and verify relation between line and phase values.	Three phase circuits	04
14	Measure the line and phase values of voltage and current of three-phase delta connected balanced load and verify relation between line and phase values.		04
Total Hours			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	DC Circuit & Network Reduction	02(02)	03(03)	03(03)	08(08)
2	DC Circuit Analysis	02(02)	03(00)	03(03)	08(05)
3	DC Network Theorems	02(00)	03(00)	06(06)	11(06)
4	Basic Concepts of AC	04(00)	06(06)	03(00)	13(06)
5	Single Phase AC Circuits	00(02)	03(03)	09(03)	12(08)
6	Three Phase Circuits	02(00)	03(03)	03(00)	08(03)
	Total	12(06)	21(15)	27(15)	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	3	R	2	4	R	2	4	R	2	6	R	2	6/9
	1	R	2	2	R	2	5	R	2										
2	1	U	3	1	U	3	5	A	3	6	U	3	4	U	3				3/5
3	4	U	3	5	U	3	4	U	3	1	A	3	2	U	3				3/5
4	6	U	3	2	A	3	5	U	3	4	U	3	3	U	3				3/5
5	1	A	3	6	A	3	4	A	3	5	A	3	2	A	3				3/5
6	3	A	6	5	A	6	3	A	6										2/3

❖ **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	--	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 equipments. 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)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	2	3	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	3	3
3	-	3	-	-	-	-	-	-	-	-	3	3
4	-	3	2	2	-	-	-	2	-	2	-	3
5	-	3	2	2	-	-	-	2	-	2	-	3
6	-	3	2	2	-	-	-	2	-	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 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, 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, P.K. Kharbanda, S. Chand & Company Ltd., Third, 1990	13: 978-8121901048
6	Circuits and Network Analysis	A. Sudhakar, Shyammohan S. Palli, Tata McGraw-Hill Publishing Co. Ltd., , Third Edition, 2007	0-07-460394-9

❖ **E-REFERENCES:**

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- <http://www.electrical4u.com/nodal-voltage-analysis-and-nodal-analysis-electronics-tutorials/> accessed on 17/09/2016
- [u.com/single-and-multi-mesh-analysis](http://www.electrical4u.com/single-and-multi-mesh-analysis/), accessed on 10th, 15th, 17th April 2021
- <http://www.allaboutcircuits.com/textbook/direct-current/chpt-10/mesh-current-method/> accessed on 17/09/2021

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

1. Ammeter MI 0-5-10A
2. Voltmeter MI 0-150-300V
3. Wattmeter 0-3000W
4. Digital Multi-meter, Tong-tester.
5. Rheostat assorted sizes
6. Variable Inductor, Capacitor.
7. Dimmerstat 15A, 300V
8. Variable rectifier 100 A, 300VDC
9. CRO
10. Trainer Kits of theorems.

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Shri.A.M.Arekar	I/C Head, Electrical Engineering	Government Polytechnic, Nagpur.
3	Shri.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.A.A.Alegaaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Shri.M.N.Gawande	Lecturer in Electrical Engineering & CDC I/C.	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE203G
COURSE TITLE	: ELECTRICAL AND ELECTRONICS MEASUREMENT
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH/TU CREDIT = 1 CLOCK HR., 1PR CREDIT = 2 CLOCK HR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs
PT.	: 01 HR

❖ **RATIONALE:**

Electrical diploma holders have to work as technician in industries. They have to work as production, maintenance, testing engineer in various industries such as power generation, transmission, distribution, traction etc. They have to deal with different electrical machines and equipment. While performing above task they have to measure different electrical parameters and quantities. After completion of this course diploma engineering students will develop the skills required for the measurements and handling of different measuring instruments in the field of electrical engineering.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify electrical measuring instruments.
2. Choose electrical measuring instruments to measure current and voltage.
3. Use of wattmeter and energy meter for electrical measurement.
4. Select the method for measurement of different parameters.
5. Use various bridges for measurement of different parameters.
6. Use electronic meter for electrical measurement.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Fundamental of Measurement	1a. Classify given qualities of a measuring instruments. 1b. Describe given types of errors in measuring instruments. 1c. Identify given measuring instruments. 1d. Classify different torque and their necessities.	1.1 Need of measurement & significance of measurement qualities of instrument-sensitivity, accuracy, precision, stability, reliability, standards & calibration, resolution. 1.2 Types of errors-gross error, systematic error, random error. 1.3 Classification of instruments:- Null and deflection type instruments, Absolute and secondary instruments, Analog and digital instruments. 1.4 Necessity of different torque in measuring instruments-Deflecting, controlling torque and damping torque.	05
2. Measurement of Current and Voltage	2a. Identify given measuring instruments. 2b. Calculate range extension of ammeter & voltmeter-by shunt and series resistance of given data. 2c. Draw the connection diagram of given type of transformer for extension of ranges. 2d. Describe procedure for calibration of a given device.	2.1 Construction & principle of following instruments– a) Permanent Magnet Moving Coil (PMMC) b) Moving Iron(MI) 2.2 DC ammeter and voltmeter Range extension of ammeter & voltmeter-by shunt and series resistance, advantages and disadvantages of shunt and series resistor used for range extension. Calculate range extension of ammeter & voltmeter-by shunt and series resistance AC voltmeter rectifier type (half wave and full wave). 2.3 Instrument transformer. Principle of current transformer (CT) and potential transformer (PT), their use in extension of ranges, precautions to be taken while using CT. 2.4 Calibration of voltmeter and ammeter using standard meter and potentiometer.	08

3. Measurement of Power and Energy	3a. Describe construction & principle of given type of wattmeter 3b. Calculate Multiplying factor of wattmeter from given data. 3c. Describe with a sketches given type of measurement of power in three-phase circuit for balanced and unbalanced load. 3d. Calculate active and reactive power in three- phase balanced load by one wattmeter method of two-wattmeter method. 3e. Describe the procedure for calibration of given meter.	3.1 Principle and construction of dynamometer type wattmeter single phase and Poly-phase wattmeter , Errors and their compensation. 3.2 Calculation of Multiplying factor of wattmeter. Significance of power factor in power measurement. 3.3 Measurement of power in three-phase circuit for balanced and unbalanced load. 3.4 Measurement of active and reactive power in three- phase balanced load by one wattmeter method and two- wattmeter method. 3.5 Difference between power and electrical energy. Construction and working principle of Single phase and three phase induction type of energy meter Calibration of single phase electronic energy meter using direct loading.	10
4. Special Meters	4a. Describe the construction and working of given type of meters. 4b. Select type of meter to measure given parameter. 4c. Describe the given type of meter with help of diagram.	4.1 Construction and working principle of Single phase and three phase Power Factor meter, Electro- dynamometer type power factor meter. 4.2 Construction and working principle of Frequency meter, Weston and Ferro-dynamic type frequency meter. Construction & working principle of Weston type synchro scope. 4.3 Construction and working principle of Rotating type phase sequence indicator. Construction and working principle of Clip-on-ammeter.	10
5. Measurement of Circuit Parameters	5a. Classify different types of resistances with their values. 5b. Select proper methods for measurement of resistance for given application with justification. 5c. Describe given types of measurement of	5.1 Measurement of Resistance: Classification as low, medium and high resistance. 5.2 Methods used for measurement of each type of resistance. i. Low resistance- potentiometer, Kelvin double bridge method. ii. Medium resistance- Wheat stone bridge. iii. High resistance-Megger.	10

	earth resistance. 5d. Identify application of given AC bridges.	Megger – Construction, working principle and its application 5.3 Measurement of earth resistance by fall of potential method, earth resistance tester-construction, working principle and measurement of earth resistance. 5.4 Introduction to A.C. bridges- Anderson bridge for measurement of inductance, Schering bridge for measurement of capacitance, Bridge balance equation only. Introduction and working principle of LCR meter.	
6. Measurement by Electronic Meters	6a. Draw a block diagram of given device. 6b. Classify the application of given meter. 6c. Describe the construction and working of given type of meter. 6d. Select the electronic meter to measure given parameter.	6.1 Need of electronic meters Introduction of CRO, block diagram of CRO. Introduction of Function Generator, block diagram of Function Generator. 6.2 Digital Energy meter- Block diagram, working principle and its application 6.3 Digital multi meter- Block diagram working principle and its application. 6.4 Construction and working principle of Tri-vector meter	05
		Total Hrs	48

B .LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify measuring instruments on the basis of symbols on dial, type, accuracy and scale.	Fundamental of Measurement	02
2	Identify the components of PMMC and MI instruments using cut section models.	Measurement of current and voltage	02
3	Measure current and voltage using Current transformer and Potential transformer.		04
4	Measure AC and DC quantities in a working circuit.		02
5	Measure active & reactive power in three-phase balanced load by single wattmeter method.	Measurement of power and energy	02
6	Measure active & reactive power in three-phase balanced load by two wattmeter method & observe the effect of power factor variation on wattmeter readings		04

7	Calibrate energy meter at various power factor by- Standard energy meter /Meter test bench.		02
8	Use the following meters to measure different electrical quantities 1) Clip-on ammeter 2) Phase sequence indicator	Other meter	04
9	Measure low resistance by Kelvin’s double bridge.	Measurement of circuit parameters	02
10	Measure insulation resistance of AC/DC motor using Megger.		02
11	Measure different parameters using LCR meter.		02
12	Measure various electrical quantities using digital multi- meter.	Measurement by Electronic Meters	02
13	Use Tri-vector meter for measuring KW, KVAR and KVA of a power line.		02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Fundamental of measurement	02(00)	03(03)	00(00)	05(03)
2	Measurement of current and voltage	04(02)	03(00)	03(03)	10(05)
3	Measurement of power and energy	02(00)	06(03)	06(06)	14(09)
4	Other meters	02(02)	06(03)	03(00)	11(05)
5	Measurement of circuit parameters	00(02)	03(06)	09(00)	12(08)
6	Measurement by Electronic Meters	02(00)	03(00)	03(06)	08(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			Options
	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	2	R	2	3	R	2	4	R	2	6	R	2	6/9
	4	R	2	2	R	2	5	R	2										
2	1	U	3	2	U	3	2	A	3	1	U	3	2	A	3				3/5
3	3	U	3	4	U	3	3	U	3	3	U	3	3	A	3				3/5
4	4	U	3	5	U	3	4	A	3	3	A	3	4	U	3				3/5
5	6	U	3	6	A	3	5	A	3	5	U	3	5	U	3				3/5
6	3	A	6	5	A	6	6	A	6										2/3

T-Unit/Topic Number
R–RememberL- Level of Question
U– UnderstandM-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		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 circuit diagram, selection of equipment. writing procedure etc.	10
2	Performance(i.e. recording ,calibrating and testing)	20
3	Skills and Results	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	-	-	3	3	-
2	3	3	-	3	-	-	3	3	-
3	3	3	-	3	2	-	3	3	-
4	3	-	-	3	-	-	3	3	-
5	3	-	-	3	-	-	3	3	-
6	3	-	-	3	2	-	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	Electric & Electronic Measurement & instrumentation	A. K. Sawhney, Dhanpat Rai & Sons, 18 th Edition, 2007	13:9788177000160
2	Electrical Measurement & Measuring Instruments.	E. W. Golding, Pitman Publisher, 5 th Edition, 1968	13: 978-0273402022 10:0273402021
3	Electrical Measurements & Measuring Instruments	N.V. Suryanarayana, S, Chand & Co. 1 st Edition, 2001	81-219-2011-6
4	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

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=ZgvanZ1h83s>, accessed on 1th February,2022
- <https://www.youtube.com/watch?v=gkeJzRrwe5k>, accessed on 1th February,2022
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- <http://www.electrical4u.com/moving-iron-instrument/>, accessed on 1th February,2022
- <http://www.electrical4u.com/electrical-measuring-instruments-types-accuracy-precision-resolution-speed/>, accessed on 1th February,2022
- <https://www.electrical4u.com/electrical-engineering-articles/measurement/> 1th February,2022
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- <http://circuitglobe.com/two-wattmeter-method-of-power-measurement.html> ,accessed on 1th February,2022.
- <https://www.youtube.com/watch?v=784LkH03L1E> accessed on 1th February,2022
- <https://www.youtube.com/watch?v=KX5GAooRduI> accessed on 1th February,2022
- <https://www.youtube.com/watch?v=joXA6KXFDa4> accessed on 1th February,2022
- <https://www.youtube.com/watch?v=5cfafCeejBk> accessed on 1th February,2022
- <https://www.youtube.com/watch?v=XG74iiCAWeY> accessed on 1th February,2022

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

1. Megger 500/1000 V Hand driven.
2. PMMC and MI type instrument.
3. CT 20/5A ,PT 460/115 V
4. Ammeter (0-5-10-15-20 A) Voltmeter (0-150-300-500)
5. Single-Phase Energy Meter
6. Electronic Energy Meter. Accuracy Class 1.0 & Current Rating : 5-30Amp
7. 3 phase resistive, inductive, capacitive load , Wattmeter LPF, unity
8. Tong tester ACA: 3/15/60A + 5% ACV: 300/600V + 5%, Size: 120x70x35mm.
9. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% $\pm$ 1 digit.
10. Tri vector meter (upto 100A)3 phase 3 wire,110V
11. Kelvin's double bridge kit.

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Prof.A.M.Arekar	Chairman ,PBOS & HOD Electrical Engg. Deptt.	Government Polytechnic, Nagpur.
3	Prof.Mrs.A.A.Alegaonkar	CDC Coordinator & Lecturer , Electrical Engg.Deptt.	Government Polytechnic, Nagpur
4	Prof.Ms.P.S.Rithe	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur.
5	Prof.M.C.Musale	Expert & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
6	Prof.M.N.Gawande	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
7	Prof.Mrs.A.P.Gandhi	Expert & Lecturer in Electrical Engg. Deptt	Government Polytechnic, Nagpur
8	Prof.Mrs.P.M.Sonwane	Expert & Lecturer in Electrical 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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE204G
COURSE TITLE	: D.C.MACHINES AND TRANSFORMERS^{\$}
TEACHING SCHEME	: TH:03; TU: 00;PR: 04 (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:

This course deals with the basic fundamentals of DC machines and transformers. These machines are used in power system for generation, transmission & distribution and also in utilization systems. Knowledge gained by the students will be used in the study of technological subjects such as power system operation & control, utilization system, switchgear & protection and manufacturing processes. The knowledge and skills obtained by the students will be used in discharging technical functions such as supervisor, controller and R & D technician.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Recommend DC Generator for particular application .
2. Select DC Motor for particular application.
3. Perform various tests on transformer.
4. Select special transformer for particular application.
5. Select three phase transformer for particular applications
6. Operate transformers in parallel and calculate load sharing between two parallel transformers.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs .
1. DC Generator	1a. State necessity of DC machine. 1b. State various laws relate to AC and DC machines. 1c. Compare AC and DC machines on various points. 1d. Identify the different parts of DC machine and state materials used for parts. 1e. Draw the sketch and state the functions of different parts of DC machine. 1f. Compare armature and wave Winding. 1g. Derive EMF equation of DC Generator. 1h. Describe characteristics and state applications of DC generator. 1i. Describe various losses in D.C.generator.	1.1 Introduction to DC and AC. Machines., Laws related to DC and AC machines, Classification of AC machines, Differences between ACand DC machines. 1.2 Necessity of D.C. Machines, Construction, Different parts of D.C. Machines and their functions, Different materials used for parts 1.3 Types of Armature winding- Lap and Wave windings 1.4 DC Generator Principle, EMF equation. 1.5 Types and Characteristics of DC generators and their applications. 1.6 Total losses in DC generator. (No Numerical on above topics)	06
2. DC Motor	2a. State principle of DC Motor. 2b. State types of DC Motor. 2c. Draw connection diagrams of various types of DC motors. 2d. Draw different characteristics of DC motors. 2e. Describe characteristics of various types of DC motors. 2f. State necessity of DC motor starter. 2g. Draw constructional	2.1 D.C. Motor Principle, back EMF and its significance, Voltage equation of D.C. Motor, Torque equation, Armature torque and Shaft torque 2.2 Types of DC motor, their Characteristics and applications. 2.3 Necessity of Starter, Types of starters- Two point, three point, four point, their construction and working. 2.4 Speed control of D.C. Motors, flux and armature control methods for speed control of series and shunt motors.	09

	details of various DC motor starters. 2h. Describe working of various DC motor starters. 2i. Describe the speed control methods of DC motors. 2j. Calculate Losses and efficiency of DC motor.	2.5 Losses and efficiency of DC motor, Calculate Losses and efficiency of DC motor (Numerical on 2.5 only)	
3. Single Phase Transformer	3a. State working Principle of transformer and types of transformer. 3b. Describe Constructional parts and their function. 3c. Compare shell type and core type transformer. 3d. Derive EMF equation of Transformer. 3e. Draw phasor diagram of no-load and on load. 3f. Draw approximate equivalent circuits. 3g. Describe Open Circuit and Short Circuit Test of single-phase transformer. 3h. Calculate losses, efficiency and Regulation. 3i. Calculate all day efficiency.	3.1 Working Principle of transformer 3.2 Constructional parts and their functions, Types of transformer. Comparison between shell type and core type transformer 3.3 Different material used in construction. 3.4 EMF equation 3.5 Voltage transformation ratio, KVA rating. 3.6 Concept of ideal transformer, practical transformer 3.7 Phasor diagram- no-load and on-load 3.8 Equivalent resistance and reactance, Approximate equivalent circuit diagram 3.9 Open Circuit and Short Circuit Test on single-phase transformer 3.10 Losses, efficiency and regulation of Single-phase transformer, direct loading test. 3.11 All day efficiency, Calculate all day efficiency 3.12 Applications of single phase transformers	14
4. Special Transformers	4a. Describe construction and operation of Single-Phase autotransformer. 4b. Compare autotransformer with two winding transformer. 4c. Describe construction and operation of special transformers. 4d. State applications of	4.1 Single-Phase autotransformer, construction, operation and applications. Comparison with two winding transformer. 4.2 Current transformer (CT), construction, operation and applications. 4.3 Potential transformer (PT), construction, operation and applications. 4.4 Single phase Welding transformer, construction, operation and applications. 4.5 Single phase Isolation	05

	special transformers.	transformer, construction, operation and applications. 4.6 Single phase furnace transformer construction, operation and applications. 4.7 Pulse transformer construction, operation and applications. 4.8 'K' factor.	
5. Three Phase Transformers	5a. Demonstrate the parts of three- phase transformer and their functions. 5b. Calculate transformation ratio. 5c. Draw vector groups. 5d. Compare three-phase transformer unit and three-phase bank of single-phase transformer unit. 5e. Describe working principle construction and operation of three phase autotransformer.	5.1 Different parts of three-phase transformer and their functions. 5.2 Transformation ratio, Numerical based on transformation ratio. 5.3 Polarity marking and phasing out test. 5.4 Vector groups, its advantages, applications and Connections. 5.5 Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989 5.6 3-phase to two-phase conversion, Comparison between three-phase transformer unit and three-phase bank of single-phase transformer unit. 5.7 Three-phase autotransformer, Working principle, construction, operation and its applications	10
6. Parallel Operation of Single Phase and Three Phase Transformers	6a. State the necessity of parallel operation. 6b. State the conditions to be fulfilled for satisfactory operation of transformers. 6c. Calculate load sharing of transformers. 6d. State the factors affecting parallel operation of transformers. 6e. State the advantages of parallel operation of transformers.	6.1 Necessity of parallel operation. 6.2 Conditions to be fulfilled for parallel operation of single phase and three phase transformers. 6.3 Load sharing between two single phase transformer and two three phase transformers. Calculate load sharing of transformers. 6.4 Factors affecting parallel operation. 6.5 Advantages of parallel operation of transformers	04
Total Hrs.			48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify different parts and windings of DC compound machine.	1.DC Generator	02
2	Find the value of critical resistance of DC shunt generator by plotting OCC		02
3	Perform load test on DC shunt generator.		04
4	Perform load test on DC cumulatively compounded generator.		04
5	A) Start DC shunt motor without starter. B) Start DC shunt motor with starter and reverse the direction of rotation of motor.	2.DC Motor	02+02
6	Start DC series motor by using 2 point starter and to reverse the direction of rotation of motor.		04
7	Control the Speed of D.C. shunt motor using (i) field control and (ii) armature control methods.		02+02
8	Perform load test on D. C. shunt motor and plot Speed- torque characteristics.		04
9	Perform load test on D. C. series motor and plot Speed torque characteristics.		04
10	Perform polarity test on single-phase transformer.	3. Single-phase Transformer	02
11	Find transformation ratio of single-phase transformer.		02
12	Find the regulation and efficiency of single-phase transformer by direct loading.		04
13	Perform (i) Open Circuit (O.C.) and (ii) Short Circuit (S.C.) test on single-phase transformer and determination of equivalent circuit, regulation and efficiency.		02+02
14	A) Use CT to measure high value of current. B) Use PT to measure high value of voltage.	4. Special Transformers	02+02
15	Identify different parts and windings of single phase autotransformer.		02
16	Identify different parts of Three phase Distribution Transformer.	5. Operation and control of three phase Transformers	02
17	A) Perform phasing out test on three-phase transformer. B) Perform polarity test on three-phase transformer.		02+02
18	Perform (i) open circuit (O.C) and (ii) short Circuit (S.C.) test on three-phase transformer & determine regulation & efficiency.		02+02
19	Perform Parallel operation of single-phase transformer and record their load sharing.	6. Parallel Operation of single phase and three phase Transformers	04
Total Hrs			64

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	DC Generator	02(00)	03(03)	00(00)	05(03)
2	DC Motor	02(00)	03(03)	06(03)	11(06)
3	Single- phase Transformer	04(02)	06(03)	06(06)	16(11)
4	Special Transformers	00(02)	06(03)	00(00)	06(05)
5	Operation and control of three phase Transformers	02(02)	06(03)	06(00)	14(05)
6	Parallel Operation of single phase and three phase Transformers	02(00)	00(00)	06(06)	08(06)
	Total	12(06)	24(15)	24(15)	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	3	R	2	5	R	2	6	R	2	6/9
	3	R	2	4	R	2	5	R	2										
2	1	U	3	2	U	3	2	A	3	1	U	3	2	U	3				3/5
3	2	A	3	3	U	3	3	U	3	2	A	3	3	U	3				3/5
4	3	A	3	3	A	3	4	U	3	3	A	3	3	A	3				3/5
5	4	U	3	5	U	3	5	U	3	4	U	3	5	U	3				3/5
6	5	A	6	6	A	6	6	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 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	2	2	3	2	2	-	-	2	2
2	3	2	3	2	2	-	-	3	-
3	3	2	3	3	2	-	-	3	3
4	2	2	1	1	2	-	-	2	2
5	3	2	3	3	2	-	-	3	3
6	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	Electrical Machines	S.K. Bhattacharya, The McGraw Hill companies, Seventh Reprint, 2011	13:978-0-07-066921-5 10:0-07-066921-X
2	Principle of Electrical Machines	V K Mehta, Rohit Mehta, S. Chand Publishing, 2nd Edition, 2002	9788121921916
3	Electrical Technology Vol.II AC & DC Machines	B.L.Theraja, S. Chand & Company Ltd., Third, 1990	10: 8121924375 13: 978-8121924375
4	Basic Electrical Engineering	V.N.Mittle, Arvind Mittal, The McGraw Hill Education Pvt. Ltd, Reprint, 2011	13: 978-0-07-059357-2
5	Experiments in Basic Electrical Engineering	S.K.Bhattacharya and K.M.Rastogi., New Age International Publisher, Reprint, 2009.	978-81-224-1042-6

6	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
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❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108108076/1> , accessed on 25th February 2022
- <http://www.electrical4u.com> , accessed on 25th February 2022
- <https://www.youtube.com/watch?v=-xebh8wU8gY> accessed on 25th February 2022
- <https://www.youtube.com/watch?v=fWyzPdyCAzU>, accessed on 25th February 2022
- <https://www.youtube.com/watch?v=bCEiOnuODac>, accessed on 25th February 2022
- <http://www.electrical4u.com/electrical-power-transformer-definition-and-types-of-transformer>, accessed on 25th February 2022
- <https://nptel.ac.in/courses/108105017>, accessed on 25th February 2022

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

1. Auto transformer (Dimmerstat), single-phase, Input-240 V, Output 0-270 V, Current rating - 4A, portable table model.
2. Auto transformer (Dimmerstat), three-phase Input-440 V, Output 0-470 V, Current rating - 12A, table model.
3. D.C. Shunt, Series and Compound Generators, Voltage rating 220 Volts, Power rating 2 KW.
4. D.C. Shunt and Series Motors, Voltage rating 220 Volts, Power rating 2 KW.
5. Single phase transformer, 50 Hz, 2 KVA, 230/115 V
6. Three phase transformer , 50 Hz, 3 KVA, 440/230 V
7. CT and PT of suitable ratio.

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

S.N.	Name	Designation	Institute / Industry
1	Mr.A.M.Arekar	I/C HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Mr.M.C.Musle	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
4	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
5	Mrs.A.P.Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Smt.N.J.Suryawanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Smt.P.M.Sonvane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Smt.P.S.Rithe	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Mr.B.P.Bale	Dy.Engineer	MSEDCL,Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGG.
COURSE CATEGORY	: CORE COURSE
COURSE CODE	: EE205G**
COURSE TITLE	: ELECTRICAL MATERIALS AND WIRING
TEACHING SCHEME	: TH:03; TU:00; PR:02 (CLOCK HRS.)
TOTAL CREDITS	: 04 (1TH/TU CREDIT = 1CLOCKHR., 1PR CREDIT = 2CLOCKHR.)
TH. TEE EXAM	: 01 HR (Objective Type online Examination)
PR. TEE EXAM	: 02 HRS (External)
PT. EXAM	: 30 Minutes. (Objective Type)

❖ RATIONALE:

This course is basic technology course. Knowledge of materials used in the manufacturing of electrical machines/goods, essential. Electrical materials and domestic appliances subject is intended to teach techniques of electrical, repairs, fault finding, testing, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skill and attitudes to discharge the function of supervisor in industry and can start his own small-scale enterprise.

❖ COURSE OUTCOMES:

1. Identify properties and applications of different electrical engineering materials.
2. Select various electrical engineering materials for particular application.
3. Follow safe precautions when undertaking electrical works.
4. Perform different types of Electrical wiring/cabling activities..
5. Implement relevant earthing system.
6. Design proper illumination scheme for residential unit

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics	Hrs.
1. Conducting Materials	1.a. Identify of given electrical Engg materials. 1.b. Define the Resistivity. 1.c Describe effect of temperature on resistivity of given materials. 1.d. Identify given conducting material. 1.e. Describe the concept of given superconducting material. 1.f. Choose different conducting material as per requirement.	1.1 Classification of material:-conductor, insulator, semi-conductor, magnetic material their energy band diagram. 1.2 Resistivity, effect of temperature, impurities, stress on Resistivity of conductor. 1.3 Requirements of high/low conducting material 1.4 Low resistivity conductor, copper, copper-zinc alloys, cadmium-copper alloy, chromium-copper alloy, bronze, reinforced copper, aluminum and aluminum alloys. Steel-cored aluminum galvanized iron and steel, classification of steel and their applications-carbon steel, alloy steel, stainless steel & tool steel, effect of carbon on conductivity- their properties and applications. 1.5 Low resistance material- contacts materials. Classification of contact materials, important alloys for contacts in various electrical equipments, sintered material.-their properties and applications. 1.6. Materials of low conductivity; Materials used in making - Precision electrical measuring instruments - Standard resistances - Resistance elements for rheostats and similar control devices - Carbon, construction of carbon elements depending on the requirements as per their use, properties and applications 1.7 Concept of super conducting materials 1.8 Use of super conducting materials for various engineering applications	08

2. Insulating Materials	2.a. Choose different properties of given Insulating material. 2.b. Use insulating material as per applications. 2.c. Describe the given different classes of insulation. 2.d. Select insulating material for proper application.	2.1 Electrical properties- volume, Resistivity, breakdown voltage, dielectric strength, Different effects of electric current. 2.2 Mechanical properties- Thermal properties, chemical properties and physical properties 2.3 Insulation classes 2.4 Physics of dielectrics, the dielectric as an electric field medium, polarization, electrical conductivity of gases, liquids, solid dielectrics 2.5 Gaseous dielectrics-Air, Nitrogen, Sulphur hexa-fluoride- their properties and applications. 2.6 Liquid dielectric: Their properties and applications. a. Petroleum insulating oils Insulating oils for transformers and switchgears. 2.7 Solid insulating materials classification-their properties and applications. a. Fibrous material impregnating coating, Filling and bonding materials. 2.8 Resins: Synthetic and natural, varnishes, impregnated fibrous material.- their properties and applications. 2.9 Rubber-Types, their properties and applications. 2.10 Mica and mica base materials-their properties and applications. 2.11 Ceramic materials-their properties and applications. 2.12 Glasses- Their properties and applications.	08
3. Magnetic Materials & Special purpose Material	3.a Describe given terms related to magnetic material. 3.b. Describe the given magnetization curve 3.c. Select material according to requirement of given magnetic core. 3.d.. Choose the Materials used for special purpose devices. 3.e. Describe the salient features of properties of special purpose material.	3.1 Introduction flux -magnetic field strength,,magnetic circuit,magnetic force, permeability, reluctance, MMF, flux density,residual magnetism remenance, coercive force, Retaintivity. Relation between magnetic flux intensity and flux density. 3.2 Spontaneous magnetization curve, hysteresis loop,	08

	3.f. Describe the salient features of given applications of special purpose devices.	3.3 Classification of magnetic materials- Paramagnetic, Ferromagnetic, Diamagnetic material. 3.4 Soldering materials-Introduction, types of solders, material used, properties and use. 3.5 Structural materials-Introduction, factors for selecting a structural material, Materials used for making, a) Tower and poles b) RCC poles c) Steel poles 3.6 Fluorescent material-Introduction, properties, material used, & application	
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4.Electrical Wires & cables	4.a. Justify the criteria for selecting wire/cable and other electrical components for the given type of installation. 4.b. Describe with sketches the. Installation of wiring systems for the given type of occupancy. 4.c . Describe with sketches the wiring type as per the functional requirements of the given type of occupancy. 4.d Apply the process of installing the given type of cables.	4.1 Types of wires , components and accessories of electrical wiring systems 4.2 Wire joints-a) sraight twist joint, Britannia joint,married joint, tee joint,duplex or double tee joint,pig tail joint,sraf joint 4.3 Electrical accessories:- a) Switch- Their types according to construction such as surface switch,flush switch,pull switch,rotary switch, knife,crimping tool,lugs, switch, pendent switch,main switch(ICDP,ICTP),their types such as single pole,double pole,two way,two way centre off,series parallel switch. b) Holders-Bayonet cap lamp holder,pendent holder, batten lamp holder,angle holder,bracket holder,tube light holder,screw type Edison and goliath edison lamp holder,swivel lamp holder. c) Sockets outlets and plugs- Two pin,three pin,multi pin sockets,two pin and three pin plug d) Others-Iron connector, adeptor,ceilling rose,distribution box,neutral link,bus bar chamber,wooden/,mica boards,moulded/MS Concealed boxes of different sizes. 4.4Electrical wiring systems (such as PVC casing and capping,Conduit wiring etc). 4.5 Electrical wiring types (one lamp control, staircase and godown) . 4.6 Types of Cables, Classification of cables, factors determining selection of cables. 4.7Cable joint methods-a) Joints in non flexible cables,b) joints in flexible cablesStraight through joints, tee joints, terminal joints, conductor joints, Britannia joints, telephone joint, married joints, sleev joint, imprecation joint. 4.8 Cable laying method- a) Direct laying b) Draw in system c) cable laying rocks inside tunnel.	08
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5. Fuse & Earthing system	5.a Select material for fuse. 5.b Recommend with justification the necessity of the type of earthing in the given electrical installation systems. 5.c. Justify the criteria for recommending the earthing system for the given electrical installation. 5.d. Describe with the sketches prepare installation of the given earthing system. 5.e. Prepare the testing procedure for the given earthing systems.	5.1 Fuse material –Definition of fuse, function of fuse ,desirable charectristics of fuse material, factors on which fuse rating depends,metals & alloy used for fuse wire,their properties and applications. 5.2 Fuse terminology,types of fuses Rewirable fuse, HRC,ELCB,MCB,RCCB. 5.3 Necissity of earthing,types of earthing systems. 5.4 Installation of earhing systems. 5.5 Testing/measurement of earthing resistance for various installations as per IE Rules. 5.6 Significance and adverse effects of improper earthing systems.	06
6. Illumination in residential installation	6.a Describe the given terms related to illumination. 6.b Illustrate different laws of illumination. 6.c Justify the given factors affecting on the illumination. 6.d Design consideration of good lighting scheme with different types of lighting arrangements 6.e. Identify the use of given lamps & their illumination levels. 6.f. Describe the construction & working of given lamps. 6.g. Design the illumination scheme for small installation & Calculate number of luminaries.	6.1 Introduction, Terminology used in illumination such as –Luminous flux, Luminous intensity, Lumen, Illumination or illuminance ,lux, space-height ratio, utilization factor, depreciation factor, luminous efficiency-definition & values for different luminaries. 6.2 Laws of illumination –Inverse Square law, Cosine law, Numerical based on illumination received directly underneath, illumination received on horizontal screen and screen moved horizontally at certain distance. 6.3 Factors affecting the illumination. 6.4 Different types of lighting arrangements, design consideration of good lighting scheme. 6.5 Various types of lamps, Lumens per watt of different types of lamps, lux level required for different places as per SP 72:2010. 6.6 Calculation of average lux level. 6.7 Numerical based on design of illumination scheme for residential unit.	10
TotalHrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1.	Identify different conducting materials using resistivity test.	Conducting materials	2
2.	Identify different resinous materials using burning test.	Insulating materials	2
3.	Identify different magnetic materials.	Magnetic materials	2
4	Select and place relevant fuses in different lighting circuits.	Special purpose material	2
5	Prepare wire joints (GI Wire different joints)	Electrical Wiring	2
6	Prepare staircase wiring and test it	Electrical Wiring	2
7	Prepare godown wiring and test it		2
8	Prepare switch board containing four switch four socket arrangements (with fuse,indicator,internal wiring etc)		2
9	Perform cable laying from incoming bus to a machine installation.		2
10	Prepare cable joints.(Different joints)	Earthing System	2
11	Measure earth resistance of earth electrode using earth tester		2
12	Test insulation resistance of cables using Megger		2
13	Test/Measure earthing system resistance of a building.		2
14	Measure illumination level of residential building by lux meter.	Illumination in residential installation	2
15	Measure illumination level with and without reflectors used in the various Luminaries		2
16	Measure the illumination output of different lamps(Incandescent,Fluorescent,CFL) and compare it with their wattage.		2
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)	Progressive Test(PT)	Students	TwoPT (average of two tests will be computed)	25	--	Test Answer Sheets	1, 2,3
		Assignments		Continuous	15	--	Assignment Book/ Sheet	1, 2,3
	TEE(Term End Examination)	EndExam	Students	End Of the Course	60**	24	Online Exam.	1, 2,3
				Total	100	40		
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	20	--	Rubrics & Assessment Sheets	4,5,6
		Journal Writing		Continuous	05	--	Journal	4,5,6
				TOTAL	25	10		
	TEE (Term End Examination)	EndExam	Students	End Of the Course	50#	20	Rubrics & Practical Answer Sheets	4,5,6
Indirect Assessment	Student Feedback on course		Students	After First Progressive Test	Student Feedback Form			1, 2,3, 4,5,6
	End Of Course			End Of The Course	Questionnaires			

❖SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
01	Conducting materials	02 (00)	03 (00)	06 (03)	11 (03)
02	Insulating materials	02 (02)	03(03)	03(00)	08 (05)
03	Magnetic Materials & special purpose material	02 (00)	03 (03)	03 (06)	08(09)
04	Electrical Wires & Cables	02 (02)	03 (03)	06 (00)	11 (05)
05	Fuse & Earthing system	02 (02)	03 (03)	03 (03)	08 (08)
06	Illumination in residential installation	02 (00)	06 (00)	06 (06)	14 (06)
	Total	12 (06)	21 (12)	27 (18)	60 (36)

R– Remember

U– Understand

A– Analyze /Apply

❖QUESTION PAPERPROFILEFOR THEORY PAPER:

Q. No	Bit1			Bit2			Bit3			Bit4			Bit5			OPTION
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
Q. 01 to Q. 35	1	R	2	2	U	2	1	A	2	1	A	2	1	A	2	30/35
	2	R	2	2	R	2	2	U	2	2	U	2	3	A	2	
	3	R	2	3	U	2	3	A	2	3	A	2	3	A	2	
	4	R	2	4	R	2	4	U	2	4	U	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	A	2	6	A	2	6	A	2	

T=Unit/TopicNumber L=Level ofQuestion M=Marks

R-Remember

U-Understand

A-Analyze/Apply

❖ **SCHEME OF PRACTICAL EVALUATION:**

S.N.	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment's. writing procedure etc.	10
2	Performance (i.e. assembling, dismantling, testing & fault finding)	20
3	Skills and Results	10
4	Viva voice	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
1	2	--	-	-	-	-	-	1	-
2	2	--	-	-	-	-	-	1	-
3	2	--	-	--	2	--	2	-	-
4	3	3	3	--	1	--	1	1	-
5	3	3	3	--	1	2	-	3	2
6	--	3	3	--	-	2	1	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.	Electrical Engineering Materials	N. Alagappan, NT Kumar, Tata McGraw-Hill Publishing Company Ltd. 1988	978-0-07-460420-5
2.	Electrical Engineering Materials	Basak T.K., New Age International Publisher, First, 2010.	978-81-224-2773-8
3.	Engineering Materials	R.K. Rajput, S.Chand & Co. Ltd., First Edition, 2000.	81-219-1960-6
4.	Electrical Wiring Estimating and costing	Uppal S.L, Garg G.C	KKhanna Publishers, New Delhi, 2013 ISBN-13: 978-81-7409-240-3

5.	BasicShop Practical's in ElectricalEngineering	M.L.Anwani,DhanpatRaipublication 2016	EBK18759-71
6.	ElectricalEngineering Material	Dr. RakeshDogra, S.K.Kataria & Sons, 2010	81-88458-48-1
7.	ElectricalEngineering Materials & Semiconductor Devices	J.B.Gupta,Renu Gupta, S.K.Kataria& Sons, 2012	13-978-93-5014-300-1 10-9350143003
8	Electrical Estimating and costing	Gupta J.B	S.K.Kataria & Sons,New Delhi,2012,ISBN: 978-93-5014-279-0
9.	ElectricalEngineering ObjectiveType	M.Handa,A.Handa.SatyaPrakashan,First Edition:1985,Reprint:2004-2005	81-7648-043-2
10	IS: 732-1989,Code of practice for electrical wiring installation	Bureau of Indian Standard	-----
11	SP 30 National Electrical code 2010	Bureau of Indian Standard	-----
12	SP 72 National Lighting codes 2010	Bureau of Indian Standard	-----
13	Electrical Design Estimating and costing	K.B.Raina and Dr.S.K.Bhattacharya,New Age International Ltd,First Edition :1991 Reprint : 2011	81-224-0363-8 978-81-224-0363-3

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- ✓ <https://www.youtube.com/watch?v=A9KSGAnjo2U,assessedon> on 9 Feb 2022
- ✓ www.vssut.ac.in/lecture_notes/lecture1426861925.pdf,assessed on 9 Feb 2022
- ✓ [www.springer.comHomeNew &ForthcomingTitles,assessed](http://www.springer.comHomeNew&ForthcomingTitles,assessed) on 18 feb 2022
- ✓ [https://www.youtube.com/watch?v=Md2vDpD5eWU, assessed](https://www.youtube.com/watch?v=Md2vDpD5eWU,assessed) on 18 feb 2022
- ✓ <http://www.electrical4u.com,assessed> on on 18 feb 2022 ,
- ✓ [http://www.electricaltechnology.org/2015/09, assesed on](http://www.electricaltechnology.org/2015/09,assessedon) 18 feb 2022
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- ✓ [https://www.youtube.com/watch?v=BmwdSoGBIlg,assessed on](https://www.youtube.com/watch?v=BmwdSoGBIlg,assessedon) 18 feb 2022
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- . [www.nptelvideos.in/electrical engineering/lamps](http://www.nptelvideos.in/electrical%20engineering/lamps) on 18 feb 2022
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- . https://youtu.be/2DBoS3E_ojc on 18 feb 2022
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- . [https://www.electricaltechnology.org › 2012/11 › stair-..](https://www.electricaltechnology.org/2012/11/stair-) On 18 Feb 2022

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

1. Digital Multi-meter
2. Megger 500/1000V
3. Digital Earth Tester/Earth tester 3 spikes.
4. Standard Wire gauge
5. Outside micrometer 0-25mm
6. lamp, crimping tool, lugs, continuity tester, wire gauge, knife, safety hands gloves, safety boots, safety goggles, safety rubber mats (ISI Marks)
7. Exhaustive samples of wire/wire bundles (as per standard table), samples of non-armoured and armoured cables, single pole one way and two switches, Fluorescent tube circuit, ceiling roses, switch boards, casing-capping strips, PVC and iron conduits, different types of fuses, earthing equipments and all other wiring components for L.T Electrical installation system, line tester.
8. Exhaustive samples of insulators, insulating oils
09. Lux meter-Display 3-1/2 digit 18mm LCD, Ranges 0-50,000 lux : 3 ranges, sampling rate: 0.4 second, operating temperature 0-50⁰ C (32≈122F⁰) Accuracy : ±5%.
10. Control circuits for various luminaires

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

S.N.	Nam	Designation	Institute/ Industry
1.	Prof.A.M. Arekar	I/C, Head of Electrical Engineering	GovernmentPolytechnic, Nagpur.
2.	Prof.N.J.Suryawanshi	Lecturer inElectrical Engineering	GovernmentPolytechnic, Nagpur.
3.	Dr.G.V.Gotmare	/C, Head of Electrical Engineering G.P.Gondia	MSBTE Nominee
4.	Mrs.A.A.Alegaonkar	Lecturer inElectrical Engineering,G.P.Nagpur	CDC Coordinator Member (Internal)
5.	Mr.M.N.Gawande	Lecturer inElectrical Engineering,G.P.Nagpur	CDC In-charge (Member Secretary
6	A.P. Gandhi	Lecturer inElectrical Engineering G.P.Nagpur	Member (Internal)

(MemberSecretaryPBOS)

(ChairmanPBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EC213G
COURSE TITLE	: INDUSTRIAL ELECTRONICS
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 describes the fact, principle and technique of electronic devices like solid state power devices, and circuits and their applications in electrical systems, so that students can use knowledge in acquiring supervisory skill and prototype testing skill.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Illustrate the construction of power devices.
2. Use power devices in industrial circuits.
3. Construct electronics circuit using power devices.
4. Apply the testing skill of industrial system.
5. Assemble & test different electronics control circuits using Thyristors.
6. Analyze the functioning of electronics control in industrial system.

❖ COURSE DETAILS:

A:THEORY

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Power Semiconductor Devices.	1a. Describe various types of power diodes. 1b. Describe various types of power transistors. 1c. Describe various types of Thyristors. 1d. Describe various types of devices used for firing of Thyristors.	1.1 Power diodes: symbol, working principle of General Purpose diodes, fast recovery diodes, schottky diode, MOS diodes 1.2 Power transistors: symbol and working principle of Power BJT, Power MOSFET 1.3 Thyristors: symbol, working principle & characteristics of SCR, DIAC, TRIAC, GTO, IGBT 1.4 Devices used in firing circuit: symbol, working principle of UJT, PUT, SUS, SBS	10
2. SCR Triggering Methods	2a. Describe the various types of SCR turn-on method. 2b. Describe various firing circuits.	2.1 SCR turn-on methods -working principle, circuit diagram of High voltage, High temperature, Light activated, dv/dt and Gate turn-on methods 2.2 Firing Circuits– working principle, circuit diagram of Diode-Resistance Firing Circuit, Diode-Resistance Capacitance Firing Circuit, UJT Firing Circuit, PUT Firing Circuit, Pulse Transformer Firing Circuit, DIAC Firing Circuit	08

3. Commutation and Protection of SCR	3a. Describe the various types of SCR Turn-off Method. 3b. Describe the various types of Commutating Circuits. 3c. Identify various protection methods of power devices.	3.1 SCR Turn-off Method– working principle, circuit diagram of Line Commutation, Load Commutation, Forced Commutation. 3.2 Commutating Circuit - working principle, circuit diagram of Voltage Commutation, Current Commutation, Pulse Commutation, Jones Commutation. 3.3 Protection of Power Semiconductor Device -working principle, circuit diagram of Overvoltage Protection, Over current Protection, Gate Protection, Over temperature Protection.	08
4. Inverters and Choppers	4a. Describe the inverters in given points. 4b. Identify various types of inverters. 4c. Describe the choppers in given points. 4d. Analyze various types of choppers with circuit diagram and waveform	4.1 Inverters: Necessity, Classification, Advantages, Disadvantages and Applications. 4.2 Circuit diagram, working principle and waveforms of basic inverter circuit, Series Inverter, Parallel inverters. Comparison between series and Parallel inverter. 4.3 Choppers: Necessity, classification, applications and 4.4 Circuit diagram, operation and waveforms of Basic chopper circuit, Step up, Step down, Morgan chopper, Jones chopper	08

5. Converters and Cycloconverter	5a. Identify various types of controlled rectifiers 5b. Analyze various types of three phase controlled rectifiers 5c. Describe cycloconverter with given points.	5.1 Controlled rectifiers: circuit diagram, working and waveforms of Half wave controlled rectifier (HWR) and Full wave controlled rectifier (FWR) with R, RL, RL with freewheeling diode - No derivation 5.2 Types, circuit diagram, working and waveforms of three phase converter (HWR and FWR) using Power diode and SCR 5.3 Cycloconverter: necessity, Types, Advantages, Disadvantages applications, principle of operation of basic cycloconverter circuit	08
6. Regulated Power Supply.	6a. Analyse the various types of regulators. 6b. Identify various SMPS.	6.1 Voltage Regulators: circuit diagram, Working principle of Shunt regulators, series regulators, transistorized voltage regulator Protection circuits 6.2 Switched Mode Power Supplies (SMPS) - Concept of SMPS, Various schemes of SMPS, Design aspects of SMPS	06
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Analyse the given specifications from data sheets of various power electronic devices and prepare a report for them.	Power semiconductor devices	02
2	Measure forward current for various forward voltage by setting gate current of SCR and plot V-I characteristics of SCR.		02
3	Find the value of Holding current, Latching current, Forward break over voltage.		02

4	Measure output current for input forward voltage and reverse voltage applied, Plot the V-I characteristics of DIAC, Find the breakdown voltage.		02
5	Measure forward current and reverse current for various forward and reverse voltage and plot V-I characteristics of TRIAC.		02
6	Analyse the UJT triggering circuit for SCR firing.	SCR Triggering Methods	04
7	Measure the output voltage of three phase half wave rectifier and plot the input and output waveforms.	Converters and cycloconverter	02
8	Measure the output voltage of three phase full-wave rectifier and plot the input and output waveforms.	Converters and cycloconverter	02
9	Measure the value of load voltage by using series inverter circuit and plot the waveforms.	Inverters and Choppers	02
10	Measure the value of load voltage by using parallel inverter circuit and plot the waveforms.		04
11	Find the voltage and current of Step up chopper and plot the V-I characteristics of Step up chopper.		04
12	Develop a mini project using industrial electronics devices. Test the functioning of it. Write a report on it.		04
TOTAL			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Power semiconductor devices.	02(02)	00(00)	00(00)	02(02)
2	SCR Triggering Methods	02(05)	09(03)	00(00)	11(08)
3	Commutation and protection of SCR	05(02)	06(06)	00(00)	11(08)
4	Inverters and Choppers	02(00)	03(06)	06(00)	11(06)
5	Converters and cycloconverter	02(00)	06(06)	06(00)	14(06)
6	Regulated Power supply	05(00)	06(00)	00(06)	11(06)
	Total	18(09)	30(21)	12(06)	60(36)

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**[illegible]

❖ 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	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)							PSOs	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	
3	3	3	-	-	-	-	-	-	-
4	3	3	2	2	1	-	1	1	1
5	3	3	2	2	1	1	1	1	1
6	3	3	2	2	1	1	1	1	1

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 & power electronics	H.C. Rai , Umesh Publisher-New Delhi edition 2012	9788188114146
2	An Introduction to Thyristors and their Applications	M. Ramamurthy, East West Press, New Delhi 1991	8185336679, 9788185336671

3	Power Electronics	P.C. Sen, Tata-McGraw Hill, New Delhi 2012	0074624008, 978007462400 5
4	Power Electronics and Its Applications	Alok Jain, Penram India 2008	818797222X, 978818797222 8.
5	Power Electronics	M D Singh, K.B. Khanchandani, Tata McGraw-Hill 1998	0074633694 978- 0074633694

❖ E-REFERENCES:

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- <https://www.electronicshub.org/scr-turn-on-methods/> accessed on 25 February 2022.
- <http://www.electrical4u.com/thyristor-protection-or-scr-protection/> accessed on 25 February 2022
- <http://www.electrical4u.com/chopper-dc-to-dc-converter/> accessed on 25 February 2022
- <http://www.electrical4u.com/gate-characteristics-of-scr-or-thyristor/> accessed on 25 February 2022

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:

1. Digital Multi-meter: 3.5 digit with R, V, I measurements, diode and BJT testing
2. Cathode Ray Oscilloscope (CRO)/ Digital Storage Oscilloscope (DSO):
20 MHz/30 MHz 2 Channel, 2/4 Trace
3. Signal/Function Generator: 3MHz, sine/square/triangular/ ramp and pulse signal,
Output amplitude-20V open circuited, Output impedance 50Ω.
4. Regulated DC Power Supply: 0- 30 Volt, 2A with digital display.

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

S.N.	Name	Designation	Institute / Industry
1	Dr. R.V.Yenkar	HOD (EC)	Government Polytechnic, Nagpur.
2	Dr.V.H.Mankar	HOD (EC)	Government Polytechnic, Nagpur
3	Prof .J.P.Kelwade	Lecturer In Electronics (Selection Grade)	Government Polytechnic Nagpur
4	Mrs.J.A.Raut	Lecturer In Electronics	Government Polytechnic, Nagpur
5	Mr.Sandip V.Darwekar	Director	Beta Computer Pvt. Ltd. Nagpur
6	Mrs. Gazala Ali	HOD, Electronics	Anjuman Polytechnic, Nagpur

7	Prof.Kapil Pachpor	Lecturer in Electronics	Govt. Polytechnic, Amravati
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(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY: PROGRAMME CORE COURSE
COURSE CODE : EE251G
COURSE TITLE : ELECTRICAL WORKSHOP
TEACHING SCHEME: TH:00; TU: 00;PR: 04(CLOCK HRs.)
TOTAL CREDITS : 02 (1 TH/TU CREDIT = 0 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM : --
PR. TEE EXAM : 02 HRs
PT. EXAM : --

❖ **RATIONALE:**

Electrical Workshop course develops the techniques of electrical repairs, fault finding, testing, fabrication and manufacturing of various items used in electrical field. This course will help the student to acquire skill and attitude to discharge the function of supervisor in industry and can start his own small –scale enterprise.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Use electrical workshop & testing tools.
2. Select accessories, starter, batteries and wiring systems for electrification.
3. Perform different electrical tests.
4. Rewind electrical motors and transformers.
5. Conduct testing, fault finding, and maintenance of domestic appliances.
6. Prepare a given mini project.

❖ **COURSE DETAILS:****A. THEORY :**

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

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Use following electrical workshop tools- • Screw driver • Spanners and wrenches • Bearing Puller • Hammers and Mallet • Pliers and rawl punch • Hand drill machine, portable drilling machine • Electrician's knife.	Introduction	02
2	Use following testing tools- • Tester • Test lamp • Multi-meter • Megger • Series test board • Earth tester		02
3	To identify different electrical accessories in electrical workshop lab	Electrical Accessories, starter & batteries	02
4	To prepare board of two lamp control by two different switch with socket outlet		04
5	To identify different types of starter (DOL starter, Automatic star delta starter).		02
6	To identify faults in different types of starter		02
7	To decide current setting of starter.		02
8	To perform the series connection of batteries.		02
9	To perform the parallel connection of batteries..		02
10	To select different types of batteries according to types of D.C motor (D.C Series motor, D.C Shunt motor)		04

11	Disassemble the different parts of single phase induction motor & Identify the faults of motor	Testing & Repairing	02
12	Assemble the single phase induction motor		02
13	Give the supply & start the single phase induction motor		02
14	Disassemble the different parts of Three phase induction motor & identify the faults		02
15	Assemble the Three phase induction motor.		02
16	Give the supply & start the Three phase induction motor.		02
17	Prepare given mini project • Prepare flow chart (action plan) for mini project. • Procure different materials for selected mini project. • Select the project based on rewinding of any one of single phase motor, three phase motor, small capacity single phase transformer.	Mini Project	02 02 04
18	Perform different tests of motor/transformer • Continuity test • Short circuit test		02 02
19	Test and fault findings of given domestic appliances • Electric Iron • Electric toaster • Electric room heater • Electric mixture & Grinder • Vacuum cleaner	Test-Fault findings of home appliances	02 02 02 02 02
20	Troubleshoot the following domestic appliances (Select any two) • Ceiling fan • Electric Mixture & Grinder • Washing machine • Air cooler • Hair drier • Electric hot plate/Segri • OTG (Oven toaster grill) • Vacuum cleaner • Electric Geyser • Microwave oven	Troubleshoot of domestic appliances	02 02 02 02 02 02 02 02 02 02
Total Hrs			64

❖ **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	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	---	---	----	----
		Class Room Assignments		Assignments	---	----	---	----
	TEE	End Exam	Students	End of the Course	---	---	----	----
				Total	---	---	---	----
Direct Assessment Practical	CA (Continuous Assessment)	Skill Assessment	Students	Continuous	40	--	Rubrics and Assessment Sheets	1, 2, 3,4,5,6
		Journal Writing		Continuous	10	--	Journal	1, 2, 3,4,5,6
				Total	50	20		
	TEE	End Exam	Students	End of the Course	50	20	Rubrics & Practical Answer Sheets	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, /sketch	10
2	Performance	20
3	Testing	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
1	3	3	3	3	3	---	1	3	---
2	---	3	3	3	---	---	1	3	---
3	1	2	2	3	1	---	1	3	---
4	--	3	3	3	3	---	---	3	---
5	2	3	3	3	---	---	---	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	Study of home appliances & Devices	K.B.Bhatiya, Khanna publisher.	8174092656
2	Rewinding Small motors	K.Wilkinson, Elsevier, 1 st Edition	9781483135380
3	SP 30 National Electrical code-2010	Bureau of Indian Standard	-----
4	IS: 732-1989, Code of practice for electrical wiring installation	Bureau of Indian Standard	-----
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
6	Electrical wiring Estimating & costing	S.L.Uppal, G.C.Garg, Khanna publications, Sixth Edition 2009, second	978-81-7409-240-3

reprint:2011

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=EAudT9QOZzY>, accessed on 25 Jan2022
- <https://www.youtube.com/watch?v=BXgpqLLXz0U>, accessed on 25 Jan 2022
- www.slideshare.net/bawaparam/made-by-param accessed on 25 Jan 2022
- www.electricaltechnology.org/2013/09/electrical-wiring.html accessed on 25 Jan 2022
- www.electricaltechnology.org › EE Review, accessed on 25 Jan 2022
- https://www.youtube.com/watch?v=wsLYedGKcrE&index=1&list=PLm-Crpu8c7pQBzhmvQwpf1vllq_6Is88M, accessed on 25 Jan 2022.
- https://www.youtube.com/watch?v=yPvYd03cKJU&index=4&list=PLm-Crpu8c7pQBzhmvQwpf1vllq_6Is88M, accessed on 25 Jan2022,

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

1. Drilling machine
2. Electrician tool kit.
3. Wire,cables,crimping tool, lugs
4. Single phase induction motor,1KW,240V,1440rpm
5. Three phase squirrel cage induction motor, 3KW, 440V, and 1440 rpm.
6. Digital millimeter
7. Megger500/1000V.
8. Electric mixer-575 watt, 230V.
9. Electric iron-1100watt,230V.
10. Ceiling fan Sweep-1200mm(48''),230V.
11. Air cooler with semi exhaust fan-450mm,230V.
12. Electric toaster-1500W,230V.
13. Electric Geyser-25L,230V
14. Electric washing machine-washing capacity6.5Kg
15. Electric Hot plate/Segri
16. Air conditioner-1.5ton,230V

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

S.N.	Name	Designation	Institute/ Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Prof.A.M.Arekar	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
3	Prof.N.J.Suryawanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Shri.Nilesh Kodand	COE.Manager Assembly, Maintenance, Mahindra & Mahindra Nagpur	Industry Expert

5	Shri.Sudhir Joshi	General Manager, Ashok Leyland,Bhandara	Industry Expert
6	Dr.P.M.Daigavane	Head of the Department, Electrical Engg. G.H.Raisoni College of Engg,Nagpur	Member from Academics (External)
7	Dr.G.V.Gotmare	I/C, Head of Electrical Engineering G.P.Gondia	MSBTE Nominee
8	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering, G.P.Nagpur	CDC Coordinator Member (Internal)
9	Mr.M.N.Gawande	Lecturer in Electrical Engineering,G.P.Nagpur	CDC In-charge (Member Secretary)
10	Smt.A.P. Gandhi	Lecturer in Electrical Engineering G.P.Nagpur	Member (Internal)
11	Smt.P.M.Sonwane	Lecturer in Electrical Engineering G.P.Nagpur	Government Polytechnic, Nagpur.
12	Smt.P.S.Rithe	Lecturer in Electrical Engineering G.P.Nagpur	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)



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

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY: PROGRAMME CORE COURSE
COURSE CODE : EE206G^s
COURSE TITLE : ELECTRICAL MACHINE OPERATION AND CONTROL
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:**

Induction motors are widely used in various industries as drive motors for variety of machines. Due to its rugged construction, smoother and efficient operation, it has replaced de motors in variety of applications. By reason of the important role played by synchronous machines (alternators and motors) in the electrical generation systems, the electrical technologists also need to be well versed in the construction and working of these machines. Further fractional horse power (FHP) machines are used in many control circuits of automation systems. Since technologists are expected to maintain industrial systems involving these machines it is highly essential to provide them necessary knowledge about construction and operation of these machines. This course therefore, aims to equip the students with the fundamental requirements of using these machines in different applications.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Determine the given parameters of three phase induction motor.
2. Suggest the suitable starter and speed control method for given three phase induction motor
3. Suggest the suitable single phase motor for the different applications.
4. Choose the specific three phase alternator for different load conditions.
5. Use synchronous motors for different applications.
6. Select relevant special FHP motors for different applications

❖ **COURSE DETAILS:**
A. THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Three Phase Induction Motor	1a. Describe the construction and working of given induction motor with suitable diagram . 1b. Calculate given rotor quantities of Induction Motor under different operating conditions. 1c. Select relevant induction motor based on as per the given load torque- speed requirements . 1d. Illustrate the behavior of I.M. under given abnormal conditions. 1e. Determine the given performance parameters of the motor from power stages of Induction Motor.	1.1 Construction and working of of 3 phase induction motors 1.2 Squirrel cage induction motor and Slip ring induction motor 1.3 Its Working principle. production of rotating magnetic field, Synchronous speed, rotor speed and slip. 1.4 Rotor quantities: frequency, slip induced emf, torque ,power factor at starting and running condition, Calculate synchronous speed ,rotor frequency, induced emf, power factor at starting and running condition 1.5 Torque-Slip Characteristics of Three Phase Induction Motor: 1.6 Effect of change in Rotor Circuit resistance, Effect of supply voltage on Torque-Slip Characteristics 1.7 Motor selection for different applications as per the load torque-speed requirements 1.8 Behavior of three phase induction motor under abnormal conditions a. Single Phasing of Induction motor, Crawling and Cogging or Magnetic Locking 1.9 Induction motor as a generalized transformer with phasor diagram Power flow diagram , calculate rotor loss , rotor input, mechanical power and efficiency of three phase induction motor	12

2. Starting and Speed Control of Induction Motor	2a. Describe with neat sketch the operation of the relevant starter for the given motor. 2b. Select suitable method of speed control of given applications . 2c. Suggest the relevant three phase Induction Motor starters for the given rating of motor and application.	2.1 Generalized construction of starter, wiring diagram and working of • Direct on line starter. • Star delta starter-Manual and automatic starter • Autotransformer starter. • Rotor resistance starter. • Concept, operation & advantages of soft starters. 2.2 Necessity of speed control of 3 phase I.M., methods of speed control, Stator Side speed control – • Pole Changing, • Stator Voltage control, • Frequency Control(V/Fcontrol) Rotor Side speed control – • Rotor resistance variation, • EMF injection method 2.3 Starter selection for different applications as per the given three phase induction motor ratings.	06
3. Single Phase Induction Motor	3a. Describe with neat sketch 3b. construction and working of the given single phase induction motor. 3c. Compare the torque –speed characteristics of the given type of single phase induction motor. 3d. Suggest the relevant single phase motor for given applications.	3.1 Double field revolving theory, principle of making these motors self-start. Construction and working of : • Resistance start induction run, • Capacitor start induction run, • Capacitor start capacitor run, • Shaded pole induction motor. • AC Series motor, • Universal motor, • Hysteresis motor. 3.2 Torque-speed characteristics for all of the above motors. 3.3 Motor selection for different applications as per the load torque-speed requirements.	06
4. Three Phase Alternator	4a. Describe with neat diagram construction and working of the given type of an alternator. 4b. Calculate given parameters of EMF equation of an alternator. 4c. Describe loading of an alternator at given power factor with its suitable vector diagram . 4d. Determine the voltage	4.1 Definition and Construction of Three Phase Alternator. a) Armature: stationary and Rotating b) Rotor : Salient Pole and Cylindrical 4.2 Derivation of EMF Equation of an Alternator, Chording factor, Distribution Factor and their effect on EMF generation, calculate emf induced in alternator. 4.3 Alternator loading: Factors affecting	12

	regulation of an alternator using given method of voltage regulation. 4e. Justify given methods of cooling of an alternator. 4f. Justify the sharing of given load by parallel operation of three phase alternator. 4g. Describe the effect of given input parameters on load sharing of an alternators.	the terminal voltage of alternator; Armature resistance and Leakage reactance Armature reaction at various power factors and Synchronous impedance vector diagrams of loaded alternator 4.4 Voltage Regulation of Three Phase Alternator : Synchronous Impedance Method ,Direct Loading method , Calculate voltage regulation of alternator with synchronous impedance method. 4.5 Losses in alternator, heating and temperature rise, cooling of turbo alternator. Hydrogen & D.M. water-cooling. 4.6 Necessity of parallel operation of an alternator, Conditions of parallel operation and its load sharing. 4.7 Effect of excitation and Steam Power input on load sharing of an alternator .	
5. Synchronous Motor	5a. Describe with diagram starting of synchronous motor with the given method . 5b. Describe the effect of the excitation variation for the given loading conditions 5c. Describe given curves of a synchronous motor. 5d. Justify the given causes of hunting of synchronous motor with its effects and remedies. 5e. Suggest suitable synchronous motors for given applications.	5.1 Principle of working significance of load angle. Methods of Starting of Synchronous Motor. 5.2 Synchronous motor on load with constant excitation ,effect of excitation at constant load 5.3 V-Curves and Inverted V-Curves. 5.4 Hunting / Phase swinging: its causes , effects and remedies. 5.5 Applications of synchronous motor for power factor correction, constant-speed, constant-load drives and voltage regulation .	06
6. Special FHP Machines	6a. Describe the construction and working principle with suitable wiring diagram of the given FHP motor. 6b. Compare the torque –speed characteristics of the given type of special FHP machines. 6c. Suggest suitable special FHP motor for the given application.	6.1 Construction and working of : • PMDC motor, • Reluctance Motor, • BLDC motor , • stepper motors, • AC and DC servomotors. 6.2 Torque speed characteristics of above motors. 6.3 Applications of above special FHP motors.	06
Total Hrs			48

❖ **LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Perform the direct load test on the three phase squirrel cage induction motor and plot the curves i)efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv)_ torque - slip / speed characteristics.	Unit –I Three phase Induction motor	02
2	Perform the No-load and Blocked-rotor tests on given 3- squirrel cage induction motor and determine the equivalent circuit parameter.		04
3	Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two).	Unit- II Staring and speed control of Three phase Induction motor	02
4	Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) stator voltage control,ii) rotor resistance starter (iii) pole changing methods (any two).		02
5	Identify different windings & components of single phase capacitor start Induction Run motor & Connect to start & reverse the direction of rotation	Unit- III Single phase Induction motor	02
6	Conduct the direct load test to determine the efficiency and speed regulation on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.		02
7	Perform the direct loading test on the given three phase alternator and determine the regulation.	Unit-IV Three phase Alternator	04
8	Determine the regulation of the given three phase alternator from OC and SC tests (Synchronous impedance method).		04
9	Start 3 phase synchronous motor & run synchronous motor in forward & reverse direction.	Unit-V Synchronous motor	02
10	Conduct the test to plot the 'V' curves and inverted 'V' curves of 3-phase synchronous motor.		04
11	Control the speed and reverse the direction of stepper motor.	Unit-VI Special FHP Machines	02
12	Control the speed and reverse the direction of the BLDC motor.		02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Operation of Three phase Induction Motor	04(00)	03(00)	06(06)	13(06)
2	Starting and speed control of Three phase Induction Motor	02(02)	00(03)	06(00)	08(05)
3	Single phase Induction Motor	00(02)	06(03)	03(00)	09(05)
4	Three phase Alternator	04(00)	03(03)	06(06)	13(09)
5	Synchronous motor	02(00)	06(00)	00(06)	08(06)
6	Special machines	00(02)	03(03)	06(00)	09(05)
	Total	12(06)	21(12)	27(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
	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	4	R	2	4	R	2	5	R	2	6/9
	2	R	2	3	R	2	6	R	2										
2	1	U	3	3	U	3	3	U	3	1	A	3	1	A	3				3/5
3	4	U	3	2	A	3	2	A	3	2	U	3	3	U	3				3/5
4	3	A	3	5	U	3	4	A	3	4	A	3	4	U	3				3/5
5	4	A	3	5	U	3	6	U	3	6	U	3	4	A	3				3/5
6	1	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		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 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	1	3	3	3	-	-	3	3	3
2	-	-	-	3	-	-	3	3	3
3	1	3	-	3	-	-	3	3	3
4	1	3	3	3	-	-	3	3	3
5	1	3	3	3	-	-	3	3	3
6	1	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 text book of Electrical technology Vol II	Theraja B. L. & Therja A. K., S. Chand and Co. New Delhi	ISBN 10: 8121924375
2	Electrical Machines	Bhattacharya S.K. Kothari D. P. and Nagrath I. J. Tata McGraw Hill, New Delhi	Tata McGraw Hill, New Delhi ISBN 9780075415396
3	Basic Electrical Engineering	Mittal V. N., McGraw Hill, New Delhi, 2014	ISBN 9780074516324
4	Alternating Current	M.G. Say, Pitman Publishing Ltd.- 4th Edition	ISBN- 0 273 36197

	Machines	2013	
5	Special Electrical Machines	Janadhan E.G. Prentice Hall India, New Delhi	ISBN: 9788120348806
6	Electrical Machinery	P.S.Bhimbra. Publisher: Khanna Publishers Edition: 7th Edition, 2011	9788174091734, 8174091734
7	Laboratory Courses in Electrical Engineering	S. G.Tarnekar, P.K.Kharabanda, S.B. Bodhakhe, S.D. Naik, S. Chand & Company Ltd., Reprint 2010	81-219-0104-9

❖ **E-REFERENCES:**

- https://youtu.be/KTzd_PueN44, accessed on 25th January 2022
- <https://www.youtube.com/watch?v=-j9mjXW-r8o>, accessed on 25th January 2022
- <https://youtu.be/mQ-gPMDv-tI>, accessed on 25th January 2022
- <https://youtu.be/-BiQzamGi58>, accessed on 25th January 2022
- <https://youtu.be/hjE-73Yyoas>, accessed on 25th January 2022
- <https://youtu.be/f0vrTNmCTkc>, accessed on 30th January 2022
- <https://www.youtube.com/watch?v=5t1S8qy9oVk>, accessed on 30th January 2022
- <https://youtu.be/bCEiOnuODac>, accessed on 30th January 2022
- <https://youtu.be/eyqwLiowZiU>, accessed on 30th January 2022

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

1. Induction motors 3 hp/ 5hp, 415 V, 50 Hz, 1440 RPM squirrel cage type
2. Induction motors 3 hp/ 5hp, 415 V, 50 Hz, 1440 RPM slip ring type.
3. Clip on meter (amp, volts) digital/analog
4. Digital multimeter 4 ½ digit with standard make for measurements
5. Ammeters MI Type: AC/DC 0-5-10Amp
6. Voltmeter MI Type: AC /DC, 0-150/300V, 0-250/500V
7. Wattmeter: Three phase double element 5/10Amp, 250/500V or sr no 6
8. Wattmeter: Single phase, single element 2.5/5Amp, 200/400V,
9. Low power factor wattmeter: Single phase, 2.5/5Amp, 250/500V
10. Auto transformer: 3-phase, 5kVA, 0 to 500V.
11. Load bank: Resistive, 3-phase, 5kW, 415V
12. Load bank: inductive, 3-phase, 2 to 5kVAR, 415V
13. Load bank: capacitive, 3-phase, 2 to 5kVAR , 415V
14. Star- delta, auto transformers starters
15. Tachometers: contact and non-contact types: 100 to 10000 RPM
16. Brake load or other suitable means to load motors
17. Three phase alternator: 5kVA, 415 V, 50 Hz, 4 pole, 1500 RPM.
18. Three phase synchronous motor: 3hp, 415 V, 50 Hz, 1500 RPM.

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

S.N.	Name	Designation	Institute / Industry
1	Prof.A.M.Arekar	Chairman ,PBOS & HOD Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	MSBTE member, PBOS & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Gondia
3	Prof.M.N.Gawande	Member Secretary PBOS & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
4	Prof.Ms.A.A. Alegaonkar	CDC Coordinator& Lecturer , Electrical Engg.Deptt.	Government Polytechnic, Nagpur
5	Prof. M.C.Musale	Lecturer , Electrical 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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE207G^{\$}
COURSE TITLE	: ELECTRICAL POWER AND DISTRIBUTION
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02(CLOCK HRs.)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCKHR.)
TH.TEE	: 03 HRs
PR.TEE	: 02 HRs
PT	: 01 HR

❖ **RATIONALE:**

The electricity is generated in bulk at remote places and transmitted to long distances and then distributed in cities, villages and to industry. The transmission and distribution of electric power is a complex issue which requires knowledge of different types of transmission lines and power equipments. Technicians are required to operate and maintain the power transmission and distribution system so that electrical energy is continuously available to the consumers economically. After completion of this course student will be able to supervise installation, operate and maintain equipments in substation, supervise the installation and laying of overhead lines and underground cables as well as assist in-charge in planning and designing distribution system.

❖ **COURSE OUTCOMES :**

After completing this course students will be able to–

1. Maintain the components of the transmission and distribution lines.
2. Calculate efficiency & voltage regulation of transmission line from the given data.
3. Interpret the parameters of extra high voltage transmission system.
4. Distinguish different types of distribution system.
5. Identify various components & functioning of load dispatch center.
6. Interpret layout drawing of various substations .

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Transmission & Distribution Line Components	1a. Classify given Line supports on the basis of given points. 1b. Describe the given type of conductor using diagram. 1c. Calculate potential distribution over a string of suspension insulators and string efficiency for given insulator string.	1.1 Single line diagram with components of electric supply transmission & distribution systems, Introduction to main components of overhead lines, Line supports : desirable characteristics, types- wooden poles, steel tubular and rail poles, RCC poles, Steel towers for single circuit and double circuit. 1.2 Conductors- desirable properties, types- copper, all-aluminum (AAC), all-aluminum alloy (AAA), aluminum conductors steel reinforced (ACSR), cadmium copper, galvanized steel, composite conductors, bundled conductors, Spacing between conductors span, significance of sag. 1.3 Line insulators : desirable properties of insulator materials, selection of material, types of insulators (For transmission and distribution lines), applications, causes of insulator failure, Potential distribution over a string of suspension insulators, string efficiency, methods of improving string efficiency. Numerical based on string efficiency for string of three suspension insulator , guy insulator, ground wires .	12
2. Transmission Lines parameters and Performance	2a. Classify transmission line on the basis of length and voltage. 2b. Calculate regulation and efficiency of given short transmission line on given data. 2c. Describe given effects	2.1 Concept of R, L & C of line Parameters, Classification of transmission lines, Regulation and efficiency of transmission line. 2.2 Short transmission line: equivalent circuit representation and phasor diagram, derivation for regulation and efficiency, effect of load power factor on	08

	occurring in transmission line.	regulation and efficiency of short lines, calculate regulation and efficiency of short transmission lines. Medium transmission line: Nominal- PI & nominal-T circuit representation and analysis, phasor diagram. Long transmission line: Equivalent circuit representation phasor diagram. 2.3 Skin effect, proximity effect, Ferranti effect, Transposition of power conductors, Corona effect, factors affecting corona, advantages and disadvantages, methods of reducing corona loss.	
3. EHVAC and HVDC Transmission	3a. Describe configuration of EHV-AC transmission link. 3b. Classify given HVDC system on given points. 3c. Classify EHVAC & HVDC transmission system on the basis of given points.	3.1 EHV-AC transmission system: Necessity, applications, configuration of EHV-AC transmission link. 3.2 HVDC transmission system : Necessity , applications, types of HVDC system, configuration & parts of HVDC system, standard rated voltage 3.3 EHV-AC versus HVDC transmission system, comparative technical and economical advantages and limitations of EHVAC & HVDC system.	06
4. Distribution Systems & voltage control	4a. Classify radial, loop and ring mains system on the basis of given points . 4b. Calculate voltage drop, current in 1-phase distributors on given data. 4c. Describe given method of voltage control. 4d. Describe flexible AC transmission line .	4.1 Introduction, feeders, distributor and service lines. Construction of overhead distribution lines, earth wire, guarding . Primary distribution systems & Secondary distribution systems , Types of different distribution schemes : Radial, ring mains and grid , layout , advantages , limitations & applications. 4.2 Voltage drop in 1-phase & 3-phase distributors, sending end & receiving end voltage, distributor fed at one end and fed at both ends (calculate voltage drop, current in 1-phase distributors), design Consideration for feeder and distributor	10

		4.3 Voltage control – Importance , permissible voltage variation Methods of voltage control- excitation control and automatic voltage regulation of alternators, tap changing transformer, shunt compensation, 4.4 Flexible AC transmission line : Need & Definition, New trends in wireless transmission of electrical power.	
5. Inter-connected Power System and Load Dispatch	5a. Describe concept of national grid & concept of smart grid. 5b. Describe SCADA system with block diagram. 5c. Describe the concept of load dispatch, load shedding.	5.1 Interconnected power system, introduction, merits and limitations, concept of national grid, concept of smart grid, features & applications , scope in India 5.2 Load frequency or real power control, Automatic voltage or reactive power control, SCADA system. 5.3 Concepts of load dispatch, load shedding.	06
6. Substations	6a. Classify substations according to service & location on given points. 6b. List Substation equipments and auxiliary systems & state their functions. 6c. Draw block diagram of PLCC system and state its applications.	6.1 Introduction, classification of substations according to service & location, typical single line connection diagrams of substation layouts, 11 KV/ 0.415KV pole mounted distribution substation, 33KV/11KV substation, 132 KV or 220 KV substations. 6.2 Substation equipment and auxiliary systems, their functions, substation earthing. 6.3 Power line carrier communication (PLCC) system- Block diagram and applications. Applications of fibre optics in electrical power systems.	06
Total Hrs			48

❖ **LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	I. Identify different types of transmission and distribution line supports. II. Prepare report and draw sheet.	1. Transmission & Distribution line components	04
2	I. Identify different types of overhead line insulators. II. Prepare report and draw sheet.		04
3	I. Identify different types of transmission line conductors. II. Prepare report and draw sheet.		04
4	I. Identify different components of HVDC terminal substation. II. Prepare report and draw sheet.	3. EHVAC and HVDC Transmission	02
5	I. Identify different components of 132 or 220 or 400 KV outdoor substation. II. Prepare report and draw sheet.	6. Substations	04
6	Visit to 11KV/0.415KV substation. Prepare report and draw sheet.	6. Substations	04
7	Prepare visit report of load dispatch centre. Observe all activities.	5. Inter-connected Power System and Load Dispatch	04
8	Interpret the given layout drawing of HVDC terminal substation and identify the type of its configuration.	3. EHVAC and HVDC Transmission	02
9	Interpret the meaning of various symbols and indicators on panel drawing of interconnected power system collected from load dispatch centre.	5. Inter-connected Power System and Load Dispatch	04
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Transmission & Distribution line components	04(02)	03(03)	09(03)	16(08)
2	Transmission Lines parameters & Performance	04(02)	06(03)	06(06)	16(11)
3	EHVAC and HVDC Transmission	02(00)	03(03)	00(00)	05(03)
4	Distribution Systems & voltage control	00(02)	06(00)	06(06)	12(08)
5	Inter- connected Power System and Load Dispatch	02(03)	03(00)	00(00)	05(03)
6	Substations	03(00)	03(03)	00(00)	06(03)
	Total	15(09)	24(12)	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			Options
	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	5	R	2	6/9
	1	R	2	2	R	2	4	R	2										
2	1	U	3	3	U	3	4	U	3	5	R	3	1	A	3				3/5
3	4	A	3	5	U	3	6	U	3	2	U	3	1	U	3				3/5
4	2	U	3	4	A	3	6	R	3	3	U	3	4	A	3				3/5
5	1	A	3	2	U	3	4	U	3	6	U	3	4	A	3				3/5
6	1	A	6	2	A	6	2	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:**

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 sheets	20
2	Report writing (if any)	10
3	Viva voce	20
	TOTAL	50

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

Course Outcomes (COs)	Program Outcomes (POs)							PSOs	
	1	2	3	4	5	6	7	1	2
1	-	3	-	-	-	-	3	-	3
2	-	3	-	-	-	-	-	-	3
3	-	3	-	-	-	-	-	-	3
4	-	3	2	-	-	-	-	-	3
5	-	3	2	2	-	-	-	-	3
6	-	3	2	2	-	-	-	-	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	A Course In Electrical Power	J.B.Gupta, S.K.Kataria & Sons, Pvt. Ltd.,1990.	978-9350143742
2	Transmission and Distribution of Electrical power	K. B. Raina, K.C. Singal and Y.K. Anand, Tata McGraw- Hill Publication Ltd., 1985.	8122403638
3	Principles Of Power System	V. K. Mehta, S.Chand & Co Pvt. Ltd., 2000.	81-219-0594-X
4	Electrical Power System	C. L. Wadhawa, New Age International, 01-Jan-2005.	978-81-224-2839-1
5	A Text book on Power System Engineering	A. Chakrabarti ,M.L.Soni, P. V. Gupta, Dhanpat Rai& Co. (P) Ltd., 2000.	81-7700-020-9

❖ **E-REFERENCES:**

- <http://nptel.ac.in/syllabus/syllabus.php?subjectId=108108033>, accessed on 27th January, 2022
- <http://www.electrical4u.com/electrical-power-transmission-system-and-network/>, accessed on 27th January, 2022
- <https://www.youtube.com/watch?v=lr1jgbR5ca8&list=PLD4ED2FAF3C155625&index=10>, accessed on 27th January, 2022
- <https://www.electrical4u.com/power-line-carrier-communication/> accessed on 27th January, 2022

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

1. Types of conductors
2. Various Line Insulators

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Mr.A.M.Arekar	I/c. Head Electrical Engineering	Government Polytechnic, Nagpur.
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Mr.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mrs.A.P.Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
7	Mrs.N.J.Suryavanshi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
8	Ms.P.M.Sonwane	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
9	Ms.P.S.Rithe	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE208G^{\$}
COURSE TITLE	: ELECTRICAL ESTIMATION AND CONTRACTING^{\$}
TEACHING SCHEME	: TH: 03; TU: 00; PR: 02 (CLOCK HRs.)
TOTAL CREDITS	: 04 (1 TH CREDIT =1 CLOCK HR., 1 PR CREDIT= 2 CLOCK HRS.)
TH. TEE	: 04 HRs
PR. TEE	: 02 HRs
PT. EXAM	: 1 ½ HRs

❖ **RATIONALE:**

Installation of Electrical Equipment, Machines and Wiring is major task to be completed by a Diploma Holder in Electrical Engineering. The student should be able to collect the required information for estimating and costing any given electrical installation project. The student should understand given installation plan and draw layout .He should carry out survey to know current market rate of each component .He should be able to calculate material required for an installation project. Knowledge of this course will be help him to work as a Contractor, an Entrepreneur .Also he can execute different electrical installation projects. The knowledge of this course is useful to test of any new installation. The student must know IE rules and Indian Electricity Act 2001 while dealing an electrical installation and testing .

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Prepare documents related to Quotations ,Tenders and Contract.
2. Estimate material for electrical installation in residential scheme.
3. Develop wiring diagram for electrical installation in commercial installation with estimation.
4. Calculate cost of electrical installation of an industrial installation
5. Prepare estimate for electrical installation of streetlight and distribution line .
6. Estimate cost for electrical installation of 11 KV Substation.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Estimation, Contract, Tender	1a. Use safety practices in a given electric work. 1b. Compare given types of estimation. 1c. Identify good qualities for becoming good estimator. 1d. Prepare tender and quotations, bills for given requirements.	1.1 Introduction • Scope and features of National Electrical Code 2011 (NEC 2011), • Types of electrical installation- Non industrial and industrial, • Standard value of voltages and their limits, • Fundamental principles for electrical installations • Safety in electrical work, permit to electrical work, safety instruction and safety practices 1.2 Estimating and costing. • Purpose of estimating and costing, Qualities of good estimator, essential elements of estimating and costing • Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate • Factors to be considered while preparation of detailed estimate and economical execution of work. 1.3 Contracts • Concepts of contracts, types of contracts, contractor, role of contractor, qualities of good contractor 1.4 Tenders and Quotations • Type of tender, tender notice, preparation of tender document, and method of opening of tender • Quotation, quotation format, comparison between tender and quotation. • Comparative statement, format of comparative statement. Order format, placing of purchasing order • Principles of execution of works,	04

		planning, organizing and completion of work, Billing of work.	
2. Residential Installation	2a. Interpret given civil drawing . 2b. Interpret given electrical drawing. 2c. Inspect given installation. 2d. Estimate material required for given residential building electrification 2e. Apply different standard test for residential electrical installation.	2.1 Domestic Dwellings/Residential Buildings, its classification, Necessity and reading of Civil Engineering Building Drawing. 2.2 Wiring Layout, Single line Diagram, Wiring Diagram, Installation Plan, Interpretation of electrical installation plan and electrical diagrams. 2.3 General requirements and inspection of electrical installation is according to IS:732. 2.4 Electrical installation for residential building. • Guidelines on design and construction of wiring installations as per part I section 9 of NEC- 2011-Difference between residential & industrial load, rules/requirements related to lighting load followed in electrical installation. • Positioning of equipment-Importance of plan and layouts in electrical installation. • Principles of circuit design in Lighting and power circuits- a) Light and fan circuit , b) Power circuit • Procedure for designing the circuits. • Load calculation and selection of size of conductor- a) Load assessment, b) Selection of size of conductor. • Selection of rating of main switch and protective switch gear. • Calculation of length of wire and other materials, Calculation of labour cost • Sequence to be followed for preparing estimate. • Design & drawing, estimation & costing of a residential installation having maximum 5 KW load. (Numerical based on above) 2.5 Testing of wiring installation as per IS: 732-1982.	10

		Testing insulation resistance - between earth and conductors, between conductors, Testing polarity test of single pole switches, Testing of earth continuity path, Residential building Service Connection- types underground and overhead and estimation for it.	
3. Commercial Installations	3a. Compare nonindustrial installation with residential installation on given points. 3b. Design installation plans, wiring diagrams and single line diagrams of given commercial installation. 3c. Prepare schedule of material and estimation for given commercial load. 3d. Recommend suitable earthing for given commercial installation. 3e. Develop single line diagram of given commercial complex. 3f. Apply inspection and testing procedure for given commercial installation.	3.1 Types of Commercial installations- Office buildings, shopping and commercial centres etc., Comparison of office buildings, shopping and commercial centres with residential installation, Electric service & supply- different types of distribution arrangement for medium and large installation. 3.2 Design consideration of electrical installation in commercial buildings. 3.3 Design procedure of installation- • Calculate number of luminaries according to recommended values of illumination • Calculate total load • Deciding number of sub-circuits • Deciding size and rating of switch board and distribution boards. • Deciding size of cables. • Deciding size of conduits • Bus bar and bus bar chamber • Mounting arrangement of switch board & distribution board • Calculation of length of wire and other materials. • Preparation of material schedule • Calculation of labour cost • Estimation and costing of unit. 3.4 Earthing of commercial installation. Selection of earth electrode & earth conductor. 3.5 Design electrical installation scheme of commercial complex such as cinema theatre, auditorium, three star hotel and public hospital. Drawing single line diagram and preparation of material schedule and detailed estimation	12

		(Problems based on it) 3.6 Erection, Inspection and testing of installation as per part 1 section 13 of NEC 2011.	
4. Industrial Installation	4a. Identify type of given manufacturing industry. 4b. Identify type of given industry depending on power consumption. 4c. Compare industrial load with other type of load on given factors.. 4d. Describe various characteristics of given industrial load. 4e. Draw wiring diagram or installation of given electric motors. 4f. Identify requirements of given industrial load. 4g. Calculate different quantities for given industrial load. 4h. Design and prepares estimate for given industrial installations. 4i. Prepare list of material required with costing. 4j. Design and estimate the cost of electric installation of given agriculture pump and floor mill. 4k. Inspect and test any industrial installation.	4.1 Introduction to industrial buildings based on manufacturing. 4.2 Classification based on power consumption 4.3 Difference between non- industrial and industrial load. 4.4 General characteristics of industrial building, selection of wiring system 4.5 Drawing of wiring diagram and single line diagram for single phase and three phase motors. 4.6 Design consideration in industrial installations. 4.7 Design procedure of installation- Drawing of installation plan, Calculation of total load, Selection and rating of wire & Cable size, main switch, fuses, distribution board, bus-bar, cable route, motor starter, earthing wire & earthing, Calculation of length of wire and other Materials, Preparation of material Schedule, Calculation of labour cost, Estimation and costing of unit. 4.8 Design electrical installation scheme of factory/ small industrial unit example: Factory having total aggregate three - phase load approximately 30KW, Preparation of material schedule and detailed estimation (Problems based on it) 4.9 Installation & estimation of agricultural pump & flourmill 4.10 Erection, Inspection and testing of installation as per part 1 section 13 of NEC 2011.	12
5. Streetlight and Distribution Line Installation	5a. Identify requirements of streetlight required for given conditions. 5b. Describe given terms related to public lighting installations. 5c. Select equipment and light sources for given streetlight. 5d. Estimate the cost of	5.1 Classification of outdoor installations, streetlight/ public lighting installation 5.2 Terminology used according to NEC2011 – Terms related to highway, lighting installation, photometric terms, luminaries etc. Aims of public lighting installation, Classification of roads, standard layout of roads.	06

	given streetlight. 5e. Compare overhead line with underground distribution line on given points. 5f. Identify material required for given distribution line. 5g. Select correct rating of cables for given distribution line. 5h. Estimate the cost installation of given distribution system	5.3 Street light pole structures. Selection of equipment, sources used in street light installations. 5.4 Cables, recommended types and sizes of cable, Control of street light installation. Design, estimation and costing of streetlight. 5.5 Introduction to overhead and underground distribution line. 5.6 Materials used for distribution line HT (11KV) and LT (415 V), Poles and their fittings, Conductors and their accessories, Earth wire and its accessories, Insulators stays and their accessories, Anti-climbing devices, danger sign boards, guarding wire & their types and other materials, requirement and specifications according to IS. 5.7 Cables used for distribution line, factors determining selection of LT/ HT power cables, cable laying and cable termination method according to IS. 5.8 Design, estimation and costing of HT, LT overhead line and underground cabling. (Problems)	
6. Installation of Substation	6a. Draw single line diagram of power system depending on given voltage level. 6b. Identify equipment required for a given substation. 6c. Calculate load factor for given load. 6d. Design and Estimate cost of given 11 kV sub- stations.	6.1 Introduction to different substations in power system, their representation using single line diagram and various voltage levels, reason for establishing substations 6.2 Types of 11 KV Distribution substations their line diagram, typical layout and specifications according to IS, functions of various equipment in substations. • Outdoor- H- pole mounted, Platform mounted, floor mounted. • Indoor floor mounted. 6.3 Estimation of load, load factor, diversity factor & determination of rating of distribution transformer. 6.4 Design, estimation and costing of outdoor and indoor 11 KV sub-station.(Problems)	04
		Total Hrs.	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	i) Prepare three quotations from given quotation. ii) Prepare comparative statement of these quotations.	1. Estimation, Contract, Tender	02 02
2	Design a 3 room residential electrical installation wiring. i) Draw installation plan and wiring diagram on drawing sheet. ii) Prepare schedule of Material. iii) Estimate cost of above installation.	2. Residential Installation	02 02 02
3	Design a commercial electrical installation system. i) Draw installation plan and wiring diagram on drawing sheet. ii) Prepare schedule of Material. iii) Estimate cost of above installation.	3. Commercial Installation	02 02 02
4	Design an electrical installation system for industrial load. i) Draw installation plan and wiring diagram on drawing sheet ii) Prepare schedule of Material iii) Estimate cost of above installation	4. Industrial Installation	02 02 02
5	Design an electrical installation system for streetlight for small premises.. i) Draw installation plan and wiring diagram on drawing sheet. ii) Prepare schedule of Material and Estimate cost of above installation.	5. Streetlight and Distribution Line Installation	02 02
6	Design an electrical installation system for L.T. line. i) Draw installation plan and wiring diagram on drawing sheet. ii) Prepare schedule of Material and Estimate cost of above installation.	5. Streetlight and Distribution Line Installation	02 02
7	Design & estimate 500 KVA, 11/0.400KV outdoor sub-station. Prepare report & draw sheet.	6. Installation of Substation	02
Note: A2 size drawing sheet should be used for drawing. In case practical hours are insufficient then portion practical can be completed in home.			
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)	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			

❖ SPECIFICATION TABLE FOR THEORY PAPER:

SN	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Estimation, Contract, Tender	02(00)	00(00)	04(04)	06(04)
2	Residential Installation	00(02)	06(06)	06(00)	12(08)
3	Commercial Installations	02(00)	00(00)	12(12)	14(12)
4	Industrial Installation	02(00)	00(00)	12(12)	14(12)
5	Streetlight and Distribution Line Installation	00(00)	04(04)	04(00)	08(04)
6	Installation of Substation	02(02)	04(00)	00(00)	06(02)
	Total	08(04)	14(10)	38(28)	60(42)

❖ 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
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	1	R	2	3	R	2	4	A	2	6	R	2	2	R	2	6	R	2	4/6
2	1	A	4	5	U	4	1	A	4										2/3
3	5	A	4	6	U	4	5	U	4										2/3
4	2	U	6	2	A	6	2	U	6										2/3
5	3	A	12	3	A	12													1/2
6	4	A	12	4	A	12													1/2

❖ SCHEME OF PRACTICAL EVALUATION:

S.N.	Description	Max. Marks
1	Design of any scheme-Drawing, load calculation, selection	10
2	Drawing installation plan and diagrams	20
3	Skills and Interpretation of Results	10
4	Viva voce	10
	TOTAL	50

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

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

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	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		

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Electrical Design Estimating and Costing	K.B. Raina, Dr. S. K. Bhattacharya, New Age International Publisher, First, Reprint 2010	10:81-224-0363-8 13:978-81-224-0363-3
2	Electrical Estimating & Costing	N. Allagappan, S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd, First Edition, 2000	13: 9780074624784
3	Electrical Estimating and Costing	Surjit Singh, Ravi Deep Singh, Dhanpat Rai & Sons, 2014	13:1234567150995
4	A Course in Electrical Installation Estimating and Costing	J.B. Gupta, S.K. Kataria & Sons; Reprint Edition, 2013	10: 9350142791 13: 978-9350142790
5	SP-30:2011 , National Electrical Code 2011	Bureau of Indian Standard.	-
6	IS: 732-1989, Code of Practice for Electrical Wiring Installation	Bureau of Indian Standard.	-
7	IS: 694-2010, Polyvinyl Chloride Insulated Unsheathed And Sheathed Cables/Cords With Rigid And Flexible Conductor For Rated Voltages Up To And Including 450/750 V	Bureau of Indian standard.	-

❖ **E-REFERENCES:**

- <https://beeindia.gov.in/sites/default/files/ctools/Energy%20Efficient%20Street%20Lighting%20Guidelines.pdf>, accessed on 7th November, 2021
- <https://www.youtube.com/watch?v=npSbEs8gJOs>, accessed on 7th November, 2021
- <https://law.resource.org/pub/in/bis/S05/is.694.2010.pdf> , accessed on 7th November, 2021
- <https://law.resource.org/pub/in/bis/S05/is.732.1989.pdf> , accessed on 7th November, 21
- <https://law.resource.org/pub/in/bis/S05/is.sp.30.2011.pdf> , accessed on 7th November, 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	Mr.A.M.Arekar	HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	HoD, Electrical Engg. Deptt.	Government Polytechnic, Gondia
3	Mr.M.N.Gawande	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur
4	Smt.A.A.Alegaonkar	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 ELECTRICAL ENGINEERING
COURSE CATEGORY: PROGRAMME CORE COURSE
COURSE CODE : EE209G
COURSE TITLE : INSTRUMENTATION
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:

In many Industries engineering diploma holders are expected to handle basic instruments for the measurement of various parameters such as temperature, pressure, flow and level in different types of industries. Transducers are used for modern control. Atomization is a need of an hour for industry to maintain the quality and increase productivity with optimization.. Students should be conversant with the basic principles of transduction of physical variables into electrical signals, signal conditioning circuits, basic data acquisitions systems.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different switches used in instrumentation system.
2. Select appropriate transducers/sensors for given application.
3. Measure non-electrical quantities using proper instruments.
4. Identify signal conditioning system
5. Use data acquisition systems in various applications.
6. Identify various digital display devices.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Fundamentals of Instrumentation	1a. Describe with sketches function of the given components used in Instrumentation system. 1b. Select the given switches used in the instrumentation system 1c. Describe the role and applications of instrumentation system in industries.	1.1 Function of each block of Instrumentation system with block diagram. (Transduction, signal conditioning, signal presentation). 1.2 Construction, working and application of switching devices- Push button, limit switch, float Switch, pressure switch, thermostat, zero speed switch, electromagnetic relay. 1.3 Role of instrumentation system in Industry and its Application.	02
2. Transducer and Sensor	2a. Classify the transducer on the basis of their application. 2b. Differentiate the working of the given types of transducers with sketches. 2c. Suggest the transducer for particular application.	2.1 Classification-Active and passive, analog and Digital, Primary and secondary, Mechanical and Electrical 2.2 Advantages of electric transducers • Required Characteristics of transducers. • Factors affecting the choice of transducers • Construction and principle of Resistive transducer- Potentiometer –variac and strain gauges - Only definition and formula for gauge factor 2.3 Types of strain gauge like unbonded, bonded and semiconductor. • Construction and principle of Inductive transducers- L.V.D.T. and R.V.D.T, their applications. • Construction, principle and applications of transducers – Piezo- Electric transducer, photoconductive Cells, photo voltaic cells.	08

3. Measurement of Non- electrical Quantity	3a. Describe given types of wireless sensor. 3b. Describe with sketches the construction of the given type of Temperature measurement. 3c. Describe with sketches the construction of the given type of pressure transducer. 3d. Describe with sketches the construction of the given type of speed measurement. 3e. Describe with sketches the construction of the given type of Vibration measurement. 3f. Select the relevant instrument for given flow Measurement. 3g. Select the proper thickness measurement method 3h. Suggest the devices used for Measurement of Radiation.	3.1 Definition and classification of sensor Working Principle of Thermal, Electric, Optical and Magnetic sensor 3.2 Temperature measurement – Construction & Working of RTD Thermistor & Thermocouple, Radiation pyrometer, technical Specifications and ranges. 3.3 Pressure measurement – Construction and Working of bourdon tube, bellow, diaphragm and strain gauge, Combination of diaphragm and inductive transducer, bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit. 3.4 Construction and Working of Speed Measurement by contacting and non- Contact type- DC tachometer, photo-electric tachometer, toothed rotor tachometer generator – magnetic pickup and Stroboscope. 3.5 Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer, Piezo electric type. 3.6 Construction and Working of Flow Measurement by Electromagnetic a Turbine flow meter. 3.7 Construction and Working of Liquid level measurement by resistive, inductive, capacitive gamma rays and Ultrasonic methods. 3.8 Construction and Working of Thickness measurement 3.9 Construction and Working of resistive, inductive, capacitive, ultrasonic and Nuclear methods.	12
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4. Signal Conditioning.	4a. Describe functions of given system of OP-AMP. 4b. Compare the given control system loop configuration . 4c. Identify different applications of OP-AMP in the given circuit diagram 4d. Sketch the circuit diagram with relevant waveforms for filter. 4e. Describe the function of the given Circuits.	4.1 Basic Concept of signal conditioning System. • Draw basic block diagram of OP-AMP • Draw pin configuration of IC 741. • Define Ideal OP-AMP and Electrical Characteristics of OP-AMP. • Different Parameters of op-amp:- Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate Gain bandwidth, output ,Short circuit current. 4.2 Compare Open loop and Closed loop control system with block diagram 4.3 Use of op-amp as Inverting, Non- inverting mode, Adder, Subtractor, Differential amplifier and Instrumentation amplifier with sketches , explanation and formula 4.4 Filters: Types of RC filters and Frequency response. 4.5 Samples and hold circuits operation and its application.	08
5. Data Acquisition System.	5a. Describe given part of DAS with block diagram 5b. Compare the salient features of the given Channel on given points. 5c. Convert given Ana log- to digital and digital-to analog method. 5d. Describe working of given data processing systems.	5.1 Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder 5.2 Draw Signal Channel and Multi- channel DAS- Block diagram with its function, Difference between Signal Channel and Multi-Channel DAS. 5.3 Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method. 5.4 Digital to Analog conversion- Construction and Working of binary weighted resistance method.	10

		5.5 Data logger- Block diagram and working of Data Logger and PC based monitoring system , Comparison between DAS and Data logger.	
6. Data Transmission, Telemetry and Display Devices	6a. Describe given methods of Data Transmission. 6b. Describe working principle of Telemetry System. 6c. Compare given types of Modulation System. 6d. Justify the use of Digital Display device. 6e. Select the Virtual Instrument for given applications.	6.1 Concept and methods of data Transmission Of Electrical and electronic transmission. 6.2 Construction and principle of telemetry system and its type - Electrical telemetering system- Voltage, current and frequency. 6.3 Comparison between Amplitude Modulation, Frequency Modulation and Phase Modulation systems with its application. 6.4 Digital display device-operation and its application of seven segment display, dot matrix display and concept of $3\frac{1}{2}$, $4\frac{1}{2}$ digits. • Working principle of nixi- tube, LED LCD and its application. 6.5 Concept of Virtual Instrumentation. General block diagram and architecture of a virtual instrument • Advantages and Disadvantages of Virtual Instrumentation	08
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify different switches used in instrumentation system.	Fundamentals of Instrumentation	02
2	Measure linear displacement by L.V.D.T.	Transducer and Sensor	02
3	Measure the strain with the help of strain gauge		02
4	Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.	Measurement of non-electrical quantity	02
5	Measure pressure using pressure sensor kit.		02
6	Measure angular speed using stroboscope and tachometer.		02
7	Measure the flow using flow meter.		02
8	Measure the liquid level by using resistive method.		02
9	a. Use op-amp as inverter, non-inverting mode	Signal Conditioning.	02
	b. Use op-amp as adder, differentiator and integrator		02
10	Convert digital data into analog data by using analog to digital converters.	Data Acquisition System.	04
11	Convert analog data into digital data by digital to analog converter		04
12	Identify various digital display devices.	Data Transmission, Telemetry & Display Devices	04
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Fundamentals of instrumentation	02(02)	03(03)	00(00)	05(05)
2	Transducer and Sensor	02(02)	03(03)	03(03)	08(08)
3	Measurement of non-electrical quantity	02(02)	06(00)	06(03)	14(05)
4	Signal Conditioning.	02(00)	03(00)	06(06)	11(06)
5	Data Acquisition System.	02(00)	03(03)	06(03)	11(06)
6	Data Transmission, Telemetry & Display Devices	02(00)	03(03)	06(03)	11(06)
	Total	12(06)	21(12)	27(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	2	R	2	3	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	3	5	U	3	5	U	3	6	U	3				3/5
4	6	U	3	2	A	3	3	A	3	2	A	3	3	A	3				3/5
5	3	A	3	4	A	3	4	A	3	5	A	3	6	A	3				3/5
6	5	A	6	6	A	6	4	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 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	3	-	-	
2	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	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	Electric & Electronic Measurement & instrumentation	A.K. Sawhney, Dhanpat Rai & Co. Author, Nineteenth revised edition 2011 reprint, 2014	10: 8177001000
2	Instrumentation devices and system	C. S. Rangan, G. R. Sharma. &V. S. V. Mani -Pen ram International Publishing India Pvt. Ltd. Fifth edition	10: 0074633503
3	Electronics and instrumentation	V. K. Mehata, S. Chand & Company Pvt. Ltd., Third Edition- Reprint, 2010	81-219-2729-3
4	Industrial instrumentation & control.	S. K. Singh Edition, reprint. Publisher, Tata McGraw-Hill, 1987.	007451914X, 9780074519141.

❖ **E-REFERENCES:**

- www.electrical4u.com/transducer-types-of-transducer/, accessed on 21th Sep 2016
- www.physics.utah.edu/Phys5719/Temperature/, accessed on 21th Sep 2016
- <https://www.youtube.com/user/BTCInstrumentation>, accessed on 21th Sep 2016.
- www.youtube.com/user/BTCInstrumentation accessed on 21th Sep 2016.
- [energy.gov/sites/prod/files/2013/10/.../QSR-Instrumentation Control.pdf](http://energy.gov/sites/prod/files/2013/10/.../QSR-Instrumentation%20Control.pdf) accessed on 21th Sep 2016
- <https://dewesoft.com/daq/what-is-a-sensor>
- https://kanchiuniv.ac.in/coursematerials/Virtual_Instrumentation_Janani%20R.pdf
- <https://www.youtube.com/watch?v=QUA1NfHbcEk>-Data logger
- https://www.youtube.com/watch?v=ILC_MVwch2A-Introduction to Pneumatic and Hydraulics
- <https://www.youtube.com/watch?v=oAKo391JYzc>-Binary weighted resistance
- <https://www.youtube.com/watch?v=QcVqqleL5kA>-Seven Segment Display-Assignment

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

1. Switches:-SPST, 20VA.
2. LVDT-120V Single Phase Input with up to 140V Outputs
3. Strain gauge
4. Temperature by PT-100
5. Pressure sensor kit.
6. Flow meter.
7. Tachometer
8. Op-amp
9. Pneumatic controller-Air Compressor (optional) Pressure range 0 to 150 psi and 0 to 10kg/cm supply. 230V AC Motor power 0.5 HP, 1440RPM: 20 W LED light

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

S. N	Name	Designation	Institute / Industry
1	Mr. A. M. Arekar	Chairman ,PBOS &, HOD Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Mr. M. C Musale	Lecturer in Electrical Engineering deptt.	Government Polytechnic, Nagpur.
3	Mr.M.N.Gawande	Member secretary PBOS & Lecturer,Electrical Engg.Deptt.	Government Polytechnic, Nagpur
4	Mrs.A.A.Alegaonkar	CDC Coordinator (Internal) & Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
5	Mrs.A.P.Gandhi	Member(Internal) & Lecturer in Electrical 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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: EE210G
COURSE TITLE	: RENEWABLE ENERGY TECHNOLOGIES
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:**

Renewable energy is crucial in improving climate change on earth. Renewable technologies will yield a cleaner environment. All the world is now focusing on the generation of energy through renewable sources. This course is designed for electrical diploma student to explore possibility of harnessing electrical energy from renewable sources such as Solar Thermal, Solar Photovoltaic, Wind, biomass and other renewable sources.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Apply technology of Photo-Voltaic Cell for energy generation.
2. Use suitable Solar Thermal Technology.
3. Identify different parts in power plants of Wind Power Plant with its working.
4. Compare Hydrogen Energy with other energy sources.
5. Select suitable Waste to Energy Technology.
6. Select suitable type of Renewable Energy Power Plant.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Solar Photo Voltaic	1a. Justify need of Renewable Energy Source on given points. 1b. Compare given terms related to solar radiation. 1c. Describe working of given types of solar PV cell. 1d. Calculate parameters of PV Cell with given data. 1e. Connect given PV Cells in series and parallel combination. 1f. Connect given components of PV System. 1g. Apply correct procedure of installation, maintenance, troubleshooting, safety precaution in given Stand Alone PV System.	1.1 Energy Scenario –World and India, Energy problem, Energy and Environment, Climate Change, Carbon Credit 1.2 Solar radiation - Solar spectrum, extraterrestrial radiation, radiation on the earth surface. - Terms related to solar radiation- radiation , irradiation, insolation, beam radiation, diffuse radiation, Solar constant, solar radiation at a given location, annual radiation in solar radiation optimal tilt for solar equipment, monthly averaged global radiation at optimal tilt. 1.3 Solar Cell - - Solar Cell- Generation principle - Parameters of solar Cell, - Types of Solar Cells and their Conversion Efficiency, - Factors affecting electricity generated by a solar cell 1.4 Solar PV Module- - Rating of PV Module, - Standard PV module parameters, - Factors affecting electricity generated by PV module - Measurement of Vsc and Isc 1.5 Solar PV Array- - Connections of module in series , parallel and series parallel, estimation of number of modules to be connected in series and parallel and their total power 1.6 Solar PV Systems- - Block diagram and working - Components- Battery, Inverter, charge controller, maximum	12

		power point tracking (MPPT), their description 1.7 Standalone Solar PV system- • Installation- preparation for installation, General considerations for installation, Maintenance, Troubleshooting Electrical and mechanical safety	
2. Solar Thermal Technologies	2a. Select type of Solar Collector in given conditions.. 2b. Estimate rating of Solar Water Heating System for given data. 2c. Use Solar Thermal Technology in a given Solar Thermal power Plant.	2.1 Solar Thermal Technologies- • Principle of conversion of solar radiation into heat, Types of collectors-flat-plate collectors, Concentrating collectors-Focusing, and non-focusing type, • Relative advantages and disadvantages. 2.2 Solar Water Heating System (SWHS) • Flat plate collector, components, description and features. • Evacuated tube type, components, description and features. • Selection of size of solar water heating system • Economics of solar water heating system • Calculation of payback period 2.3 Solar Thermal Power Plant Medium Temperature with Cylindrical ,Parabolic Collector , High Temperature with Receiver on Tower and Mirror arrangement • Block diagram, components, description and features.	08
3. Wind Energy	3a. Calculate power in wind with given data. 3b. Identify given parts of a Wind Power Plant. 3c. Compare given types of Electrical Generators in Wind Power Plants with other type generators . 3d. Examine site for given type of Wind	3.1 Wind Energy Basic • Power in wind- power density, energy content, Annual mean wind speed and its potential value • Betz's Law • Principle of wind energy conversion- Drag and Lift principle 3.2 Wind Power Plant (WPP) • Classification of WPP, • Wind Machines-Horizontal axis machines, Vertical axis machines • Components of WPP	08

	Power Plant.	• Necessity of speed control of wind turbine • Methods of control of WPP -Yaw control, pitch control 3.3 Types of Electrical Generators in WPPs • Type 1, Block diagram, components, description and features. • Type 2, Block diagram, components, description and features. • Type 3, Block diagram, components, description and features. • Type 4, Block diagram, components, description and features. 3.4 Site selection criteria of WPP, Problems associated with grid connection.	
4. Hydrogen Energy and Fuel Cells	4a. Describe given methods of hydrogen production, storage and transportation. 4b. Compare type of fuel cell on given points.	4.1 Hydrogen energy • Merits of hydrogen over other fuels • Comparison of hydrogen properties with Petrol Gasoline, Methane, Methanol • Merits of hydrogen over other fuels, application of hydrogen, future application of hydrogen. • Different methods of hydrogen production, Electrolysis of water-Fundamentals of Electrolysis, chemical reaction, • Electrolysis Methods-Tank type Electrolyzer and Bipolar Electrolyzer Description, advantages and limitations. • Hydrogen storage- Necessity and methods, their description, advantages and limitations. • Hydrogen transportation methods, their description, advantages and limitations. 4.2 Fuel Cells • Definition of fuel, cell, fuel cell, Difference between fuel cell and battery, Fuel cell Terminologies • Principle of operation of Fuel	08

		Cell, fuel cell construction - Advantages & Disadvantages of fuel cell, Application of fuel cells. - Compare types of Fuel Cell- PEM, AFC, PAFC, MCFC, SOFC, DMFC on operating temperature, power, efficiency, applications	
5. Waste to Energy	5a. Identify type of given waste material. 5b. Describe Waste to Energy Conversion Process by using given type of wastes. 5c. Describe Biomethanation process by showing different components in block diagram. 5d. Describe different steps in trans-esterification.	5.1 Waste to Energy Technologies - Waste Generation Trends in India - Estimated Potential in India - Advantages of setting up of waste-to-energy projects - Classification of waste- Agriculture Waste, Animal Manure, Forestry Waste, Municipal Waste, Industrial Waste, Biomass Waste, Biomedical Waste 5.2 Waste to energy conversion process - Solid waste- combustion, gasification, pyrolysis - Oil crops- Extraction- Esterification - Sugar Crops- Fermentation - Wet Biomass- Anaerobic Digestion 5.3 Bio-methanation Block diagram- Fixed Dome and Floating Dome Digesters 5.4 Biodiesel - Necessity of green fuel, Advantages. Seeds for extraction of biodiesel. Trans-esterification process, block diagram and description - Comparison of bio-diesel with high-speed diesel.	06
6. Other Renewable Energy Sources	6a. Select suitable type of power plant for given renewable energy source.	6.1 Electricity Generation from following renewable energy sources Block Diagram and Working -Micro Hydro Power Project -Pico Hydro Power Project -Ocean Energy (OTEC, Tidal and Wave) -Geothermal Energy	06
Total Hours			48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Determine various parameters of Solar PV Module and Test the effect of Light, temperature and shadow. Measure Solar Radiation.	1.Solar Photovoltaic	02
2	Calculate various parameters by connecting the solar PV modules in series and parallel.	1.Solar Photovoltaic	02
3	Design Solar PV system for residential / commercial unit.	1.Solar Photovoltaic	02
4	Prepare a chart for Troubleshooting of any PV System.	1.Solar Photovoltaic	02
5	Design solar water heating system and calculate its Payback Period.	2.Solar Thermal Technologies	02
6	Maintain Solar Water Heating System.	2.Solar Thermal Technologies	02
7	Measure wind speed using anemometer at different height and select suitable wind turbine.	3.Wind Energy	02
8	Identify different components of Wind Power Plant and write function of each part.	3.Wind Energy	02
9	Visit / Observe Wind Power Plant and Prepare visit report.	3.Wind Energy	02
10	Prepare a visit report on biogas operated power plant or Prepare a report on biogas operated Power Plant by observing video.	5.Waste to Energy	02
11	Prepare biodiesel from edible oil and analyze its properties.	5.Waste to Energy	02
12	Prepare a visit report on Micro Hydro Power project.	6.Other Renewable Energy Sources	02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Solar Photo Voltaic	02(02)	06(00)	09(00)	17(02)
2	Solar Thermal Technologies	02(02)	06(06)	00(00)	08(08)
3	Wind Energy	00(00)	08(00)	03(06)	11(06)
4	Hydrogen Energy and Fuel Cells	00(00)	03(09)	03(00)	06(09)
5	Waste to Energy	02(00)	03(00)	06(06)	11(06)
6	Other Renewable Energy Sources	04(02)	00(00)	03(03)	07(05)
	Total	10(06)	26(15)	24(15)	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	U	2	5	R	2	6	R	2	6	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	3	U	3	3	U	3	3	A	3	3	A	3	3	A	3				3/5
4	1	U	3	4	U	3	1	A	3	4	U	3	4	U	3				3/5
5	4	A	3	5	U	3	6	A	3	4	U	3	6	A	3				3/5
6	1	A	6	5	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		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 circuit diagram, writing procedure	10
2	Performance	20
3	Calculation, Interpretation of 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	3		
2	3	3	2	1	3	3	3		
3	3	3	2		3	3	3		
4	3	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	Renewable Energy Technologies - A Practical guide for beginners	Chetan Singh Solanki, PHI Learning Pvt. Ltd., First, 2008.	978-81-203-3434-2
2	Solar Energy: Principles of Thermal Collection and Storage	S.P. Sukhatme, McGraw-Hill Education (India), 3 rd Edition, 2009	10: 0070142963 13: 978-0070142961
3	Solar Photovoltaic: Fundamentals, Technologies and Application	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 3 rd Edition, 2015	8120351118, 978-81-203-5111-0
4	Wind Power Plants and Project Development	Joshua Earnest , Tore Wizelius, PHI Learning Pvt. Ltd., 2 nd Edition, 2015	978-81-203-5127-1
5	Renewable Energy Sources	D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning	978-81-203-4470-9

	and merging Technologies	Pvt. Ltd., 2 nd Edition, 2015	
6	Solar Photovoltaic Technology and System: A Manual for Technicians, Trainers and Engineers	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 5 th Edition, 2016	978-81-203-4711-3

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=Giek094C_l4&ab_channel=SmileandLearn-English, accessed on 6th November, 2021
- https://www.youtube.com/watch?v=4vPyA_wDM5c&ab_channel=A1ADVENTURE accessed on 6th November, 2021
- https://www.youtube.com/watch?v=3UafRz3QeO8&ab_channel=BioConstruct accessed on 6th November, 2021
- https://www.youtube.com/watch?v=qSWm_nprfqE&ab_channel=Lesics , accessed on 6th November, 2021
- https://www.youtube.com/watch?v=0oK_VQnPDuY&ab_channel=DeepakkumarYadav , accessed on 6th November, 2021
- https://www.youtube.com/watch?v=iPheEg-K2qc&ab_channel=RealEngineering accessed on 6th November, 2021

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

- Solar Photovoltaic Training Kit prepared by IIT, Mumbai
- Mono-crystalline Solar PV module, 50Wp
- Poly- crystalline Solar PV module, 50Wp
- Concentrated Solar Power (CSP) system 1 Kw with all accessories
- Wind Turbine 1 KW with all accessories

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

S.N.	Name	Designation	Institute / Industry
1	Mr.A.M.Arekar	HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	HoD, Electrical Engg. Deptt.	Government Polytechnic, Gondia
3	Mr.M.N.Gawande	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur
4	Smt.A.A.Alegaonkar	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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: EE211G
COURSE TITLE	: SOLAR POWER GENERATION \$
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 HR
PT. EXAM	: 01 HR

❖ **RATIONALE:**

The field of Solar Photovoltaic (PV) has been growing very fast and it is expected to grow further, possibly with higher rate. Worldwide the production of PV modules is increasing. As the cost of PV modules going down, the electricity produced using solar PV is becoming cheaper and in many scenarios it is becoming economically viable alternative supply. Government of India have been announcing policies to support the growth of solar PV technologies. In current scenario, for diploma electrical engineers, the PV technology presents an exciting and bright future.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Describe the working of renewable energy sources with the help of block diagram.
2. Define the terms related to solar radiation and Calculate Parameters of solar Cell.
3. Calculate Standard PV module parameters and describe the factors affecting electricity generated by Solar PV module.
4. Connect Solar PV modules in series, parallel and series-parallel.
5. Select Batteries, Converters, Inverters, Charge controllers and MPPT charge controller.
6. Maintain and Troubleshoot Solar PV systems.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Renewable Energy Sources	1a. State world-wide energy problems. 1b. State the meaning of carbon credits. 1c. State necessity of renewable energy sources. 1d. State types of renewable energy sources. 1e. Describe the working of renewable energy sources with the help of block diagram.	1.1 World and Indian Energy Scenario 1.2 Energy Problem, 1.3 Energy and Environment, climate change, Carbon Credits 1.4 Need for Renewable Energy 1.5 Types of renewable energy sources 1.6 Electricity generation from following renewable sources, block diagram and description. • Wind power generation • Biomass Power generation • Micro-hydro Generation	05
2. Solar Radiation and Solar Cells	2a. Define terms related to solar radiation. 2b. Describe the principle of solar cell. 2c. State types of Solar Cells and their Conversion Efficiency. 2d. Analyze factors affecting electricity generated by a solar cell.	2.1 Solar radiation • Solar spectrum, extraterrestrial radiation, radiation on the earth surface. • Terms related to solar radiation-radiation, irradiation, insolation, beam radiation; diffuse radiation, Solar constant, solar radiation at a given location, annual radiation in solar radiation, optimal tilt for solar equipment, monthly averaged global radiation at optimal tilt. 2.2 Significance and meaning of Solar cells 2.3 Solar Cell- Principle of Electricity Generation 2.4 Parameters of solar Cell (Numerical based on this topic) 2.5 Types of Solar Cells and their Conversion efficiency 2.6 Factors affecting electricity generated by a solar cell • Effect of conversion efficiency • Change in the amount of Input Light • Change in the solar cell area • Change in angle of light falling on solar cell	10

		• Change in solar cell operating temperature.	
3. Solar Photovoltaic (PV) Module	3a. Describe and calculate Standard PV module parameters. 3b. State factors affecting electricity generated by PV module.	3.1 Meaning of Solar PV Module- 3.2 Ratings of PV Module, 3.3 Standard PV module parameters, (Numerical based on this topic) 3.4 Factors affecting electricity generated by Solar PV module • Effect of conversion efficiency • Change in the amount of Input Light • Change in PV module area • Change in angle of light falling on PV module • Effect of Change in PV module temperature. 3.5 Measurement of V_{oc} and I_{sc} 3.6 Bypass Diode, Blocking Diode	10
4. Solar PV Module Arrays	4a. Estimate number of modules to be connected in series and calculate their total power. 4b. Estimate number of modules to be connected in parallel and calculate their total power. 4c. Estimate number of modules to be connected in series-parallel and calculate their total power.	4.1 Connection of Solar PV modules in series • Estimating number of PV modules required in series and their total power (Numerical based on this topic) • Mismatch in voltage in series connected PV modules • Mismatch in current in series connected PV modules 4.2 Connections of modules in parallel • Power generated by parallel connected PV modules • Estimating number of PV modules required in parallel and their total power (Numerical based on this topic) • Mismatch in module voltages connected in parallel 4.3 Connections of module in series-parallel • Estimation of number of modules to be connected in series-parallel and their total power	08
5. Batteries, Converters, Inverters,	5a. Select battery for solar PV system. 5b. Describe power converters.	5.1 Batteries • Meaning of rechargeable batteries • Types of rechargeable batteries	10

Charge Controllers and MPPT	5c. Describe charge controllers. 5d. Describe Maximum Power Point Tracking (MPPT).	• Liquid vented and Sealed or VRLA (Valve Regulated Lead-acid) batteries for Photovoltaic (PV) system. 5.2 Need for Balance of System (BoS). 5.3 Power converters and their efficiency. • Importance of efficiency of power converters. 5.4 AC to DC converters. 5.5 DC to AC converters (Inverters) • Types of inverters • Inverter specifications • Typical Inverter specifications 5.6 DC to DC power converters. 5.7 Charge Controllers • Function of a charge controller • Working of a charge controller • Types of charge controllers • Features of charge controllers • Typical specifications of PWM charge controller 5.8 Maximum Power Point Tracking (MPPT) • Power output from a PV Module • Need for Maximum Power Point Tracking • MPPT charge controller • Specifications of MPPT charge controller (Numerical based on this topic)	
6. Solar PV System, Maintenance, Troubleshooting and Safety	6a. Describe different types of solar PV system. 6b. Describe Components of Grid connected SPV system. 6c. Maintain Solar PV System. 6d. Troubleshoot Solar PV system. 6e. State Safety to be observed in Installation of Solar PV systems	6.1 Types of Solar PV Systems- Standalone Solar PV system - SPV system with only DC load - SPV system with DC load and electronics control circuitry - SPV system with DC load, electronics control circuitry and battery - SPV system with AC/DC load, electronics control circuitry and battery • Grid connected SPV system - Grid connected SPV system without battery storage/Back-up - Grid connected SPV system with	05

		battery storage/Back-up • Hybrid SPV system 6.2 Components of Grid connected SPV system • Solar PV Array • Array combiner Box • DC Cabling • DC Distribution Box • Grid connected Inverter • AC Cabling • AC Distribution Box 6.3 Maintenance of Solar PV System 6.4 Troubleshooting of Solar PV standalone System 6.5 Safety in Installation of Solar PV systems • Electrical safety • Safety precautions for batteries • Mechanical safety	
		Total Hrs.	48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Find/observe the effect of different factors on the electricity generated by a solar cell.	2.Solar Radiation and Solar Cells	02
2	Connect solar cells in series, in parallel, and in a series-parallel combination to power a small light bulb.		02
3	Find/observe the effect of different factors on the electricity generated by a solar PV module.	3 Solar Photovoltaic (PV) Module	02
4	Determine various parameters of solar PV module.		02
5	Connect the solar PV modules in series to power a DC load.	4 Solar PV Module Arrays	02
6	Connect the solar PV modules in parallel to power a DC load.		02
7	Connect the solar PV modules in series-parallel to power a DC load.		02
8	Study of off-grid solar inverter with battery charging controller.	5. Batteries, Converters, Inverters, Charge controllers and MPPT	02
9	Identify different components of Solar PV system.	6. Solar PV system,	02

10	Test the effect of Light, temperature and shadow on the electricity generator by solar PV system.	Maintenance, Troubleshooting and safety	02
11	Prepare Maintenance chart of solar PV system.		02
12	Troubleshoot solar PV system.		02
13	Prepare a visit report on Solar PV system or Prepare a report on Solar PV system by observing video CD.		04
14	Design solar PV system for residential/ commercial unit.		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 renewable energy sources	02(00)	03(03)	00(00)	05(03)
2	Solar Radiation and Solar Cells	04(00)	03(03)	06(03)	13(06)
3	Solar Photovoltaic (PV) Module	02(02)	03(00)	12(06)	17(08)
4	Solar PV Module Arrays	00(02)	06(03)	06(06)	12(11)
5	Batteries, Converters, Inverters, Charge controllers and MPPT	02(02)	06(03)	00(00)	08(05)
6	Solar PV system, Maintenance, Troubleshooting and safety	02(00)	03(03)	00(00)	05(03)
	Total	12(06)	24(15)	24(15)	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	2	R	2	3	R	2	5	R	2	6	R	2	6/9
	3	R	2	4	R	2	5	R	2										
2	1	U	3	2	U	3	2	A	3	1	U	3	2	U	3				3/5
3	2	A	3	3	U	3	4	U	3	2	A	3	4	U	3				3/5
4	4	U	3	4	A	3	4	A	3	3	A	3	3	A	3				3/5
5	5	U	3	5	U	3	6	U	3	5	U	3	6	U	3				3/5
6	3	A	6	3	A	6	4	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 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	2	2	3	2	3	-	-	2	3
2	3	2	3	2	2	-	-	2	2
3	3	3	3	2	3	-	-	3	3
4	3	2	2	2	2	-	-	2	3
5	3	1	3	2	3	-	-	3	3
6	3	1	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	Renewable Energy Technologies- A Practical guide for beginners	Chetan Singh Solanki, PHI Learning Pvt. Ltd., First, 2008.	978-81-203-3434-2
2	Solar Energy: Principles of Thermal Collection and Storage	S.P. Sukhatme, McGraw-Hill Education (India), 3 rd Edition, 2009	10: 0070142963 13: 978-0070142961
3	Solar Photovoltaic: Fundamentals, Technologies and Application	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 3 rd Edition, 2015	8120351118, 978-81-203-5111-0
4	Solar Photovoltaic Technology and	Chetan Singh Solanki, PHI Learning Pvt. Ltd., Eighth	978-81-203-4711-3

	Systems : A Manual for Technicians, Trainers and Engineers	Edition, 2017.	
5	Renewable Energy Sources and Emerging Technologies	D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd., 2 nd Edition, 2015	978-81-203-4470-9

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=mDWSW8BAM3U>, accessed on 28th February 2022
- <https://www.youtube.com/watch?v=jswDvFzGoO4>, accessed on 28th February 2022
- https://www.youtube.com/watch?v=qSWm_nprfqE, accessed on 28th February 2022
- <https://www.youtube.com/watch?v=lmtOuAed5nM>, accessed on 28th February 2022
- https://www.youtube.com/watch?v=1wk8_IDVu38, accessed on 28th February 2022

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

- Solar Photovoltaic Training Kit prepared by IIT, Mumbai
- Mono-crystalline Solar PV module, 50Wp
- Poly- crystalline Solar PV module, 50Wp
- Concentrated Solar Power (CSP) system 1 Kw with all accessories

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

S.N.	Name	Designation	Institute / Industry
1	Mr.A.M.Arekar	I/C HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Mr.M.C.Musle	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
4	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur
5	Mrs.A.P.Gandhi	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
6	Mr.B.P.Bale	Dy.Engineer	MSEDCL,Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGG
COURSE CATEGORY:	PROGRAMME ELECTIVE COURSE
COURSE CODE	: EC214G
COURSE TITLE	: MICROCONTROLLER AND APPLICATIONS
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 forms the foundation of Microcontroller to the students of Electrical Engineering. It deals with learning the need & concepts of different types of microcontrollers and their features related to hardware, instructions and programming. In today's era many electronic systems starting from electronic toys, house hold equipment to industry-based machines needs proper controlling as per demand. Hence, it is necessary to know the concept of controlling mechanism system. This course emphasizes on the basics of Microcontroller and its developments to controlling application of different devices interfaced in a complex system.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Select microcontroller for required application.
2. Develop assembly language program for various application using 8051 microcontroller.
3. Develop assembly language program to test the functions of internal microcontroller peripherals.
4. Structure the program to interface microcontroller with different external peripherals, memory and applications.
5. Identify the various advanced embedded controllers.
6. Develop sketch using Arduino IDE.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction and Architecture 8051	1a. Locate given Block of Microcomputer. 1b. Compare different architecture of Microcontroller based on given parameters. 1c. Compare families of Microcontrollers based on given points. 1d. Illustrate software development steps and tools. 1e. Paraphrase the function of given blocks of 8051. 1f. Locate the pins in Pin diagram of 8051. 1g. Paraphrase the concept of Internal and External Memory. 1h. Categories given Registers and SFRs of 8051.	1.1 Evolution of Microcontrollers, Block diagram of Microcomputer, elements of Microcomputer, types of buses. 1.2 Von Neuman and Harward Architecture. 1.3 Comparison of Microprocessor and Microcontrollers, Need of Microcontroller, Family of Microcontrollers and their specifications 1.4 Software development steps, software development tools like Editor, Assembler, Linker, Loader and Hex converters., Assemblers directives: ORG,DB,EQU,END, Assembly program using simulators like RIDE or KEIL. 1.5 Block diagram of 8051, function of each block 1.6 Pin diagram, function of each pin 1.7 Concept of Internal memory and External memory(RAM and ROM), Internal RAM structure 1.8 Reset and clock circuit, Various registers and Introduction to SFRs of 8051	10

2. 8051 Instruction Set and Programs	2a. Use given addressing modes of 8051. 2b. Classify the given instructions of 8051 microcontroller. 2c. Practice programs for different task using given instructions. 2d. Select proper directives to develop program for given requirement.	2.1 Assembly language Instruction format, Various addressing modes 2.2 Classification of instruction set: Data transfer, Arithmetic, Logical, Branching, Bit manipulation, stack, subroutine and interrupt related instructions. 2.3 Assembly Language Programs based on above instructions 2.4 Programs using Assembler directives.	10
3. 8051 Internal Peripherals and Related Programs	3a. Utilize the concept of I/O ports and related SFRs. 3b. Use the concept of Timer/counter and related SFRs. 3c. Use the concept of serial communication and related SFRs. 3d. Use the concept of Interrupts and related SFRs. 3e. Paraphrase the power saving modes and related SFR. 3f. Practice assembly language programs using given peripherals.	3.1 I/O ports- diagram, read write operation, instructions and related SFRs 3.2 Timers/counters – list, related SFRs, programming modes, operations with diagram. 3.3 Serial communication- Basics of serial communication, baud rate, related SFRs, programming modes, operations with diagram. 3.4 Interrupts- related SFRs, types, operations with diagram. 3.5 Power saving operation-modes, related SFR, 3.6 Programs for all above internal peripherals.	08
4. 8051 Interfacing and Applications	4a. Carry out memory address decoding for the given memory and range of the memory. 4b. Interface given peripherals with 8051. 4c. Interface given external memory with 8051. 4d. Program 8051 microcontroller for the given application.	4.1 Semiconductor memory – types, memory organization, Memory address decoding. 4.2 Peripherals and interfacing:- Relay, Seven segment display, LCD, 4x4, Keyboard, Stepper Motor. I/O Interfacing for above peripherals. 4.3 Interfacing of External Data & program memory (RAM and ROM) memory map (various option) 4.4 Square wave generator using port pins of 8051. Water level Controller, Traffic light controller	08

5. Advance Microcontrollers	5a. Compare RISC and CISC Processors based on given points. 5b. List the features of given ARM processor. 5c. List the features of given PIC processor. 5d. Describe AVR microcontroller based on given points. 5e. Compare different micro controllers used for Embedded system designing based on given parameters.	5.1 RISC and CISC Processors Comparison 5.2 ARM microcontroller : features and applications 5.3 PIC microcontroller : features and applications 5.4 AVR microcontroller: features, Type (Classic, Mega, Tiny), Simplified View of AVR. 5.5 Comparison between PIC, AVR, ARM processors	06
6. Introduction and Architecture of Arduino	6a. Describe working of open source embedded development board using block diagram for given blocks. 6b. Identify given pins of embedded development board. 6c. Describe the features of open source tool used for programming a development board. 6d. Design a sketch using IDE for given application.	6.1 Functional Block Diagram of Arduino 6.2 Functions of each Pin of Arduino 6.3 Arduino Development Board diagram (including different blocks only): • IDE(Integrated Development Environment) • I/O Functions • Looping Techniques • Decision Making Techniques 6.4 Designing of 1st sketch, Programming of an Arduino (Arduino ISP) , Arduino Boot loader	06
		Total	48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practi - cals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Utilize different menus available in a simulator software RIDE/KEIL and demonstrate their use.	Introduction and Architecture 8051	02
2	Interpret various blocks on 8051 microcontroller development board.		02
3	Develop & execute Assembly language programs using Arithmetic Instructions. and demonstrate outcome for a given input.	8051 Instruction set and programs	02
4	Develop Assembly language programs using Logical Instructions and demonstrate outcome for a		02

	given input		
5	Develop Assembly language program for Block transfer from & to Internal/External memory using directives and demonstrate outcome for a given input data		02
6	Develop Assembly language program to generate a square by using timer delay.		02
7	Develop an ALP to transfer 8 bit data serially on serial port.	8051 Internal Peripherals and related programs	02
8	Develop Assembly language program to interface LED with microcontroller and turn it on with microcontroller interrupt.		02
9	Develop Assembly language program to interface LCD with microcontroller and display the character and decimal numbers.		02
10	Develop Assembly language program to interface keyboard with 8051 and display the key pressed.	8051 Interfacing and applications	02
11	Develop Assembly language program to design Traffic light Controller		04
12	Develop Assembly language program to design Water Level Controller		04
13	Collect datasheets of Arm, PIC and AVR microcontroller and prepare a chart of specification.	Advance Microcontrollers	02
14	Program sketch in Arduino IDE.	Introduction and Architecture of Arduino	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 Architecture 8051	02(02)	03(03)	00(00)	05(05)
2	8051 Instruction set and programs	02(02)	06(00)	06(03)	14(05)
3	8051 Internal Peripherals and related programs	02(02)	06(06)	06(00)	14(08)
4	8051 Interfacing and applications	02(00)	03(03)	06(03)	11(06)
5	Advance Microcontrollers	02(00)	03(03)	03(03)	08(06)
6	Introduction and Architecture of Arduino	02(00)	03(03)	03(03)	08(06)
	Total	12(06)	24(18)	24(15)	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	2	R	2	3	R	2										
2	1	U	3	2	U	3	3	U	3	4	A	3	5	A	3				3/5
3	2	U	3	2	A	3	4	U	3	1	U	3	5	U	3				3/5
4	2	A	3	3	U	3	5	U	3	2	A	3	4	U	3				3/5
5	6	U	3	5	A	3	6	A	3	6	U	3	6	A	3				3/5
6	3	A	6	4	A	6	3	U	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	Writing Program, Converting it to Machine Language	10
2	Performance	15
3	Showing Execution Process and outcome	15
4	Viva voce	10
	TOTAL	50

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

Course Outcomes	Programme Outcomes.(POs)							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
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	The 8051 Microcontroller And Embedded Systems Using Assembly And C, 2/E	Mazidi, Pearson Education, Asia 2007, second edition	8131710262, 9788131710265
2	The AVR Microcontroller and embedded system using Assembly And C	Muhhamad Ali Mazidi Sarmad Naimi Sepehr Naimi, Prentice Hall, 2011	013800331-9 9780138003319
3	The 8051 Microcontroller, Architecture, Programming and Applications	Kenith Ayala, Penram International Publication. 1996	9780314201881
4	The 8051 Family of microcontroller	Rechard H. Barnett, Prentice Hall, 1995	00230628198051
5	Microcontrollers (Theory and Applications)	Ajay V. Deshmukh, Tata McGraw-Hill Education, 2005	978-0070585959
6	The AVR microcontroller and embedded system using assembly and c	Muhammad Ali Mazldl, Sarmad Naimi, Prentice Hall, 2011	978-0-13-800331-9
7	Beginning Arduino	Michael McRobetrs, Apress, 2ndEdition2013	978-1430250166

❖ **E-REFERENCES:**

- <https://nptel.ac.in/courses/117/104/117104072/>, accessed on 15th March 2022
- <https://www.theengineeringknowledge.com/introduction-to-arm-microcontroller/>, accessed on 15th March 2022
- <https://www.watelectronics.com/pic-microcontroller-architecture-and-applications/>, accessed on 15th March 2022
- <https://technobyte.org/8051-switch-interfacing-c-program-switch-debouncing/>, accessed on 15th March 2022
- <http://arduino.cc>, accessed on 15th March 2022

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

1. 8051 Microcontroller kit
2. USB Programmer
3. Desktop PC with RIDE/KEIL simulator software installed
4. Embedded development board (Arduino Board) – 20 Nos.
5. Open Source IDE for embedded systems (Arduino)
6. Computer System - 20 Nos.
7. Consumable as needed in application suggested by concern Faculty.

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

S.N.	Name	Designation	Institute / Industry
1	Dr. R.V.Yenkar	Head of Electronics & Telecommunication Engineering	Government Polytechnic, Nagpur
2.	Dr.V.H.Mankar	Head of Electronics & Telecommunication Engineering	Government Polytechnic, Nagpur
3	Prof.S.S.Pampattiwar	Lecturer in Electronics & Telecomm. Engineering	Government Polytechnic, Nagpur
4	Prof.Ms.A.A.Aghav	Lecturer in Electronics & Telecomm. Engineering	Government Polytechnic, Nagpur
5	Mr.S.V.Darwhekar	Director	Beta Computronics Pvt. Ltd., Nagpur
6	Mrs.Gazala Ali	HOD in Electronics & Telecomm. Engineering	Anjuman Polytechnic, Nagpur
7	Prof.Kapil Pachpore	Lecturer in Electronics & Telecomm. Engineering	Government Polytechnic, Amravati

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY: PROGRAMME CORE COURSE
COURSE CODE : EE213G
COURSE TITLE : PLC SCADA
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 purpose of this course is to provide the student with basic skills useful in present industrial Automation Industry in the area of Programmable Logic Controller (PLC), Distributed Control System (DCS), Supervisory Control and Data Acquisition (SCADA) and Human Machine Interference (HMI) .After completion of this course students will troubleshoot, repair, install and maintain simple to complex automated and control systems.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify various parts of the given PLC .
2. Convert given relay schematics into PLC ladder programs
3. Identify Input and Output devices used for PLC installation
4. Develop PLC ladder diagrams for simple application
5. Identify different elements of SCADA/DCS
6. Prepare application of Human Machine Interface

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Microcontrollers	1a. Describe given parts of 8051 architecture with block diagram. 1b. Describe function of given pins of 8051 chip. 1c. Describe give registers of 8051. 1d. Develop the given program of 8051.	1.1 Block diagram of 8051, Microcontroller Architecture shows that 8051 Microcontroller consists of a CPU, RAM (SFRs and Data Memory), Flash (EEPROM), I/O Ports and control logic 1.2 Pin Diagram with respect to a 40–pins, function of each Pin 1.3 PSW register Internal memory structure (RAM and ROM), Reset and clock, various registers. 1.4 I/O port pins and their functions and I/O bit manipulation programming • Programming 8051 timer, counters, serial communication. • The Program of I/O ports for interfacing external memory • 8051 instruction set Overview of 8051 instruction set and addressing modes, Moving the data (Internal and External), Arithmetic instructions, logical operations, JUMP and CALL instructions, Bit level instructions, Stack, subroutine and interrupts, Simple programs based on above instructions.	09
2. PLC Fundamentals	2a. Describe given part of PLC architecture with block diagram. 2b. Describe the function of the specified part of the given discrete IO module. 2c. Describe the function of the specified part of the given analog IO module. 2d. Describe the function of the specified part	2.1 Function of different parts of PLC such as CPU, Memory, and Power Supply and IO modules. 2.2 Digital IO module of PLC,Block diagram and specification. 2.3 Analog IO module of PLC,Block diagram and specification.(Analog Input Module and Analog Output Module) 2.4 Special modules of PLC: Communication module PID controller module Stepper motor control module	09

	of the given special IO module. 2e. Compare the salient features of the given two PLCs on given points.	2.5 PLCs in market based on CPU type, no of I/Os, speed and memory	
3. PLC Wiring Diagrams and Ladder Logic	3a. Compare the given PLC Programming languages. 3b. Identify the given parts of the ladder diagram along with the functions commonly found in PLC installation. 3c. Develop ladder logic diagram for the given situation. 3d. Describe the operation of given control devices. 3e. Prepare the relevant wiring diagram for connecting the given type of PLC. 3f. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program for the given motor control specifications.	3.1 The 5 most popular types of PLC programming languages are Structured Text (ST) Sequential Function Charts (SFC) Ladder Logic Diagram (LD) Function Block Diagram (FBD) Instruction List (IL) 3.2 Binary system, bit, byte, word, logic gates 3.3 Programming PLC using ladder diagram, Components of ladder diagram, Program scan process applied to single rung 3.4 Output control devices found in PLC Installation. 3.5 PLC based water level controller 3.6 A motor must be started and stopped from any one of three START/STOP Pushbutton stations. • Each START/STOP station contains one NO START button and one NC STOP button • Three phases magnetically operated Motor OL contacts are to be hardwired.	09
4. PLC Application and Troubleshooting	4a. Prepare sequence of events for PLC process applications for the given parameters of processes. 4b. Identify Input and Output devices used for PLC process applications. 4c. Develop Ladder Logic diagram for PLC process applications for the given Parameters of processes.	4.1 PLC process applications of • Bottle filling plant • Temperature control ON/OFF • Traffic light control • Process level control 4.2 Application of Analog Input and Output Devices of PLC 4.3 Ladder logic diagram of the following • Bottle filling plant • Temperature control ON/OFF • Traffic light control • Process level control 4.4 Trouble shooting of • Input Malfunctions	09

	4d. Justify the trouble shooting procedure for the given malfunctions.	• Output Malfunctions • Ladder Logic Program	
5. SCADA and Distributed Control System (DCS)	5a. Describe given part of SCADA with block diagram. 5b. Describe functions of given system of SCADA. 5c. Select SCADA system for the given industrial application. 5d. Justify the interfacing of the given system. 5e. Describe given part of DCS with block diagram. 5f. Describe and Select given system elements of DCS. 5g. Compare given automation systems.	5.1 SCADA contains five levels- Sensors; Programming Devices, Local Control and HMI, Coordination, Central Control 5.2 Function of SCADA –Monitoring, Control and user interface functions 5.3 Application of SCADA:-Traffic density control, water distribution, pipeline control. 5.4 Interfacing SCADA with PLC 5.5 Four basic elements of distributed control system 5.6 System elements of DCS: • Field station • Intermediate Station • Central Computer station 5.7 Comparison of SCADA,DCS and PLC	06
6. Human Machine Interface (HMI)	6a. Describe concept of Human- Machine Interface(HMI). 6b. Describe concept of Internet of things(IOT) 6c. Describe given part of DCS architecture with block diagram. 6d. Select the given HMI software for specific applications. 6e. Select benefits and importance of given HMI. 6f. Justify the given application of HMI.	6.1 Concept of HMI 6.2 Concept of IOT 6.3 Basic block diagram and their Function contains Graphical user interface with a DC motor 6.4 HMI software based on • .Factory talk view machine. • Rockwell software • Factory talk view point 6.5 Advantages of HMI, Benefits and importance of HMI 6.6 Application of HMI software based Automotive Dashboards, Electronic Displays, Audio/Video production and Building Automation and Integration of PLCC,IOT AND HMI	06
Total Hrs.			48

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Develop assembly language program for arithmetic and logic operation with 8051 simulator.	1.Introduction to Microcontroller	02
2	Develop assembly language program for study of timer/ counter in mode 1 and 2 using simulator.		02
3	Identify various parts of the given PLC and front panel status indicators.	2.PLC Fundamentals	02
4	Use the PLC for sensing level of water in tank using float switch and control level of water using ON/OFF solenoid valve	3.PLC Wiring diagrams and Ladder logic	02
5	Develop ladder program for Traffic density control system.		02
6	Use PLC for ON/OFF temperature control.	4.PLC Application and Troubleshooting	02
7	Use PLC for simulating traffic light control.		02
8	Simulate Bottle filling process on PLC simulator. Verify operation of the same process using actual PLC. Draw connection details for the same process		02
9	Identify the components of SCADA system.	5.SCADA and Distributed control system (DCS)	02
10	Develop interfacing program of PLC with SCADA.		02
11	Identify and select system elements of DCS.		2
12	Develop a SCADA mimic diagram for Tank level control or Flow control in a given system.		02
13	Use PLC HMI for display input switch status on screen.	6. Human Machine Interface (HMI)	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 Microcontroller	02(02)	06(03)	00(00)	08(05)
2	PLC Fundamentals	00(04)	06(00)	06(03)	12(07)
3	PLC Wiring diagrams and Ladder logic	00(02)	06(00)	06(06)	12(08)
4	PLC Application and Troubleshooting	00(00)	04(00)	06(06)	10(06)
5	SCADA and Distributed control system (DCS)	04(00)	00(03)	06(03)	10(06)
6	Human Machine Interface (HMI)	02(00)	06(04)	00(00)	08(04)
	Total	08(08)	28(10)	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	1	R	2	2	R	2	2	R	2	3	R	2	4	R	2	6/9
	5	R	2	5	R	2	6	R	2										
2	1	U	3	1	U	3	2	U	3	1	U	3	2	U	3				3/5
3	2	U	3	3	A	3	3	A	3	2	U	3	3	U	3				3/5
4	4	U	3	4	U	3	6	U	3	5	U	3	5	U	3				3/5
5	6	U	3	6	U	3	5	A	3	5	U	3	5	U	3				3/5
6	2	A	6	3	A	6	5	A	6										2/3

❖ **ASSESSMENT AND EVALUATION SCHEME:**

	What		To Who m	Frequency	Max Mar ks	Min Mark s	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous Assessment)	PT	Students	Two PT (average of two tests)	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/ programme execution	20
2	Observations and Recording	05
3	Interpretation of result and Conclusion	05
4	Submission of report in time	10
5	Viva	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	3	-	-
2	3		3	-	2	3	3	-	-
3	3		3	-	2	3	3	-	-
4	3		3	-	2	3	3		
5	3		3	-	2	3	3		
6	3	3	3	-	2	-	3	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	Programmable Logic Controllers and Applications	Webb, John W, Ronald Reis. A. Prentice Hall of India, New Delhi, (latest Edition)	9780136794080
2	Programmable Logic Control, Principles and Applications	NIIT, Prentice Hall of India, New Delhi, 2005.	81-203-2525-7
3	Programmable Logic Controllers	Petruszella, F.D	9780073510880
4	Programmable Logic Controllers	Bolton, W	9780128029299
5	Introduction to PLC	Dunning, G.	9788131503027

❖ **E-REFERENCES:**

- <http://electrical-engineering-portal.com/resources/plc-programming-training>
- PLC Basic Fundamentals and Wiring (Hindi): <https://www.youtube.com/watch?v=g7ONCWmRy0w>
- Programmable Logic Controller Basics PLC Professor: <https://www.youtube.com/watch?v=PLYosK87D8E>
- Basics of PLC ladder diagram: <https://www.youtube.com/watch?v=Hci-eW5lihM>
- Controlling water level by using PLC: https://www.youtube.com/watch?v=1pRv-p_HbRk
- Traffic signal control using PLC: <https://www.youtube.com/watch?v=3WATUnwCwRA> 9.
- Bottle Filling Process using PLC: <https://www.youtube.com/watch?v=8UQOhGp8gqY>
- www.nptel.ac.in http://ijareeie.com/upload/2015/september/30_A%20Study.pdf
- www.wikipedia.com
- www.electrical4u.com

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

1. Master PLC with Power supply and Hand held PLC programmer. 3 NO
2. 24 analog input module (8 analog input module 3 NO)
3. 24 analog output module (8 analog input module 3 NO)
4. 24 Digital input module (8 digits input module 3 NO)
5. 24 Digital output module (8 digits input module 3 NO)
6. 3level switch
7. PLC with min 8 I/O's and HMI and its simulation /programming software
8. Traffic light simulation practical model
9. Temperature control system

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

S. N.	Name	Designation	Institute / Industry
1	Mr.A.M.Arekar	Chairman , PBOS &, HOD Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Mr.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
3	Dr.G.V.Gotmare	HOD Electrical Engg.Deptt.	Government Polytechnic, Gondia
4	Mrs.A.A.Alegaonkar	CDC Coordinator(Internal) & Lecturer in Electrical Engg. Deptt.	Government Polytechnic, Nagpur
5	Mrs.A.P.Gandhi	Member(Internal) & Lecturer in Electrical 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 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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE301G^{\$}
COURSE TITLE	: TESTING AND MAINTENANCE OF ELECTRICAL MACHINES
TEACHING SCHEME	: TH: 03; TU: 00; PR: 04 (CLOCK HRs.)
TOTAL CREDITS	: 05 (1TH/TU CREDIT =1 CLOCK HR. 1 PR CREDIT =2 CLOCKHR.)
TH. TEE	: 03 HRs
PR. TEE	: 02 HRs
PT.	: 01 HR

❖RATIONALE:

Most of the electrical engineers are working either in industries or state electricity board as supervisor/executive. They have to understand instructions from superiors and pass on the same to the skilled workers working under them, during installation; testing & maintenance work in these areas. The work that is encountered in industry/electricity board consists of erection, installation as well as testing and maintenance requires the knowledge of installation, testing and maintenance of various electrical equipments.

❖COURSE OUTCOMES:

After completing this course students will be able–

1. Follow safety procedures while installation, testing, maintenance.
2. Maintain insulation systems of electrical equipment.
3. Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.
4. Follow proper troubleshooting procedures.
5. Test & commission electrical equipment in accordance with IS codes.
6. Undertake regular preventive & breakdown maintenance of electrical equipments.

❖ **COURSE DETAILS:****A. THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Electrical Safety Accident & Prevention	1a. Describe the safety actions for the given situation. 1b. Describe the hazards involved for the given situation & action. 1c. Describe given methods of artificial respiration. 1d. Describe given method of removing electrocuted person. 1e. Identify safety rules with dos and donts. 1f. Describe the given procedure for using fire-fighting equipment on electrical fire. 1g. Describe the given procedure of permit system for carry out maintenance work.	1.1 Concept of electrical /mechanical safety, electrical accident, its causes & preventions 1.2 Electrical shocks and its treatments. Artificial Respiration- Schaefer's method, Sylvester's method, mouth to mouth respiration Procedure of artificial respiration. 1.3 Dos and donts regarding safety in domestic electrical appliances as well for substation/ power station operators. 1.4 Concept of permit system and its preparation and regulation for attending to electrical work in substations/ power stations / overhead lines/ underground cables etc. 1.5 Electrical safety in industry/ power stations / substations at the time of operation/ control/maintenance , Fire detection alarm, fire-fighting equipments.	06
2. Insulation Testing and Maintenance	2a. Suggest the insulation materials and factors affecting on given application. 2b. Describe with sketch & procedure of given method of measurement of insulation resistance. 2c. Describe given method of cleaning and drying out insulation. 2d. Choose the given method of testing oil as per IS 1866- 1961. 2e. Identify components in given diagram and Identify mistakes in given figure and correct them. 2f. Identify condition of insulation from given data. 2g. Suggest different method	2.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS:8504-1994 2.2 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation. 2.3 Reconditioning of insulation- cleaning and drying the insulation, re-varnishing, vacuum impregnation. 2.4 Insulating oil-properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS1866-1961, purification of insulating oil.	07

3. Installation and Erection	3a. Describe given method of foundation for static & rotating electrical machinery. 3b. Justify the given method of leveling & aligning with direct coupled drive. 3c. Describe the procedure of given method of installation of transformer. 3d. Name Devices and tools required for loading, unloading, lifting and carrying heavy equipment.	3.1 Concept of foundation for installation of machinery. Requirements of foundation for static & rotating electrical machinery. 3.2 Concept of leveling & aligning. Procedure for leveling & aligning, alignment of direct coupled drive, effects of misalignment. 3.3 Installation of transformer as per I.S.-1886-1967 & procedure of installation of transformer. 3.4 Requirements of installation of pole mounted transformer. 3.5 Requirements of installation of rotating electrical machines as per I.S. 900-1965 3.6 Devices and tools required for loading, unloading, lifting, and carrying heavy equipments & precautions to be taken while handling them.	09
4. Trouble Shooting of Electrical Equipment.	4a. List the Limits of voltage, current, frequency & speed for safe working of electrical machines. 4b. Find internal & external causes for failure. 4c. List mechanical faults, electrical faults & magnetic faults in the electrical equipment. 4d. Prepare trouble shooting charts for D.C. Machines, AC Machines & Transformers.	4.1 Limits of voltage, current, frequency and speed for safe working of electrical machines. 4.2 Internal & external causes for failure/ abnormal operation of equipments. 4.3 List of mechanical faults, electrical faults and magnetic faults in the electrical equipments remedies, applications. 4.4 Preparation of trouble shooting charts for D.C. Machines, AC Machines & Transformers.	06

5. Testing & Commissioning	5a. List the Objectives of testing. 5b. Describe the given Routine tests, type tests, supplementary tests, special tests. 5c. Describe the given Direct/Indirect / Regenerative test on dc machine. 5d. List Tolerances for the given items .	5.1 Concept of testing, Objectives of testing. 5.2 Roles of I.S.S. in testing of electrical equipment. 5.3 Types of tests & concept of them, Routine tests, type tests, supplementary test, special tests 5.4 Methods of testing-Direct / Indirect/Regenerative testing. 5.5 Tolerances for the various items in respect of Induction motor, D.C. machines, Synchronous machines 5.6 Testing of transformer as per I.S.1886-1967&I.S.2026-1962. 5.7 Testing of three-phase Induction motor as per I.S.325-1970. 5.8 Testing of single-phase induction motor as per I.S.990-1965. 5.9 Testing of synchronous machines as per I.S.S. 5.10 Testing of D.C. machines– a) Direct, Indirect & Regenerative methods of testing, calibrated machines tests. b) Testing of D.C. machines as per I.S.4772.	12
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6. Maintenance	6a. Differentiate between Routine, preventive & breakdown maintenance. 6b. List the Causes of failure of electrical machines. 6c. Prepare preventive maintenance schedules for electrical machines. 6d. Give different Factors affecting preventive maintenance schedules. 6e. Identify different types of faults. 6f. Prepare maintenance Schedule for Distribution transformer, Power transformer, Single phase & three phase Induction motors, Batteries.	6.1 Concept of maintenance, types of maintenance, Routine, preventive & breakdown maintenance. 6.2 Causes of failure of electrical machines. 6.3 Preventive maintenance- advantages and procedure for developing preventive maintenance schedules for electrical machines. 6.4 Factors affecting preventive maintenance schedules. 6.5 Concept of TPM, Pillars of TPM 6.6 Identification of different types of faults developed such as Mechanical /electrical/magnetic faults due to poor maintenance. 6.7 Maintenance schedules of the following as per I.S.S. a) Distribution transformer as per I.S.1886-1967. b) Single phase & three phase Induction motors as per I.S.900- 1965. c) Batteries d) Concept of Machine Condition Monitoring and Fault Diagnostics	08
		Total Hrs.	48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Determine breakdown strength of transformer oil.	Insulation Testing and Maintenance	02
2	Perform insulation resistance test on Motor.		04
3	Perform insulation resistance test on transformer.		04
4	Prepare troubleshooting charts for electrical machines such as Transformer, D.C.machines.	Trouble	04

5	Prepare troubleshooting charts for electrical Machines such as Induction motor, and Synchronous machines.	Shooting of Electrical equipment.	04
6	Measure impedance of three-phase transformer.	Testing of Electrical machines	02
7	Measure voltage of three-phase transformer.		02
8	Measure load losses of three-phase transformer.		02
9	Find regulation and efficiency of single-phase Transformer by direct loading test.		04
10	Find regulation and efficiency of single-phase transformer by back-to-back connection method.		04
11	Compare the result of direct loading test and back to back connection test by finding regulation and efficiency of single phase transformer.		02
12	Determine efficiency of D.C. machine by Swinburn's test.		04
13	Determine efficiency of D.C. machine by Hopkinson's test.		04
14	Perform reduced voltage running up test on three-Phase Induction motor as per I.S.325-1967.		04
15	Measure no load losses and no load current of a transformer as per IS.		04
16	Perform no load test on single phase Induction Motor for the measurements of no load current, at rated voltage as per I.S.		02
17	Perform temperature rise test on single-phase Transformer.	Testing of Electrical machines	04
18	Find efficiency of M.G. set.		04

Total HRs**64**

SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Electrical Safety Accident & Prevention	02(02)	03(03)	03(00)	08(05)
2	Insulation Testing and Maintenance	02(00)	03(03)	03(03)	08(06)
3	Installation & Erection	02(00)	03(00)	06(06)	11(06)
4	Trouble Shooting of Electrical equipment.	02(00)	03(00)	03(03)	08(03)
5	Testing & commissioning	02(02)	06(03)	06(03)	14(08)
6	Maintenance	02(02)	03(03)	06(03)	11(08)
	Total	12(06)	21(12)	27(18)	60(36)

R–Remember

U – Understand

A – Analyze/ Apply

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

Q. No	Bit 1			Bit 2			Bit 3			Bit4			Bit 5			Bit 6			Option
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
1	2	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	A	3	2	U	A	1	U	3	2	U	3				3/5
3	2	A	3	3	U	3	3	A	3	2	A	3	4	U	3				3/5
4	3	A	3	4	U	3	4	A	4	5	U	3	5	A	3				3/5
5	5	U	3	5	U	3	6	U	3	6	U	3	6	A	3				3/5
6	5	A	6	6	A	6	3	A	6										2/3

T-Unit/TopicNumber

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		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 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)							PSO	
	1	2	3	4	5	6	7	1	2
1	3	3	-	-	-	-	1	3	3
2	3	3	-	-	-	-	-	3	3
3	2	3	-	3	-	-	-	3	3
4	2	3	3	2	-	-	-	3	3
5	-	3	3	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	Operation & Maintenance of Electrical Equipments Vol-I	BV S Rao, Asia Club House, First Reprint, 2011	8185099022
2	Design & Testing of Electrical Machines	M. V. Deshpande. PHI Learning Pvt.Ltd., 2010.	8120336453, 9788120336452.
3	Switchgear & Protection	Sunil S.Rao Khanna Publisher, First Edition,	10: 812033660713: 9788120336605.
4	Installation, Maintenance and Repair of Electrical Machines	M. Gupta, S.K. Kataria & Sons, Edition 2014	10: 9350145464; 13: 978-9350145463
5	Maintenance & Repairs	Rosenberg, McGRAW-HILL, 1 st Edition, May 2003	9780071396035
6	Preventive Maintenance of Electrical Apparatus	S.K. Sharotri, Glencoe/Mcgraw-Hill; 2 nd Edition, June 1969;	10: 007030839X 13: 978-0070308398

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=nP7oQre_E14, accessed on 28 FEB 2022
- <https://www.youtube.com/watch?v=IIGhKLdCk7U>, accessed on 28 FEB 2022
- <https://www.youtube.com/watch?v=QK5dMp43NJE>, accessed on 28 FEB 2022
- <https://www.youtube.com/watch?v=2o6tB4H04Mw>, accessed on 28 FEB 2022

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

1. Three phase Induction Motor. 3 HP, 440V, 50 HZ
2. Oil Testing Kit Voltage Range: 0 to 100KV AC Trip Current: 10 mA
3. Megger 500V, 1000 V

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

S.N.	Nam	Designation	Institute/ Industry
1	Prof.A.M.Arekar	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
2	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering, G.P.Nagpur	CDC Coordinator Member (Internal)
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering, G.P.Nagpur	CDC In-charge (Member Secretary)
4	Dr.G.V.Gotmare	I/C, Head of Electrical Engineering G.P.Gondia	MSBTE Nominee
5	Smt.A.P. Gandhi	Lecturer in Electrical Engineering, G.P.Nagpur	Member (Internal)
6	Smt.P.M.Sonwane	Lecturer in Electrical Engineering G.P.Nagpur	Government Polytechnic, Nagpur.
7	Smt.R.S.Rithe	Lecturer in Electrical Engineering, G.P.Nagpur	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ELECTRICAL ENGINEERING

COURSE CATEGORY: PROGRAMME CORE COURSE

COURSE CODE : EE302G^s

COURSE TITLE : SWITCHGEAR AND PROTECTIONS

TEACHING SCHEME: TH: 04; TU: 00; PR: 02 (CLOCK HRs.)

TOTAL CREDITS : 05 (1 TH/TU CREDIT) = 1 CLOCK HR., 1 PR CREDIT = (2CLOCK HR.)

TH. TEE EXAM : 03 HRs

PR. TEE EXAM : 02 HRs

PT. EXAM : 01 HR

❖ **RATIONALE:**

Safety is the major criteria of every power station and sub- station for machines/ equipment and human beings. So various protective schemes applied to various electrical equipment / machines/ bus bars, feeders, transmission lines / distribution lines etc. are essential to minimize normal and abnormal faults and for safety of human being. Operating skill of switchgear and protective systems are much essential for the technician working in the particular work area such as substation, grid station, switching station. Essential efforts are being made in this course to ensure that students develop skills in operating various controls and switchgear in power system.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Determine the various parameters of fault KVA calculations of given faults.
2. Select relevant protective relay for given power system protection.
3. Suggest suitable switchgears for different applications as per the requirement
4. Use protection systems of alternators and transformers.
5. Select suitable protection schemes for motors and bus bars for given faults.
6. Choose the appropriate protection schemes for power system components for over voltages.

❖ **COURSE DETAILS:**
A. THEORY:

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Basic Concept of Faults and Protection	1a. Describe the functions of elements of the given protective system. 1b. Describe given types of faults and abnormalities in a power system. 1c. Describe with neat sketches the concept of the Backup protection for the given protection zone. 1d. Select suitable current limiting reactors for the given situation with justification. 1e. Determine the given parameters of fault KVA calculations of given faults	1.1 Need of protection of power system. , functions of protective system. 1.2 Normal and abnormal conditions. 1.3 Types of faults and their causes. 1.4 Protection zones, Main and backup protection. 1.5 Need of current limiting reactors and their arrangements as per location .selection aspects of current limiting reactors 1.6 Fault KVA calculation-Need of fault KVA calculation, 1.7 Derivation for base impedance , Fault KVA, Per unit system , Procedure of fault KVA calculation , Calculate various parameters of fault KVA calculation of given faults.	08
2Protective Relays	2a. Justify the given fundamental quality requirements of protective relays. 2b. Estimate PSM, TSM and operating time of relay on given data. 2c. Describe the construction and working of the given type of relay in power system. 2d. Describe the working of the given Distance relay with suitable diagram 2e. Describe the working of the given Directional relay with suitable diagram 2f. Describe the working of the given Differential relay with suitable diagram. 2g. Describe the working of the given protective relay with its block diagram. 2h. Select relevant protective	2.1 Protective relay: Operation of relay Sequence of operation of relay. Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. 2.2 Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier calculation of actual operating time of relay. 2.3 Protective relays: its classification ,construction working, merits and demerits of Electromagnetic induction relay Thermal relay. Over voltage relay. Overcurrent relay 2.4 Directional relay and Non directional relay : its	12

	relay for power system protection with justification	2.5 Need and operation of Directional power relay and overcurrent relay 2.6 Distance relay--Principle of operation of differential relay, working by using balanced beam relay .Characteristic of Impedance relay, reactance relay, mho relay 2.7 Differential relay-Principle of operation of different types of differential relay. 2.8 Static relay, Microprocessor based protection: its Block diagram, operation, merits and demerits. Numeric relay- Its Block diagram, operation, its merits and demerits. 2.9 Selection of protective relays	
3. Circuit Interruption Devices	3a. Describe with neat sketches, the operation of given isolators. 3b. Describe with suitable sketches, given methods of arc extinction in the given types of circuit breakers. 3c. Select the relevant H.T. circuit breakers for the given application. 3d. Describe Gas insulated switchgear with its merits and demerits. 3e. Justify the use of given type of Insulation coordination	3.1 . Isolator- Function of Isolator, Types - Horizontal break, Vertical break, pantograph and their use. 3.2 Circuit Breaker- Role of circuit breaker Classification of circuit breakers on the basis of H.T and L.T 3.3 Arc formation process, Methods of arc extinction ➤ High resistance Method ➤ Low Resistance Method. 3.4 Terms related to the relay Arc voltage, Recovery voltage, Restriking voltage, RRRV. 3.5 Ratings of circuit breakers Making capacity Breaking capacity Short time rating 3.6 H.T. circuit breakers: its construction, Working, advantages and disadvantages and applications of ➤ Air blast circuit breaker ➤ Oil circuit breaker, ➤ Vacuum circuit breaker ➤ Sulphur-hexa-Fluoride (SF6) circuit breaker 3.7 Selection of H.T. circuit breakers 3.8 Gas insulated switchgear, its merits and demerits applications 3.9 Concept of Insulation Coordination : Type1 & Type2 coordination.	12
4. Protection of Alternator	4a. Describe the causes and remedies of the given faults in the specified machine.	Alternator Protection 4.1 Different abnormal conditions of alternator,	12

and Transformer	4b. Describe with neat diagram the given protection to the stator of alternator against given fault . 4c. Describe with neat diagram the given protection to the rotor of alternator against given fault 4d. Describe with neat diagram the given protection to the transformer against given fault. 4e. Calculate CT ratio of the specified transformer protection scheme on given data.	Types of stator and rotor faults in an alternator, 4.2 Protections to stator of alternator • Overload or Over current protection • Biased differential protection for delta and star connection. • Earth fault protection , Restricted earth fault protection • Stator Inter turn fault protection 4.3 Protection to Rotor of alternator. • Rotor earth fault protection by resistance and sensitive earth fault relay • Loss of excitation or field failure protection • Rotor overheating protection. • Protection by Negative sequence relay Transformer Protection 4.4 Types of faults in transformer, Protection system of transformer: Construction, operation of • Buchholz relay • Differential protection of transformer, principle of differential protection, Biased or percentage differential Protection: different connection of biased differential protection, • Earth fault protection, Restricted earth fault protection. • Combined over current and Earth Fault Protection. 4.5 Selection of CT, CT connections, determination of CT ratio.	
5. Protection of Motor and Bus bar	5a. Describe the causes and remedies of the given faults in given Motor. 5b. Describe the given protection scheme for low H.P. motor. 5c. Describe with suitable diagram the given protection scheme of the high H.P. motor. 5d. Select motor protection scheme for the given fault 5e. Describe with neat sketches the given Differential	Protection of Motors 5.1 Different faults in motor and their remedies. 5.2 Protections of low HP motor 5.3 Protections of high HP motor • Motor bearing failure • Motor overheating • Single phasing • Motor winding failure • Reverse motor rotation protection Busbar protection 5.4 Current differential protection of bus bar, 5.5 Earth fault and over current protection	10

	current protection scheme of given bus bar of the power system. 5f. Select busbar protection scheme for the given fault.	of bus bar. 5.6 Frame leakage protection.	
6. Transmission Line and Over Voltage Protection	6a. Describe given types of transmission line protections with suitable circuit diagram. 6b. Describe given types of overload protections with suitable circuit diagram. 6c. Describe given types of distance protections with suitable circuit diagram. 6d. Describe given internal causes of overvoltage 6e. Identify given types of lightening arrestors. 6f. Suggest the appropriate protection scheme for given power system components for overvoltage.	Transmission line Protection 6.1 Time graded protection-Radial feeder, Parallel feeder protection and ring mains protection. Current graded protection to radial feeder. 6.2 Overloading protection, over current and Earth Fault Protection, current balance differential pilot wire protection. Carrier current protection. 6.3 Distance protection, Three step distance protection, Overvoltage protection 6.4 Internal causes of over voltages, Lightening phenomenon, types of lightning strokes. 6.5 Construction and working of Lightning Arrestors such as • rod gap type, • horn gap type. • valve type, • Expulsion type, • Thyrite type • Surge absorber-its types 6.6 Protection of Substation, power station and overhead transmission line from direct lightning strokes.	10

❖ LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Identify various switchgears in the laboratory and Prepare report on specifications of LT switchgear e g. MCB, MCCB, ELCB, RCCB used in Electrical power system through market survey.	1. Basic concept of faults and protection	02
2	Plot time current characteristics of re-wire able / HRC fuse.	3.Circuit Interruption devices	04
3	Use MCB/MCCB under the normal and abnormal condition.		02
4	Identify the components of different types of circuit breakers with their specifications (through visits / video / model).		02
5	Measure the current and time of operation of thermal relay and plot its characteristic.	2. Protective relays	04
6	Measure the current and time of operation of IDMT relay and plot its characteristic.		02

7	Simulate the fault condition on power simulation model and record the performance of different relays.		04
8	Prepare report of protection schemes of alternator through visit	4. Protection of Alternator And transformer	02
9	Prepare visit report on protection schemes Transformer.		02
10	Demonstrate the operation of single phasing preventer for protection of three phase induction motor.	5. Protection of Motor and Bus bar	02
11	Prepare visit report of substation and trace protection scheme of transmission line and feeder.	6. Transmission Line and Over voltage protection	04
12	Collect information about Lightning arrestors and prepare report.		02
Total Hrs			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Basic concept of faults and protection	02(02)	00 (03)	06 (00)	08(05)
2	Protective relays	02(00)	03 (00)	06(03)	11(05)
3	Isolator And Circuit Breaker	02(02)	06(03)	06(06)	14(09)
4	Protection of Alternator And transformer	02(00)	03(03)	06(03)	11(06)
5	Protection of Motor and Bus bar	02(00)	06(03)	00(03)	08(06)
6	Transmission Line and Over voltage protection	02(02)	00(03)	06(00)	08(05)
	Total	12 (06)	18(15)	30(15)	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
	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	3	R	2	6	R	2										
2	1	A	3	2	A	3	3	U	3	2	U	3	4	U	3				3/5
3	1	A	3	2	U	3	2	U	3	1	U	3	3	A	3				3/5
4	2	A	3	5	U	3	3	A	3	4	A	3	5	U	3				3/5
5	5	U	3	3	A	3	4	U	3	5	A	3	6	U	3				3/5
6	4	A	6	6	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		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 circuit diagram, selection of equipment's. 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	1	3	-	1	-	-	3	3	3
2	1	-	-	3	-	-	3	3	3
3	1	-	-	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	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 System Protection and Switch Gear	Badriram & D. N. Viswakarma Tata McGraw Hill pub.	0-07-462350-8
2	Switchgear and protection	U. A. Bakshi & Mayuresh V Bakshi Technical Publication Pune	9788184316391
3	Power System Protection and Switchgear	B Ravindranath, M Chandar Wiley Eastern Ltd	8181-219-0632-6
4	Fundamentals of Power System Protection	Y.G. Paithankar, S. R .Bhide	978-81-86308-18-0
5	Switchgear Protection & Power System	Sunil S Rao, Khann Publisher Ltd	81-7409-029-0
6	Principles of Power System	VK Mehata, S Chand and Co. Ltd	81-219-0594-x

❖ **E-REFERENCES:**

- <https://youtu.be/egVnKfhTKsY>, current limiting reactors , accessed on 20th Jan 2022
- <https://youtu.be/2G3CEPu2OB4>, protection zones, accessed on 20th Jan 2022
- <https://youtu.be/2vUsMWqBc2g>, switchgears, accessed on 20th Jan 2022
- <https://youtu.be/UQE1xfcdGr4> , Protective relays, accessed on 20th Jan 2022
- https://youtu.be/jMemjV_UxvE , protection of alternator , accessed on 20th Jan 2022
- <https://youtu.be/2n6E1vjOqso> , protection of transformer, accessed on 20th Jan 2022
- https://youtu.be/s_IrsNHv4aQ, protection of transmission line, accessed on 20th Jan 2022
- <https://youtu.be/CDmNR-FUAhE> , protection against overvoltage , accessed on 20th Jan 2022

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

- Rheostat assorted sizes
- Dimmerstat 15A,300V
- Variable rectifier 100 A,300V DC
- DC power pack.
- HRC Fuse, MCB, ELCB, RCCB
- Thermal relay
- IDMT, DMT relay.
- Current transformer ratio 10:01
- Potential transformer ratio 300:115
- Power station simulator

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

S.N.	Name	Designation	Institute / Industry
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

 (Member Secretary PBOS)

 (Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGG.
COURSE CATEGORY:	PROGRAMME CORE COURSE
COURSECODE	: EE303G^{\$}
COURSE TITLE	: ELECTRICAL UTILIZATION AND TRACTION
TEACHING SCHEME:	TH: 04; TU: 00; PR: 00(CLOCK HRS)
TOTAL CREDITS	: 04(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 1 CLOCK HR.)
TH. TEE	: 03 HRS
PR.TEE	: --
PT	: --1 Hr.

❖ **RATIONALE:**

Electricity used in different industries for different processes such as heating, welding, electroplating, refrigeration and for motive power. Also country is leading towards the railway electrification, metro and monorail system. Every diploma electrical engineer therefore should know to operate and maintain main electrical utilities and traction systems for their efficient operations. This course will enable the students to develop knowledge and skills to maintain /troubleshoot various electrical equipment's in electrical utilities and traction systems. The students will be able to make proper selection of equipment's according to requirements to ensure economical and efficient use of electricity.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Select proper Electric heating & welding process.
2. Select proper Electric drive motor for particular application/service & determine its rating.
3. Identify mechanical & electrical components of Refrigerator and Air-conditioner & select their rating.
4. Apply principles of tariff, power factor improvement, energy conservation & identify type of Electricity theft.
5. Describe Traction power supply feeding systems and power circuit components of AC

locomotive.

6. Describe Traction motor characteristics, speed control, electric braking & traction dynamics of passenger train services.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Electrical Heating and Welding	1a. State advantages of electric heating. 1b. Classify electric heating methods. 1c. Describe the principle of direct & indirect Resistance Heating. 1d. Describe the principle of direct & indirect arc heating. 1e. Calculate length of heating element for a given resistance heating furnace. 1f. Describe the principle of core type & coreless induction heating and state their applications. 1g. Calculate rating & efficiency of induction heating furnace from given data. 1h. Describe the principle of dielectric heating and state their applications. 1i. Determine voltage & frequency necessary from a given data for dielectric heating. 1j. Describe different types of Electric resistance welding methods. 1k. Describe different types of Electric Arc welding methods. 1l. Describe different modern welding techniques.	1.1 Electric heating- Introduction, advantages, modes of transfer of heat, classification of electric heating methods. 1.2 Resistance heating- Principle, direct & indirect resistance heating, resistance furnace, heating materials, desirable properties, design of heating element, temperature control of resistance furnace, infra-red or radiant heating. 1.3 Arc furnace- Principle, types, construction, main components, advantages. 1.4 Induction heating- Principle, core type and coreless induction furnace, advantages, choice of frequency, efficiency and losses. 1.5 Dielectric heating- Principle advantages, choice of voltage and frequency for dielectric heating, applications. 1.6 Electric resistance welding- Principle, types- spot, seam, butt, projection and percussion welding. 1.7 Electric arc welding- Principle, types- carbon arc, shielded metal arc, atomic hydrogen arc, inert gas metal arc, submerged arc welding, power supply for arc welding, Electric welding equipment, electrodes, comparison between resistance and arc welding. 1.8 Modern welding techniques- Electron beam welding, ultra sonic welding, laser beam welding.	14

2. Electrical Drives	2a. Describe functions of major parts of an electric drive with block diagram. 2b. State the factors governing selection of electric motor for electric drive. 2c. Describe steady state and transient characteristics of various motors. 2d. State types of Electric braking & their comparative advantages and disadvantages. 2e. Describe different Electric braking methods applied to various motors. 2f. Describe Mechanical factors affecting selection of electric motor. 2g. Define ratings of electric drive motor. 2h. Determine rating of Electric drive motor for given load cycle. 2i. Select DC& AC motors for particular service / applications.	2.1 Factors governing selection of motor for Electric drive, Review of Electrical characteristics of motors-starting, and running, reversing, speed control. 2.2 Electrical braking, - types, comparative advantages and disadvantages, electric braking applied to DC shunt, DC series and three-phase induction motor. 2.3 Mechanical factors - Enclosures, bearings, power transmission and noise level. 2.4 Size and rating of motor, load equalization. 2.5 Selection of electric motors for industrial applications and particular service based on load characteristics & requirements.	10
3. Refrigeration and Air Conditioning	3a. Describe vapour compression refrigeration cycle. 3b. State desirable properties of refrigerants. 3c. List the refrigerants used for domestic and industrial refrigeration. 3d. Describe construction & working of domestic refrigerator. Also draw electric circuit of domestic refrigerator. 3e. Define unit of Refrigeration. 3f. Describe construction & working of split type air-conditioner. Also draw its electric circuit. 3g. Describe how	3.1 Vapour compression refrigeration system, refrigerants- desirable properties, refrigerants for domestic & commercial refrigeration. 3.2 Domestic refrigerator- Constructional features, working, refrigerants used, Electric circuit of refrigerator, power rating of refrigerator. 3.3 Air conditioning - Functions involved, types of air conditioning, Split type room air-conditioner, Constructional features, working principle and Electric circuit, power rating of air-conditioner.	08

	refrigerator & air-conditioner are rated.		
4. Economic Aspects	4a. State salient features of Indian electricity act. 2003. 4b. State objectives of framing Tariff. 4c. Describe different types of Tariff. 4d. State causes of low lagging power factor & disadvantages of low power factor. 4e. Describe methods of improving power factor. 4f. State need & benefits of energy conservation. 4g. List energy conservation opportunities in residential & industrial installations. 4h. Define Energy Audit & state its need. 4i. Describe types of energy audit. 4j. State types of Electricity theft & describe its prevention.	4.1 Salient features of Indian electricity act.2003 4.2 Tariff – objectives, types. 4.3 Power factor improvement – causes of 4.4 low lagging power factor, disadvantages of low power factor, methods of improving power factor & their location. 4.5 Energy conservation – need, benefits, energy conservation opportunities in residential & industrial installations. 4.6 Energy audit –definition, need, types 4.7 Electricity theft –theft in distribution & service connection, prevention of electricity theft.	08
5. Electrical Traction Systems & Power Supply Arrangements	5a. State advantages & limitations of Electric traction system. 5b. Describe different systems of track electrification. 5c. State advantages and problems of single phase kV AC system compared to DC system of track electrification. 5d. State advantages of Metro rail. Also list existing Metro rail schemes in India along with their supply systems. 5e. Draw single line diagram of traction substation & feeding post. 5f. Describe important	5.1 Introduction, traction systems, electric traction system, advantages & limitations. 5.2 Power supply systems for track electrification, advantages of 25 KV AC system over DC system, problems of single phase traction systems. 5.3 Metro rail- supply systems, advantages, schemes in India. 5.4 Components of traction supply system, substation, feeding post, major equipment's at AC substation, Overhead equipment (OHE), neutral section, polygonal OHE, types, current collection systems for OHE. Power circuit of AC locomotive (with DC series motor and three-phase induction motor), main equipments and their functions, EMU Trains in India. 5.5 Train lighting-requirements,	12

	components of OHE. 5g. Describe different current collection systems with their comparative advantages & disadvantages. 5h. Draw power circuit diagram of AC locomotive fitted with DC series, three phase traction induction motor. Also state functions of its main equipment. 5j. Describe concept of EMU Trains operating in India. 5k. Describe SG, EOG& HOG Train lighting system along with their comparative advantages & disadvantages.	methods of obtaining supply for train lighting – SG,EOG and HOG system	
6. Traction Motor Control & Traction Mechanics	6a. State desirable features of traction motors. 6b. Describe suitability of D.C. series motor & three phase induction motor for traction work. 6c. Describe field control and rheostatic braking of DC series motor for traction duty with neat diagram. 6d. Describe vvvf control and regenerative braking of three phase induction motor for traction duty. 6e. Draw speed time curves related to different passenger traction services. 6f. Define average & schedule speed, accelerating & adhesive weight, coefficient of adhesion related to traction mechanics. 6g. Determine distance between the stations, average & schedule	6.1 Traction motors – desirable characteristics 6.2 Suitability of D.C. series motor for traction duty, field control, rheostatic braking 6.3 A.C. Traction motors-single phase, Three phase, Linear Induction Motor 6.4 3-ph Induction motor – suitability for traction duty, advantages over dc series motor , vvvf control, regenerative braking 6.5 Speed- time curve of mainline, urban & sub-urban services, average and schedule speed, accelerating and adhesive weight, coefficient of adhesion, simplified speed-time curves, tractive effort, propulsion of train vehicle, power of traction motors, specific energy consumption, factors affecting specific energy consumption.	12

	speed, acceleration, braking retardation for a given speed time curve. 6h. Define specific energy consumption of electric train & state factors affecting it . 6i. Determine specific energy consumption of electric train from given data.		
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B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil



❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Electrical Heating and Welding	00(02)	06(03)	06(03)	12(08)
2	Electrical Drives	02(02)	03(03)	06(00)	11(05)
3	Refrigeration and Air Condition	02(00)	06(03)	00(00)	08(03)
4	Economic aspects	04(00)	03(00)	03(00)	10(00)
5	Electrical Traction Systems & Power supply arrangements	04(00)	06(06)	00(03)	10(09)
6	Traction motor control & Traction mechanics	00(02)	03(03)	06(06)	09(11)
	Total	12(06)	27(18)	21(12)	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

[illegible]

❖ **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		
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)										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
1	-	3	-	-	-	2	-	-	-	-	2	-
2	-	3	-	-	-	-	-	-	-	-	-	2
3	-	3	-	-	1	2	2	-	-	-	-	2
4	-	3	2	2	-	2	-	2	2	2	2	-
5	-	3	2	2	-	-	-	2	2	2	2	-
6	-	3	2	2	-	-	-	2	2	2	-	2

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

❖ **REFERENCE & TEXTBOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Utilization of Electric Power & Electric Traction	Gupta J.B., S.K. Kataria and Sons, Reprint, 2001.	978-9350142585
2	Utilization of Electric Power & Electric Traction	Garg G.C., Khanna Publishers	978-8174091642
3	Art & Science of Utilization of Electrical Energy	Partab H., Dhanpat Rai & Co. (Pvt.) Ltd,	9788177001440
4	Modern Electric Traction	Partab H., Dhanpat Rai & Co. (Pvt.) Ltd, 1998	1234567147206
5	Utilization Of Electric Power	Suryanarayana N.V., New Age International Publishers, Reprint 2010.	9788122405460

❖ **E-REFERENCES:**

- <http://nptel.ac.in/courses/108104011/>, accessed on 30th Sept 2021
- <http://www.electrical4u.com/electrical-drives/>, accessed on 30th Sept 2021
- <https://www.youtube.com/watch?v=fakGLu03jYg>, accessed on 30th Sept 2021

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Shri.A.M.Arekar	I/C Head, Electrical Engineering	Government Polytechnic, Nagpur.
3	Shri.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Shri.M.N.Gawande	Lecturer in Electrical Engineering & CDC I/C.	Government Polytechnic, Nagpur.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME ELECTIVE COURSE
COURSE CODE	: EE304G^{\$}
COURSE TITLE	: ENERGY CONSERVATION AND AUDIT^{\$}
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 conservation is efficient use of energy. This course is designed for creating the awareness, imparting knowledge of energy conservation in various sectors. This course also designed to develop practical skills related to energy conservation equipment. Energy Conservation is need of time due to limited sources of energy. A Diploma Holder can carry out energy audit for conserving energy. Students can use various techniques and methods of energy conservation after completion of this course. This courses focuses on conserving electrical energy mainly for Electrical Engineering students.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply energy conservation opportunities in lighting.
2. Use energy conservation techniques for induction motors and transformers.
3. Suggest measures for reducing losses in transmission line.
4. Apply suitable measures for conserving energy in industries.
5. Apply remedies for reducing environmental pollution.
6. Prepare energy audit report.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Energy Conservation in Lighting Systems.	1a. Identify role of given Govt. body in energy conservation. 1b. Select suitable luminaries for given conditions. 1c. Assess lighting system for a given facility. 1d. Apply energy conservation techniques / methods in given lighting system.	1.1 Need of energy conservation, Role of Energy Conservation Act 2003, BEE, MEDA, MNRE in energy conservation, star labelling in appliances 1.2 Recommended Luminance Levels as per National Lighting Code 2010 SP 72:2010 1.3 Procedure for assessing existing lighting system in a facility. 1.4 Energy conservation techniques / methods in lighting system by. -Replacing lamp sources -Using Energy efficient luminaries -Using light control gears/ circuits -Installation of exclusive transformer/ servo stabilizer for lighting -Periodic survey and adequate maintenance program.	06
2. Energy Conservation in Motor and Transformer	2a. Apply suitable energy conservation Methods / techniques for given electrical motors. 2b. Use various energy conservation techniques in given transformers.	2.1 Energy Conservation Methods/ Techniques for Electrical Motors by, -Improving power quality -Matching motor rating with required load -Minimizing idle and redundant running of motor. -Operating in star mode -Rewinding of motors -Improving mechanical power & transmission efficiency -Use of high efficiency or Energy efficient motors -Using energy conservation equipment like Soft starters, Automatic power factor controller, Variable Frequency Drives. -Periodical maintenance 2.2 Energy Conservation Methods/ Techniques for transformers - Using Energy efficient transformer	12

		- Using Amorphous core for Transformers - Epoxy Resin cast / Encapsulated Dry type Transformer - Periodic maintenance	
3. Energy Conservation In Transmission and Distribution Systems	3a. Identify technical losses in given Transmission and Distribution system. 3b. Improve power factor for given system. 3c. Plan demand side management for given load. 3d. Justify need of optimization of system voltage. 3e. Calculate reduction in losses by balancing a given unbalanced system. 3f. Suggest measures to reduce commercial losses for given distribution system.	Energy Conservation opportunities In Transmission and Distribution Systems by - 3.1 Overcoming technical losses 3.2 Compensating Reactive power flow 3.3 Demand side management. 3.4 Optimization of system voltage 3.5 Balancing of phase currents 3.6 Reducing commercial losses	10
4. Energy Conservation in Industries	4a. Identify type of given consumer. 4b. Calculate electric bill using given tariff system. 4c. Suggest measures for reducing losses in given industries using different measures 4d. Identify energy conservation various opportunities in given pumping system. 4e. Apply measures for saving energy in given fans and blowers. 4f. Apply different measures for saving energy in given DG sets.	4.1 Classification of Consumers-Low Tension and High Tension, Energy cost and Recent Maharashtra State Electricity Distribution company Limited tariffs 4.2 Application of Tariff System to reduce Energy bill, Energy Conservation in industry by-TOD tariff, Power factor tariff 4.3 Energy Conservation in industry by -Improving load factor -Maximum Demand controller 4.4 Energy conservation opportunities in Pumping Systems. 4.5 Tips for energy saving in fans and blowers. 4.6 Energy saving measures for DG sets.	10
5.	5a. Justify need of Co-	5.1 Need for cogeneration	06

Energy Conservation by Cogeneration And Environmental Issues	generation in given system. 5b. Describe given cycle used in cogeneration. 5c. Describe advantages of cogeneration on given points. 5d. Select cogeneration system for given factors. 5e. Assess relation between energy and environment on given points. 5f. Identify environment and social concerns related to energy generation due to given type of power plants. 5g. Apply given remedy for reducing global warming.	5.2 Classification of Cogeneration Systems on the basis of the sequence of energy use, - Topping cycle. - Bottoming Cycle 5.3 Advantages of cogeneration 5.4 Factor governing selection of cogeneration Systems. 5.5 Relation between Energy and Environment 5.6 Environment and social concerns related to energy generation 5.7 Global Environmental issues, - Causes and effects of Ozone layer depletion. - Causes, effect and remedy for Global warming. (The Green House Gas effect).	
6. Energy Audit	6a. Justify the need of energy audit. 6b. Use energy audit instruments for given parameters. 6c. Apply the procedure of Energy Audit. 6d. Identify role of energy manager for given energy system. 6e. Calculate payback period for given data.	6.1 Energy audit, need, types. 6.2 Energy audit instruments and their use. 6.3 Procedure of Energy audit (walk through audit & detailed audit.) 6.4 Energy Management, role of energy manager. 6.5 Payback period and Return on Investment , ABC analysis (Numerical)	04
		Total Hrs	48

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Measure illumination level of working place with the help of Digital Lux Meter.	1. Energy conservation in lighting systems.	02
2	Use power guard meter for measurement of different electrical quantities.		02
3	Calculate energy saving by using electronic ballast as compared to conventional chokes.		02
4	Calculate energy saving in lighting system by retrofitting tube lights with LED lamps. Calculate payback period with comments.		02 02
5	Collect data related with streetlight of institute. Prepare a report on energy conservation in street lighting .		02 02
6	Prepare a report on energy conservation in a given energy efficient motor based on design, material etc.	2. Energy conservation methods / techniques for electrical motor and transformer	02
7	Prepare a report on energy conservation opportunities in a given industry.	4. Energy Conservation In Industries	02
8	Visit to cogeneration / captive power plant. Prepare a report on it.	5. Energy conservation by cogeneration	02 02
9	i) Collect data related to electrical consumption and ii) Prepare Energy audit report of your institute / Industry/ Hospital / Residence / small workshop/hostel.	6. Energy audit	2 2
10	i) Collect Literature ii) Prepare Presentation and report iii) Give Presentation On any one of the following topics , a) Energy conservation and Environmental issues b) Market survey on energy efficient luminaries (collect the technical data) c) Market survey on energy efficient motors and transformers .(collect the technical data) d) Energy tariff system in India e) Energy conservation equipment f) Energy Management g) Energy Audit on any institute /industry h) Energy conservation act 2003	All topics	02 02 02
Total Hrs.			32

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Energy conservation in lighting systems.	02(02)	03(00)	00(00)	05(02)
2	Energy conservation in electrical motor and transformers	02(02)	06(06)	06(00)	14(08)
3	Energy conservation in transmission and distribution systems	02(00)	06(00)	03(06)	11(06)
4	Energy conservation in industries	00(00)	06(09)	06(00)	12(09)
5	Energy conservation by cogeneration and environmental issues	02(00)	03(00)	03(03)	08(03)
6	Energy Audit	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:

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	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

❖ 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	Market Survey, collection of information of energy efficient equipment / luminaries. etc.	10
2	Performance	20
3	Calculation, Result Interpretation	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		3	3	3		
2	3	3	3	2	3	3	3		
3	3	3	3		3		3		
4	3	3	3		3	3	3		
5	3	3	3		3		3		
6	3	3	3	2	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	Generation and Utilisation of Electrical Energy	D. Srilatha S. Sivnagraju M. Balasubbareddy, Pearson, New Delhi 2010	8131798771, 9788131798775 978-81-317-6774-0
2	India – The Energy Sector	P.D. Henderson, World Bank Publication, Oxford University Press, 1975.	0-19-521598-2-
3	Energy Management Handbook	W.C Turner, John Wiley and Sons Wiley Press Eighth Edition, 2015	10: 142008870X
4	Efficient Use and Management of Electricity in Industry.	B.G. Desai, J.S. Rana, A.V. Dinesh, R. Paraman, Devki Energy Consultancy Pvt. Ltd, 4 th Edition, 2016	-

❖ **E-REFERENCES:**

- <https://legislative.gov.in/sites/default/files/A2001-52.pdf> , accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=d0Bh3TQ_oEU&ab_channel=ErgoELearningbyDr.SonalDesai accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=sB0foj6GTi8&ab_channel=AMOLPARKHE accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=ZKUzm5vh3qc&ab_channel=J%C3%A4mtkraftAB accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=IovqoSrQI_w&ab_channel=ClassgoEducation accessed on 24 Dec 2021

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

1. Lux meter- Display: 3-1/2 digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges, Sampling rate: 0.4second, Operating Temperature: 0 ~ 50 °C (32 ~ 122 °F),
2. Ammeter MI 0-5-10 A
3. Voltmeter MI 0-150-300 V
4. Wattmeter 0-3000 W
5. Digital Multi-meter- 24V-250V AC/DC, Accuracy- 0.5% ± 1 digit
6. Tong tester ACA: 3/15/60A + 5% ACV: 300/600V + 5%, Size: 120x70x35mm
7. Power Guard Meter

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

S.N.	Name	Designation	Institute / Industry
1	Mr.A.M.Arekar	HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	HoD, Electrical Engg. Deptt.	Government Polytechnic, Gondia
3	Mr.M.N.Gawande	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur
4	Smt.A.A.Alegaonkar	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 ELECTRICAL ENGINEERING
COURSE CATEGORY:	PROGRAMME CORE COURSE
COURSE CODE	: EE305G^{\$}
COURSE TITLE	: ILLUMINATION 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:

Electrical engineering students should develop skills in the field of illumination engineering. This course imparts the concept, principle and design of illumination schemes. After completion of this course diploma engineering students will be able to design and install recent trends in illumination engineering and work as supervisor in this field.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply different laws, terminologies related to Illumination engineering to different applications.
2. Select suitable luminaries for different applications.
3. Select appropriate control gear for selected Illumination scheme.
4. Design Illumination Scheme for Indoor Installation.
5. Design Illumination Scheme for Outdoor Installation.
6. Select suitable Illumination level & luminaries for special lighting applications.

❖ **COURSE DETAILS:**
A.THEORY

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Fundamentals of Illumination.	1a. Define various parameters / terminologies related to illumination. 1b. State the laws of illumination. 1c. Calculate the number of lamps required for particular application. 1d. Solve numerical related to illumination.	1.1 Electromagnetic spectrum, Types of lights: a. Visible light b. Ultraviolet light c. Infrared light 1.2 Nature of light, Color of radiant energy. 1.3 Theories of Light- A) Reflection of Light. B) Refraction of Light. C) Double Refraction. 1.4 Terminology Used in Illumination such as- Light, Luminous Flux, Solid Angle, candle power, Luminous Intensity, Radiant efficiency, Luminous Efficacy of Source and Radiation, Lumen, Illumination or Luminance, Lux, Space- Height Ratio, Utilization Factor, Depreciation Factor. 1.5 Laws of Illumination-Inverse Square Law, Cosine Law- Numerical based on Illumination received directly underneath, Illumination received on horizontal screen and screen moved horizontally at certain distance. 1.6 Factors affecting the illumination. 1.7 Different types of lighting arrangements, design consideration of good lighting scheme, advantages of good illumination scheme. 1.8 Lighting system consideration for different occupancies. 1.9 Numerical based on calculation of number of lamps required for particular place.	08
2. Lamps and Lighting Accessories	2a. Define terminologies related to lamp. 2b. Choose different luminaries as per requirement of installation.	2.1 Various types of light sources 2.2 Terminology related to lamps and auxiliary apparatus-Luminous elements, filament, straight filament, single coil filament, coiled coil filament, Bulb, Clear Bulb, Frosted bulb, Opal Bulb, Coated	08

	2c. Describe construction and working of various luminaries. 2d. Select lighting scheme as per condition and application. 2e. Compare various luminaries. 2f. Identify mountings arrangement for light sources. 2g. Collect technical data of lamps and lighting accessories. 2h. Describe the effect of light sources on environment.	Bulb, Reflectorized bulb, Enameled Bulb, Colored Bulb, Hard Glass Bulb, Cap; Base, Screw Cap, Bayonet Cap, Shell Cap, Pin Cap, Pre-focus Cap, Bayonet Pin, Contact Plate, Pin, Lamp holder, Main Electrode (of Discharge Lamp, Starting Electrode (of Discharge Lamp), Arc Tube, Emissive Material 2.3 Construction, operation, lumens per watt and application of- Incandescent, Fluorescent, sodium vapor, mercury vapor, Metal halide, CFL lamps, LED lamps. 2.4 Comparison between lamps on the basis of color of light, lumens per watt, life in hours, maintenance, cost etc. 2.5 Lighting schemes: selection of lamp, illumination efficiency, glare and power consumption, 2.5.1 Direct & Indirect 2.5.2 Semi direct & semi indirect 2.5.3 General lighting scheme 2.6 Lighting calculation methods, 2.6.1 Watt per square meter method 2.6.2 Lumens or light flux method 2.6.3 Point to point method – Simple numerical. 2.7 Environmental Effects of Light Sources	
3. Illumination Control and Control Circuits	3a. State the purpose of lighting control. 3b. Describe lighting control methods. 3c. Draw control circuit for lamps. 3d. Describe the methods of light control. 3e. Select controlling methods of brightness/color of light source as per requirements. 3f. Select proper light source as per application. 3g. Design control circuit for Illumination.	3.1 Purpose and principle of lighting control. 3.2 Energy Benefits of Light Control Working principle and operation of 1. Dimmer -Resistance type dimmer 2. Dimmer Transformer a) Auto transformer dimmer b) Two winding transformer dimmer 3.3 Electronic Dimmer :working principle and operation a. Thyristor operated dimmer b. Triac operated dimmer 3.4 Enhancing Lighting control. 3.5 Methods used for light control- i. Manual Control ii. Automatic Control 3.6 a) Manual Control- (i) On /Off from single or	06

		multiple positions using fixed switches. (ii) On /Off using infrared remote controller. (iii) On /Off / dimming from fixed switch position. (iv) Multiple lighting scene control using infrared remote controller. b) Automatic Control- (i) Time switch (ii) Occupancy sensors (iii) Daylight sensor (iv) Dimming (v) Reduced voltage 3.7 a) Control circuits for lamps : single lamp controlled by single switch, two switches. b) Single Lamp control by two point method, three point method & four point method.	
4. Design of Illumination Scheme for Interior Application.	4a. State standards of interior illumination. 4b. Select lux level required for every working plane as per application 4c. Describe the methods of designing illumination scheme. 4d. Design illumination scheme for Residential, Commercial, Industrial unit.	4.1 Standards for various situations of Interior Illumination. 4.2 Methods for Designing Illumination schemes 4.3 Design Techniques. 4.4 Design considerations for Interior location of Residential, Commercial, Industrial premises. 4.5 Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit. a. Commercial- Lighting Layouts, Lighting requirements for shop interiors, illumination level required for shop/mall. b. Residential- Illumination level required for different areas of home, numerical based on its design. c. Industrial- -Factors Of Good Lighting- i. Adequate quantity of illumination, ii. Good quality of illumination -General Considerations of design for lighting	12
5. Design Of Illumination	5a. State general and specific requirement of	5.1 General Requirements For Lighting Schemes 5.2 Specific Requirements For Above	08

Scheme for Outdoor Installation	outdoor lighting scheme. 5b. Design of simple Illumination scheme. 5c. Locate specific mountings of lighting sources for outdoor applications.	Schemes. 5.3 Outdoor factory Lighting- I. General Lighting Requirements and types of installation- a) General lighting b) Local lighting c) Emergency lighting d) Industrial lighting fittings- i. Standard reflector ii. Diffusing fitting iii. Concentrating reflectors iv. Enclosed diffusing fittings v. Angle reflectors II. Recommended Values For Illuminance. III. Lighting Design methods- numerical on point to point method. 5.4 Street Lighting- a. Main objects of street lighting. b. Road classifications according to BIS, Pole Arrangement. c. Terminology related to street and street lighting d. Types of fixtures used and their suitable application. e. Lamp and Luminaries selection, illumination level for street lighting and mounting height of lamps. f. Different Design Procedures, Beam Lumen Method, Point by Point Method, Numerical Based On Point by Point Method. 5.5 Design Problems On Simple Illumination Scheme	
6. Lighting For Special Applications	6a. State the requirement of special lighting application. 6b. Describe special lighting schemes for health care center / hospitals and metro rail platform. 6c. Select recommended luminaries for hospital.	Lighting schemes and general requirements for, 6.1 Health care center /hospitals- a) i. Lighting of patient rooms- ▪ Lighting for the general wards. ▪ Maternity department ii. Lighting Of special rooms- Operation theatre b) Recommended Illumination values and glare index for different areas in a hospital according to IS 3646(Part 1) 6.2 Special purpose lamps used in photography, video films, sports	06

	6d. Describe luminaries required for special purpose.	lighting indoor and outdoor games. Lumen per watt for special purpose lamp. 6.3 Metro railway platform lighting- Types of luminaries required for Metro platform lighting, recommended level of illumination, watt per lumen for luminaries used for platform lighting of Metro railway	
Total			48

**A.
HEORY :**

❖ **LIST OF PRACTICALS / LABORATORY EXPERIENCES/ASSIGNMENTS:**

Practical	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	Measure Illumination level by lux meter.	Fundamentals of Illumination.	02
2	Calculate and compare luminous efficiency of incandescent and compact fluorescent lamp.	Lamps and Lighting Accessories	02
3	Compare performance of magnetic and electronic ballast with respect to energy saving		02
4	Prepare a report of luminaries available in the market & collect the technical data		04
5	Evaluate performance of 40 watt incandescent lamp, 8-12 watt CFL and 6-7 watt LED lamp		02
6	Measure illumination received exactly underneath 18 watt CFL lamp and when surface is moved horizontally using laws of illumination.	Fundamentals of Illumination	02
7	Design illumination scheme for any one of the following. (A) Mall (B) Cloth shop (C) Restaurant (D) Showroom. and Draw installation Plan	Design of Illumination Scheme for interior Application	06
8	Design an illumination scheme for a medium size workshop and Draw installation Plan	Design of Illumination Scheme for Outdoor Installation	06
9	Visit to metro rail station and design an illumination scheme. Prepare a detailed report.	Lighting for special Applications	06
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Fundamentals of Illumination.	00(02)	06(03)	06(03)	12(08)
2	Lamps and Lighting Accessories .	02(02)	03(03)	06(00)	11(05)
3	Illumination Control and Control Circuits .	02(00)	06(03)	00(00)	08(03)
4	Design Of Illumination Scheme for interior Application	04(00)	03(00)	03(00)	10(00)
5	Design Of Illumination Scheme for Outdoor Installation .	04(00)	06(06)	00(03)	10(09)
6	Lighting For special Applications	00(02)	03(03)	06(06)	09(11)
	Total	12(06)	27(18)	21(12)	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	2	R	2	3	R	2	4	R	2	4	R	2	6/9
	5	R	2	6	R	2	5	R	2										
2	1	U	3	1	U	3	2	U	3	3	U	3	3	U	3				3/5
3	1	U	3	2	U	3	3	U	3	5	U	3	5	U	3				3/5
4	4	U	3	5	U	3	5	U	3	6	U	3	6	U	3				3/5
5	1	A	3	6	A	3	4	A	3	5	A	3	6	A	3				3/5
6	1	A	6	2	A	6	6	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:**

	Description	Max. Marks
1	Drawing circuit diagram, selection of equipment, writing procedure etc.	10
2	Performance (i.e. assembling, dismantling, testing & fault finding)	20
3	Skills and Results	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	8	9	10	1	2
1	-	3	-	-	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-
3	-	3	-	-	-	-	-	-	-	-	-	-
4	-	3	2	2	-	-	2	2	2	2	-	2
5	-	3	2	2	-	-	2	2	2	2	-	2
6	-	3	2	2	-	-	2	2	2	2	1	2

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

❖ **REFERENCE & TEXTBOOKS:**

S. N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Applied Illumination Engineering	Jack L. Lindsey, Publisher: Fairmont Pr; 2nd edition, November, 1996	10:0881732125 13:978-0881732122
2	Lighting Engineering: Applied calculations	R.H. Simons, Robert Bean	0750650516
3	Handbook of Applied photometry	Casimer M. Decusatis	1563964163
4	Illuminating Engineering	Kamlesh Roy Publisher: Laxmi Publication, 2006	9789380386553
5	Electrical Estimating and costing	Surjitsingh, Dhanpat Rai & co., 2011 Edition.	13-1234567150995
6	Electrical Design Estimating and Costing	K.B. Raina and Dr. S.K.Bhattacharya New Age International Ltd., First Edition:1991Reprint:2011	81-224-0363-8 978-81-224-0363-3
7	National Lighting Code 2010, SP: 72 -2010	Bureau Of Indian Standards, New Delhi, 2010	-

❖ **E-REFERENCES:**

- http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Illumination%20Engg/New_index1.html accessed on 24 Jun 2021
- <http://nptel.ac.in/courses/108105060/> accessed on 24 Jun 2021
- <https://www.youtube.com/watch?v=fQrZMMWo1mA> accessed on 27 Jun 2021.
- <http://www.learnerstv.com/video/Free-video-Lecture-5780-Engineering.htm>, accessed on 27 Jun2021.
- <http://personal.cityu.edu.hk/~bsapplec/basic.htm> on 27 Jun2021.
- <http://www.boles.de/teaching/mm/pages/light-fundamentals.html> on 27 Jun2016.
- <http://www.electrical4u.com/road-lighting-design/22/07/2016>
- https://www.youtube.com/watch?v=WzSsWpK_3xA27/7/2016
- <http://www.myopencourses.com/subject/illumination-engineering-127/7/2021>
- <http://freevidelectures.com/Course/2344/Illumination-Engineering27/7/2021>
- <http://electrical-engineering-portal.com/7-key-steps-in-lighting-design-process>, accessed on19/9/2021
- <https://law.resource.org/pub/in/bis/S05/is.sp.72.2010.pdf> accessed on 22/9/2021
- <https://www.youtube.com/watch?v=fQrZMMWo1mA>, accessed on 23/9/2021.
- <https://www.youtube.com/watch?v=FjdQoBO22vk>, accessed on23/9/2021.
- <https://www.youtube.com/watch?v=WUxwNUdGycI>, accessed on23/9/2021.
- <https://www.youtube.com/watch?v=mB573i9S39A>, accessed on23/9/2021

- <https://www.youtube.com/watch?v=SFXxjeitsCI>, accessed on 23/9/2021.
- <https://www.youtube.com/watch?v=cAE7st7DiOo>, accessed on 23/9/2021
- [http://www.lutron.com/en-US/Education - training/Pages/LCE/GreenBenefits.aspx](http://www.lutron.com/en-US/Education-training/Pages/LCE/GreenBenefits.aspx), accessed on 26/9/2021
- www.lightinglab.fi/IEAAnnex45/guidebook/6_lighting%20control.pdf, accessed on 26/9/2021

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

1. Lux meter- Display: 3-1/2 digit 18mm LCD, Ranges: 0 - 50,000 Lux.3 ranges, Sampling rate: 0.4second, Operating Temperature: 0 ~ 50 °C (32 ~ 122 °F), Accuracy: ±5%.
2. Various types of ballasts
3. Various types of lamps
4. Lighting accessories
5. Lighting fixtures.
6. Lighting control gears.

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

S.N	Name	Designation	Institute / Industry
1	Dr.M.B.Daigavane	Principal	Government Polytechnic, Nagpur.
2	Shri.A.M.Arekar	I/C Head, Electrical Engineering	Government Polytechnic, Nagpur.
3	Shri.M.C.Musale	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
4	Mrs.A.A.Alegaaonkar	Lecturer in Electrical Engineering	Government Polytechnic, Nagpur.
5	Shri.M.N. Gawande	Lecturer in Electrical Engineering & CDC I/C.	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN ENGINEERING
COURSE CATEGORY:	PROJECT AND INTERNSHIP COURSE
COURSE CODE	: EE352G^{\$}
COURSE TITLE	: PROJECT
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 HR
PT. EXAM	: --

❖ **RATIONALE:**

The project work is to introduce final year students to professional engineering practices. In project work students are engaged in the analysis, synthesis and application of the courses covered in their studies and to undertake & tackle an independent problem related to Electrical Engineering. This course is very useful for understanding the higher level knowledge in the field of Electrical engineering.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify, analyze and define the problems in Electrical Engineering field.
2. Find different solutions to the problem by collecting data and select most appropriate solution using latest practices in Electrical Engineering.
3. Use and integrate knowledge of different courses and data collected to make simple design with the help of I.S.codes, Handbook, standard data book.
4. Perform project work independently as a leader as well as member of a team.
5. Assess the impact of the project on society.
6. Prepare and present project report.

❖ **COURSE DETAILS:****A. THEORY :**

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

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Practicals	Specific Learning Outcomes (Psychomotor Domain)	Units	Hrs.
1	1. Perform introductory Task - Form project batch of four-five students - Select project as per area of interest - Select topic / industrial problem / work by consulting the guide from following suggestive list 1. Energy Conservation 2. Energy Auditing 3. Renewable energy sources 4. Solar power generation 5. Industrial Automation 6. Transformer Protection 7. Line Protection 8. Microcontroller based Speed Control of machines by modern techniques 9. Air pollution, water pollution 10. Energy generation from wastage 11. Advanced technique for energy billing 12. Design and fabrication of transformer and Induction motor. 13. Ash controlling 14. Controlling of wastage of stem in Thermal power station 15. Working model of Hydro power station 16. Energy saving in Street lighting. 17. Power factor Improvement 18. Energy Theft 19. GSM based door opening system using password, Automatic Irrigation Water Controller System, Message Moving Display for Vehicles 20. SMS based vehicle Ignition controlling	1. Introductory task and Literature Survey	10

	system Topic any other than listed above can be selected with approval from guide. Perform Literature Survey • Refer various Periodicals, Journals, Books, • Internet literature related to project topic • Note down findings • Prepare database of collected literature on the • basis of title, area of work, methodology used, • type of work • Analyze industrial need • Prepare brief report		
2	Plan project • Prepare Synopsis in standard format which includes following. • Title Page: Project Title, Purpose of submission, • Institute logo, Students Name, Guide Name, • Department and Institute Name • Use Latex for preparing synopsis. • Submit the Synopsis to guide. • Approve synopsis from guide • Prepare action plan of project activities • Submit the action plan to guide. • Approve action plan from guide	2. Planning	10
3	Perform Project work • Presentation on 30% project work completion • Presentation on 60% project work completion	3. Project Work	15
4	Test Project work	4. Testing	15
5	Prepare project report in standard format, which includes following. • Title Page which includes: Project Title, Purpose of submission, Institute logo, Students Name, Guide Name, Department and Institute Name • Certificates: Student declaration, Certificate from guide • Acknowledgement • Table of contents • List of Tables • List of Figures • List of abbreviations and acronyms (if any) • Text	5. Project Writing	10

	1. Introduction, objectives 2. Literature Survey 3. Methodology/Materials/Methods/Estimate. 4. Results 5. Summary/Conclusion. 6. References Perform plagiarism check from free internet site. Submit report of plagiarism check to the guide with project report		
6	Present project work - Prepare power point presentation of work done. - Prepare yourself to handle examiner questions after presentation. - Practice group presentation. - Present before guide.	6. Presentation	4
Total Hrs			64

C. Project Report:

Students will prepare a “Project Report” with following contents

- Title page (with the name of team members and mentor teacher)
- Certificate
- Acknowledgements
- Abstract
- Content page

Chapters

- Chapter:1 Introduction
- Chapter:2 Literature Survey
- Chapter:3 Scope of the project
- Chapter:4 Methodology
- Chapter:5 Details of designs, working and processes
- Chapter6: Results and applications
- Chapter:7 Conclusions and future scope
- Appendix (if any)
- References and Bibliography

Note: The report should contain diagrams, figures and charts etc as relevant for the project.

❖ **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)	--	--	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	100	--	Project Diary, Notes, Model, Assembly	1, 2, 3,4,5,6
		Journal Writing		Assignments	--	--	Journal	1, 2, 3,4,5,6
				Total	100	40		
	TEE (Term End Examination)	End Exam	Students	End of the Course	100	40	Project Report, Model, Assembly	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	Identification of Topic	10
2	Punctuality and overall contribution	
3	Project Diary	
4	Execution of Project Work	20
5	Project Report including documentation	20
6	Presentation	20
7	Question and Answer	30
	TOTAL	100

❖ **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	-	-
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	-	-

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	Practical electrical project engineering	L. B. Roe McGraw-Hill, first edition 1978	9780070533929
2	Sensors and Transducers	Patranabis D Prentice-Hall of India Pvt.Ltd, second edition,2004	9788120321984
3	Principles of industrial instrumentation	Patranabis D, McGraw- Hill , Third edition 2010,	9780070699717
4	PCB Design &Technology	W.C.Bosshart Tata McHill,1984	0074515497

5	PCB Design Software user manual	Myer Kutz, McGraw- Hill	0-07-141041-4
6	Data manuals from different manufacturers	Data Manual	0521202728
7	Hand books on PCB design	Coombs' Printed Circuits Handbook (McGraw-Hill Handbooks)	0071350160
8	Journals On Electrical & Electronics field	Like Electrical India, IEEMA ,Electrical engineering Updates, Elektor, Electronics for you , Electronic product finder	0972-3277.
9	Energy Management and Conservation Handbook,	Frank Kreith, D. Yogi Goswami CRC Press, Second Edition September 1, 2016	9781466585164

❖ E-REFERENCES:

- <http://www.electronicshub.org/electronics-projects-ideas/> , accessed on 28th January 2022
- <http://www.electronicshub.org/solar-energy-projects-ideas/> / accessed on 28th January 2022
- <https://www.elprocus.com/electrical-project-ideas-for-engineering-students/> , accessed on 28th January 2022
- <https://nevonprojects.com/engineering-projects-2/electrical-engineering-projects/> , accessed on 28th January 2022
- <https://nevonprojects.com/project-ideas/electrical-project-ideas/> , accessed on 28th January 2022
- https://www.finalyearproject.co.in/Diploma_EEE_titles.php , accessed on 28th January 2022

❖ LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:-

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Appendix

Suggestive Project Diary Format

Week No.:
Activities Planned:
Activities Executed:
Reason for delay if any
Corrective measures adopted
Remark and signature of the Guide

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

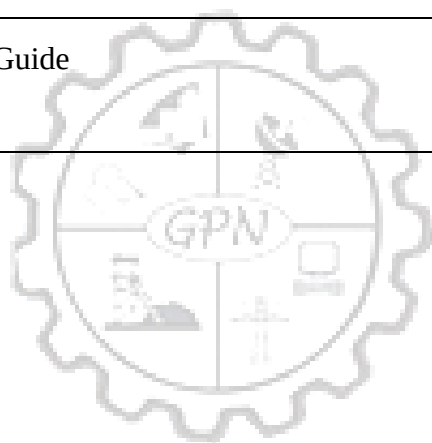
S.N.	Name	Designation	Institute / Industry
1	Prof.A.M.Arekar	Chairman ,PBOS &, HOD Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Prof.Mrs A.A. Alegaonkar	CDC Coordinator & Lecturer , Electrical Engg. Deptt.	Government Polytechnic, Nagpur
3	Prof. M.C.Musale	Expert &Lecturer in Electrical Engg.Deptt	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.N.J.Suryawanshi	Expert &Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
7	Prof. Mrs.P.M.Sonwane	Expert &Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur
8	Prof. Ms. P. S. Rithe	Expert &Lecturer in Electrical Engg.Deptt	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

Appendix
Suggestive Project Diary Format

Week No.:
Activities Planned:
Activities Executed:
Reason for delay if any
Corrective measures adopted
Remark and signature of the Guide



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 ELECTRICAL ENGINEERING
COURSE CATEGORY	: PROGRAMME CORE COURSE
COURSE CODE	: EE 351G
COURSE TITLE	: ELECTRICAL SOFTWARE & COMPUTER AIDED DRAWING
TEACHING SCHEME	: TH:00;TU:00;PR:04 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1TH/TU CREDIT =1 CLOCK HR., 1 PR CREDIT =2 CLOCK HR.)
TH. TEE EXAM	: -
PR. TEE EXAM	: 02 HRs
PT. EXAM	: -

❖RATIONALE:

The computer softwares become the essential part of world to keep pace with growing technology and demand for the timely product design. Electrical software & Computer aided drawing software allow engineer to increase productivity, improves the quality of the drawing, saves time and easier for documentation. Objective of this course is to provide practice in freehand sketching of electrical drawing, use computer based software to draw working electrical & electronics drawing. This course also provides practice to read and interpret working electrical engineering drawings.

❖COURSE OUTCOMES:

After completing this course students will–

1. Draw symbolic representation of electrical & electronics components manually.
2. Draw free hand sketches, of electrical machines and components.
3. Use CAD Tools to draw simple electrical components, machine, electrical line diagrams and control panel layouts and create electrical circuits in CAD.
4. Develop create and execute simple MATLAB program using MATLAB program
5. Simulink Electrical and Electronics circuits using MATLAB software.
6. Design simple electrical and electronics circuit using Simulink. Use simulation software like PSIM.

❖ **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.
	Using Manual Drawing Tools	Introduction	
1	Draw different electrical (including electronics) symbols using drawing instruments as per IS: 1032 or new equivalent IS*.		04
2	Draw the free hand drawing of electrical machine parts * and draw the free hand drawing of electrical components.		04
Using CAD Software			
3	Locate components of CAD classic screen by creating new drawings CAD Screen layout, drawing area, menu and toolbar, status bar*.	Drawing	02
4	Work with toolbar and commands* using CAD software.		02
5	Draw a line diagram using absolute coordinate method use LIMITS, UNITS, LINE, ARC Commands: Absolute coordinate method*.		04
6	Drafting set up:: units, angle, area, coordinate system, limits, grid, object snap*.		02
7	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET commands.		04
8	Modify two dimensional drawings using modify commands-copy, mirror, trim, rotate, chamfer.		02
9	Draw the layout of the 11KV/400V distribution substation using electrical CAD software.		02
Using MATLAB Software			
10	Install MATLAB software at computer.& Explore the MATLAB working environment like –various windows, creating new file and opening and saving new file	Introduction to MATLAB	04

11	• Create a One Dimensional Array • Create a Two Dimensional Array • The Transpose operator • Array Addressing-Vector and Matrix • Use a Colon in Addressing Arrays • Add elements to Existing Variables & • Delete Elements Develop a MATLAB program to solve electrical network • Use Mathematical Operations with Arrays • Define two vectors • Define two 2x3 matrices A and B • Subtracting matrix B from matrix A • Define a matrix C that is equal to A+ B • Build in function for Handling Arrays	Develop MATLAB program	04
12	Create a virtual Sine Wave with amplitude & frequency variation • Set up the Sine Wave block to use the sin() math library function to calculate block output. • Use Sine Wave block dialog box, set Time to Use external signal so that an input port appears on the block icon. • Connect a clock signal to this input port using a Digital Clock block. • Set the sample time of the clock signal to the sample time of the Sine Wave block.	Simulink	04
13	Simulate R-L-C circuit using MATLAB Software • Open the circuit simulator and create a blank circuit. • Use simulink library. • Use simpower system. • Select AC sources. • Build the circuit after placing and connecting all the components. • Run Simulation. • Open an oscilloscope window, View scope. • Check “Show Current” to plot current vs. time. • Save the circuit, as plain text (.txt)	Simulink	04
14	Simulate motor drives using MATLAB Software. • Simulate the simple induction motor drive. • Get the AC4 Model from the Electric Drives Library system. • Connect AC4 Model to a Voltage Source. • Connect AC4 Model to a Mechanical Load • Build Example Circuit. • Define Set Point. • Observe Simulation Results		04
15	Simulate Half Wave rectifier • Take suitable power electronics switching device from library along with ac voltage source. • Construct half wave bridge circuit • Develop gate pulse according to switching pattern. • Connect R-L load • Observe waveform.	Simulink	04

16	Simulate Full Wave rectifier • Take suitable power electronics switching device from library along with ac voltage source. • Construct full wave bridge circuit • Develop gate pulse according to switching pattern. • Connect R-L load • Observe full wave rectified voltage & current.	Simulink	06
17	Simulate power system component using power system tools in PSIM or PSCAD • Study the various elements used in Power system. • Take the reference from help browser. • Try different power system circuit diagrams.	PSIM or PSCAD	04
18	Draw one quadrant chopper operation using PSIM Software. • Take suitable switching devices, preferably MOSFET or IGBT. • Take suitable DC source, and load. • Draw one quadrant chopper circuit. • Simulate to observe the output dc voltage as positive. along with positive current flowing through load.	PSIM	04
Total Hrs			64

❖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		Assign-ments		--	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		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	Free hand sketch	10
2	Drawing work/skill	20
3	Printout layout aesthetic	10
4	Viva Voce	10
	TOTAL	50

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

Course Outcomes (COs)	POs							PSOs	
	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
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	Electrical Engineering Drawing	S.K.Bhattacharya, New Age International Publishers, Reprint, 2005.	81-224-0885-9
2	Engineering Drawing Practice for Schools & Colleges-SP- 46:1988	Bureau Of Indian Standards, Reprint, 1998.	81-7061-091-2
3	Computer Aided Electrical Drawing	M. Yogesh, B. S. Nagaraja, N. Nandan, PHI Learning; 1 st Edition, 2014	978-81-203-4953-7

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=bowpbOReHMs>, accessed on 23 Feb 2022
- <https://www.edrawsoft.com/wiringdiagram.php>, accessed on 23 Feb 2022
- <https://www.edrawsoft.com/floorplan.php>, accessed on 23 Feb 2022

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

- 1.Computers Latest vesrsion
- 2.CAD Software
- 3.MATLAB with SIMULINK
- 4.PSIM

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

S.N.	Nam	Designation	Institute/ Industry
1	Prof.A.M.Arekar	I/C, Head of Electrical Engineering	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	I/C, Head of Electrical Engineering G.P.Gondia	MSBTE Nominee
3	Mr.M.N.Gawande	Lecturer in Electrical Engineering, G.P.Nagpur	CDC In-charge (Member Secretary
4	Mrs.A.A.Alegaonkar	Lecturer in Electrical Engineering, G.P.Nagpur	CDC Coordinator Member (Internal)
5	Ms.A.P. Gandhi	Lecturer in Electrical Engineering G.P.Nagpur	Member (Internal)
6	Prof.N.J.Suryawanshi	Lecturer in Electrical Engineering	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 CLOCK HR.)

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
5	Elaborate industrial problems - Discuss with the supervisor and workers - Identify the problem in any of the industrial process/system - Record your findings	Problem Identification	90
6	Compile, prepare and present report on activities carried out. Prepare industrial training report in standard format, which includes following. - Title Page which includes: Title, Purpose of submission, Institute logo, Students Name, Industry Name, Department and Institute Name - Certificates: Student declaration, Certificate from industry - Acknowledgement - Text 1. Introduction to Industry 2. Safety Practices in Industry 3. Industrial Process 4. Working Experience 5. Results 6. Summary/Conclusion. 7. References Use Latex for preparing report. Perform plagiarism check from free internet site. - Submit report of plagiarism check to the allotted teacher with industrial training report - Prepare Power Point presentation - Present before panel of teachers	Report Writing and Presentation	60
Total Hrs.			480

❖ **SPECIFICATION TABLE FOR THEORY PAPER:** Not Applicable

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:** Not Applicable

❖ **ASSESSMENT AND EVALUATION SCHEME:**

☐	What		To Whom	Frequency	Max Marks	Min Marks	Evidence Collected	Course Outcomes
Direct Assessment Theory	CA (Continuous)	Progressive Test (PT)	Students	Two PT (average of two tests will be computed)	--	--	--	--
		Assignments		Continuous	--	--	--	--
	TEE (Term End)	End Exam	Students	End of the Course	--	--	--	--
				Total	--	--	--	--
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every week	40	--	Rubrics, Assessment 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 & Presentation	1,2,3,4,5,6
				Total	100	40		
	TEE	End Exam	Students	End of the Course	100	40	Rubrics, Report & Presentation	1, 2, 3, 4,5,6
Indirect Assessment	Student Feedback on course		Students	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)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/ME/CE/EE/PK/MT/TX/IT/CM/ MC/AI/EC/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE201G
COURSE TITLE	: INDUSTRY 4.0**
TEACHING SCHEME	: TH:02; TU: 00; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: ---
PT. EXAM	: 20 Min (Objective Type)

❖ **RATIONALE:**

The course is designed for students to cover the concepts of Industry 4.0 is a novel paradigm for industrial production in which digitization plays a fundamental role. The world is at the onset of the Industrial Revolution and this revolution is very much driven by the smarts in automating decision making and processes. Advancements in IT has resulted in immense improvements in computational power across nearly all electronic devices and enhanced capabilities in connecting the dots in an increasingly networked society. This course provides a comprehensive coverage on, among others, the role of data, manufacturing systems, various Industry 4.0 technologies, applications and case studies.

❖ **COURSE OUTCOMES:**

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

1. Identify the phases for implementing core idea of Industry 4.0
2. Select Proposed Framework for Industry 4.0. based on IoT
3. Apply Proposed Framework for Technology Roadmap used in Harnessing and sharing knowledge in organizations.
4. Select cases studies of Industry 4.0 and Identify the opportunities, challenges brought about by Industry 4.0

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction to Industry 4.0	1a. Select various Industrial Revolution in the context of Industry 4.0. 1b. Identify the change India is prepared for Industry 4.0 on the given data 1c. Identify Need and challenges of Industry 4.0 on the basis of given points. 1d. Compare Industry 4.0 factory with present factory on the basis of given points. 1e. Identify how Predictive analysis helps many industries to manage resources based on the given data.	1.1 The Various Industrial Revolutions, Core idea of Industry 4.0 • What is Industry 4.0? • Technologies that Drive Industry 4.0 • Challenges for Industry 4.0 1.2 How is India preparing for Industry 4.0 Digitalization and the Networked Economy 1.3 Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 1.4 Comparison of Industry 4.0 Factory and Present Factory, • Quality 4.0 • Supply Chain 4.0 1.5 Predictive Analytics for Smart Business Transformation • Maintenance 4.0 • Maturity Models for Industry 4.0	08
2. Road to Industry 4.0	2a. Identify the concept of Smart Devices, Products, Smart Logistics and Smart Cities on the given points. 2b. Analyze the concept for Proposed Framework for Industry 4.0 on the basis of given points. 2c. Differentiate technologies of Industry 4.0 and their global forerunners on the basis of given points.	2.1 Smart Manufacturing, Smart Devices and Products, Smart Logistics and Smart Cities • Industrial Control Systems and IIoT • Automation & Software Technologies 2.2 Proposed Framework for Industry 4.0. Four components of Industry 4.0 • Instrumented • Interconnected • Inclusive • Intelligent 2.3 Technologies for enabling Industry 4.0 • IoT • Big data/Industrial Analytics • Cloud Manufacturing • Robotics	06

		• Artificial Intelligence (AI) • Additive Manufacturing	
3. Technology Roadmap for Industry 4.0 And Role of Data, Information , Knowledge and Collaboration in Future Organizations	3a. Identify framework for Technology Roadmap for Industry 4.0 on the basis of given points. 3b. Differentiate Collaborative robots and Universal Robots w.r.t components. 3c. Select the Support System for Industry 4.0 from the given points. 3d. Analyze the concept of Harnessing and sharing knowledge in organizations on the given data.	3.1 Proposed Framework for Technology Roadmap, Strategy Phase • Internal IT roadmap • DevOps roadmap • Infrastructure roadmap • Architecture Roadmap • Software Roadmap • Internal Systems Roadmap • Hardware Procurement Roadmap 3.2 Robotic Automation and Collaborative Robots, Recent Technological Components of Robots (5 important components) • Manipulators • End Effectors • Feedback Devices • Controllers • Locomotive Devices 3.3 Decision Support System for Industry 4.0, Resource-based view of a firm:-Using Microsoft Power BI to implement a decision support system - a Business Intelligence solution data as a new resource for organizations, Harnessing and sharing knowledge in organizations	10
4. Business Issues in Industry 4.0, Case Studies and Augmented Reality in The Age of Industry 4.0	4a. Identify key Opportunities and Challenges in business Industry 4.0 on the given points. 4b. Identify the Skill Key areas for workers in the Industry 4.0 on the basis of given data. 4c. Identify strategies for manufacturing companies to transition to Industry from the given data. 4d. Select the Case studies based on IIoT from the given data. 4e. Identify the Industrial Applications of AR	4.1 Opportunities and Challenges Opportunities • Real-time data • Advanced maintenance and monitoring possibilities • Real-time monitoring, IoT-enabled quality improvement and cobots (collaborative robots) • Superior sustainability and better working conditions • Earn the trust and loyalty the modern consumer with personalization opportunities Challenges • A Gap in Technical Skills • Data Sensitivity • Interoperability • Security • Handling Data Growth	08

	based on the given technology. 4f. Identify the limitation of Industry 4.0 on the basis of given points.	4.2 Future of Works and Skills for Workers in the Industry 4.0 Era 4.3 Strategies for competing in an Industry 4.0 world Types of Competitive Strategy • Cost Leadership • Product differentiation • Customer Relationship Management (CRM) • Cost Focus • Commitment to Customers Strategy 4.4 IIoT case studies • Carnival Corp's Ocean Medallion • Schwering & Hasse's Quality Manufacturing • Samsung and Hipaax's TaskWatch Solution • Caterpillar's Asset Intelligence Platform • Bosch's Nexeed Track and Trace 4.5 AR Hardware and Software Technology, Industrial Applications of AR 4.6 Limitations of Industry 4.0	
		Total	32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Industry 4.0	01(00)	02(00)	02(00)	05(00)
2	Road to Industry 4.0	01(00)	02(00)	03(01)	06(01)
3	Technology Roadmap for Industry 4.0 and Role of data, information, knowledge and collaboration in future organizations	02(00)	02(01)	05(01)	09(02)
4	Business issues in Industry 4.0, Case Studies and Augmented Reality in the Age of Industry 4.0	02(00)	03(01)	05(01)	10(02)
	Total	06(00)	09(02)	15(03)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	A	1	1	U	1	1	U	1	4	A	1	30/35
	2	R	1	2	U	1	2	U	1	2	A	1	2	A	1	
	2	A	1	2	A	1	3	R	1	3	R	1	3	U	1	
	3	U	1	3	U	1	3	A	1	4	R	1	4	R	1	
	4	U	1	4	U	1	4	U	1	4	U	1	4	A	1	
	4	A	1	4	A	1	4	A	1	4	A	1	1	A	1	
	3	A	1	3	A	1	3	A	1	3	A	1	3	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO
	1	2	3	4	5	6	7	1	2	3
1	3	3	-	-	-	-	3	-	-	-
2	3	-	-	-	-	-	3	-	-	-
3	3	-	-	-	-	-	3	-	-	-
4	3	3	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-

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	Managing Transformation- Objectives to Outcomes	J.Satyanarayana, Prentice Hall, India	13:9788120345379
2	The State, IT and Development.	Kenneth Kenniston, R K Bagga and Rohit Raj Mathur Sage Publications India Pvt. Ltd.	9780761933991
3	e-Government – The Science of the Possible	J.Satyanarayana, Prentice Hall, India	13:9780134195728

❖ **E-REFERENCES:**

- <http://www.csi-sigegov.org/publications.php> accessed on 22/07/2022
- <https://negd.gov.in> accessed on 03/08/2022
- <https://www.nisg.org/case-studies-on-e-governance-in-india> accessed on 04/08/2022

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

1. Computer System with Latest Configuration
2. Internet connectivity
3. Applications developed for accessing different e-governance projects.

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.V.Sarode	Head of Department (Computer Engg.Dept.)	Government Polytechnic Nagpur
2	Mr.M.A.Rahman	Lecturer in Computer Engineering	Government Polytechnic Nagpur
3	Mr.A.A.Uike	Lecturer in Computer Engineering	Government Polytechnic Nagpur
4	Mr.P.S.Thakre	Lecturer in Computer Engineering	Government Polytechnic Nagpur
5	Mr. Dipak Dhote	Operations Manager,	IT-Network Infosystems Pvt LTD, Nagpur
6	Dr.Rakesh Kadu	Assistant Professor, I.T.	Ramdeobaba College of Engg, and Management, Nagpur.
7	Mrs.V.A.Raje	System Analyst	MSBTE,RO Nagpur

 (Member Secretary PBOS)

 (Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/ME/CE/EE/PK/MT/TX/IT/CM/MC/ AI/EC/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE203G
COURSE TITLE	: INTRODUCTION TO E-GOVERNANCE**
TEACHING SCHEME	: TH:02; TU: 00; PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: ---
PT. EXAM	: 20 Min (Objective Type)

❖ **RATIONALE:**

The course is designed for students to cover the concepts of e-Governance and to understand how technologies and business models shape the contours of government for improving citizen services and bringing in transparency.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify the concepts, terminology and technology of e-government.
2. Develop environment for promoting Digital System Infrastructure and National Data Warehouses.
3. Apply the knowledge of Cyber Laws and security.
4. Use Architecture and models of e-governance for innovation and change management.
5. Identify Challenges and Approach of E-government Security.
6. Analyze using available tools the given case studies of e-governance.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to E-Governance	1a. Identify Need of E-Governance from the given points. 1b. Identify the factors for global trends of growth in E-Governance from the given points. 1c. Analyze the model of Digital Governance from the given data. 1d. Select the Maturity Models of E-Governance from the given points.	1.1 Needs of E-Governance, Issues in E-Governance applications and the Digital Divide; Evolution of E-Governance, its scope and content 1.2 Present global trends of growth in E-Governance and related issues. 1.3 Models of E-Governance: Introduction; Model of Digital Governance: Broadcasting/ Wilder Dissemination Model, Critical Flow Model, Comparative Analysis Model, Mobilization and Lobbying Model, Interactive-service Model/Government-to-Citizen-to-Government Model (G2C2G) 1.4 Evolution in E-Governance and Maturity Models: Five Maturity Levels, Characteristics of Maturity Levels, Difference between E-governance and E-government	06
2. E-Governance Infrastructure and Strategies	2a. Differentiate between Digital system and Traditional system on the basis of given points. 2b. Choose the concepts of National Data Warehouses with Data Warehousing and Data Mining from the given points.	2.1 E-readiness, Digital System Infrastructure, Legal Infrastructure, Preparedness, Institutional Infrastructure, Preparedness, Human Infrastructure, Preparedness, Technological Infrastructure, Preparedness System Calls-Concept, types of system calls. 2.2 Introduction to National Data Warehouses: Census Data, Prices of Essential Commodities; Other areas for Data Warehousing and Data Mining..	05
3. Cyber Security in E-Governance	3a. Select threats and Assessing damages in cyber security based on given characteristics. 3b. Identify the need of Security in Mobile	3.1 Cyber Security: Information System Threats and attacks, Classification of Threats and Assessing Damages . 3.2 E-Government key Security Challenges (Network Security, Identification, Access Control,	05

	and Wireless computing based on given data. 3c. Analyze the security framework for given organization on the given points. 3d. Identify the need of security metrics on the basis of given points.	Usability), 3.3 Security Implication key Organizations, Laptops Security Framework for Information Security. 3.4 Security Metrics Information Security Vs Privacy, Basic Principles of Information Security, Confidentiality, integrity Availability in Information Security, information Classification and their Roles	
4. Architecture and Models of e-governance	4a. Select the PPP Architecture of e-governance Model from the given points. 4b. Identify the need for innovation and change management in e-governance. 4c. Identify the issues related with corruption in e-governance.	4.1 Architecture and models of e-governance i.e. The Broadcasting Model, Critical Flow Model including Public Private Partnership (PPP).. 4.2 Need for innovation and change management in e-governance 4.3 Major issues including corruption in e-governance .	04
5. Digital India and Security for e-Government	5a. Identify various key vision areas of Digital India. 5b. Analyze the concept of nine pillars of Digital India. 5c. Determine the strategies to create own Digital Lockers and e-sign. 5d. Identify the Security Management Model based on the Security Standards.	5.1 Digital India : the Umbrella Programme, Key Vision Areas, Participation in digital & financial space through mobiles and Banking . 5.2 Nine pillars of Digital India, e-Governance related Policies, Digital Lockers and e-Sign 5.3 Challenges and Approach of E-government Security. 5.4 Security Management Model	06
6. Case Studies in e-Governance	6a. Analyze different Laws of e-Governance in the Indian Context. 6b. Select case studies in e-governance based on Services provided by NIC. 6c. Identify the Role of NIC center of the	6.1 Indian Context: Cyber Laws, Implementation in the Land Reform, Human Resource Management Software. 6.2 NIC-NET, Collectorate, Computer-aided Administration of Registration Department (CARD), Smart Nagarpalika, National Reservoir Level and Capacity Monitoring System,	06

	district from the given.	Computerization in Maharashtra, Ekal Seva Kendra, Sachivalaya Vahini, Bhoomi, IT in Judiciary, E-Khazana, Directorate General of Foreign Trade (DGFT), PRAJA, E-Seva, E-Panchyat. 6.3 General Information Services of National Informatics Centre (NIC).	
		Total Hrs	32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to E-Governance	02(00)	02(00)	00(00)	04(00)
2	E-Governance Infrastructure and Strategies	01(00)	02(00)	02(01)	05(01)
3	Cyber Security in E-Governance	01(00)	01(00)	04(01)	06(01)
4	Architecture and models of e-governance	00(00)	02(01)	03(00)	05(01)
5	Digital India and Security for e-Government	01(00)	02(00)	03(01)	06(01)
6	Case Studies in e-governance	01(00)	00(01)	03(00)	04(01)
	Total	06(00)	09(02)	15(03)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	R	1	1	U	1	1	U	1	2	R	1	30/35
	2	U	1	2	U	1	2	A	1	2	A	1	2	A	1	
	3	R	1	3	U	1	3	A	1	3	A	1	3	A	1	
	3	A	1	3	A	1	4	U	1	4	U	1	4	U	1	
	4	A	1	4	A	1	4	A	1	5	R	1	5	A	1	
	5	U	1	5	U	1	5	A	1	5	A	1	5	A	1	
	6	R	1	6	U	1	6	A	1	6	A	1	6	A	1	

❖ **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	--	--	Journal	
		Journal Writing		Assignments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO	PSO
	1	2	3	4	5	6	7	1	2	3
1	3	3	3	3	-	-	3	3	-	-
2	3	3	-	-	-	-	3	-	-	-
3	3	-	3	3	-	-	-	3	-	-
4	3	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	Managing Transformation-Objectives to Outcomes	J Satyanarayana, Prentice Hall, India	13:9788120345379
2	The state, IT and Development.	Kenneth Kenniston, R K Bagga and Rohit Raj Mathur Sage Publications India Pvt. Ltd.	9780761933991
3	e-Government – The Science of the Possible	J Satyanarayana, Prentice Hall, India	13:9780134195728

❖ **E-REFERENCES:**

- <https://www.csi-sigegov.org.in/publications.php> accessed on 22/06/2022
- <https://negd.gov.in> accessed on 27/07/2022
- <https://www.nisg.org> accessed on 03/08/2022

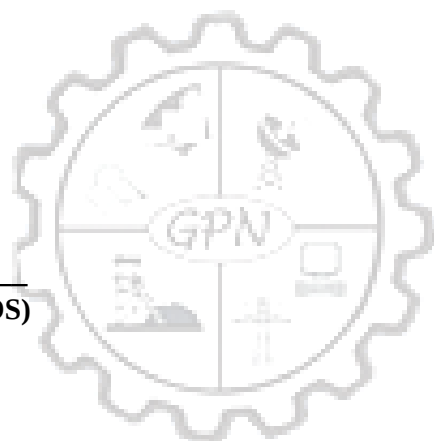
❖ **LIST OF MAJOR EQUIPMENTS/INSTRUMENTS WITH SPECIFICATION:**

NIL

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

S.N.	Name	Designation	Institute / Industry
1	Dr.M.V.Sarode	Head of Department (Computer Engg.Dept.)	Government Polytechnic Nagpur
2	Mr.M.A.Rahman	Lecturer in Computer Engineering	Government Polytechnic Nagpur
3	Mr.A.A.Uike	Lecturer in Computer Engineering	Government Polytechnic Nagpur
4	Mr.P.S.Thakre	Lecturer in Computer Engineering	Government Polytechnic Nagpur
5	Mr. Dipak Dhote	Operations Manager,	IT-Network Infosystems Pvt LTD, Nagpur
6	Dr. Rakesh Kadu	Assistant Professor, I.T.	Ramdeobaba College of Engg, and Management, Nagpur.
7	Mrs.V.A.Raje	System Analyst	MSBTE,RO Nagpur

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

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

COURSE CATEGORY: OPEN ELECTIVE COURSE

COURSE CODE : OE204G

COURSE TITLE : CYBER SECURITIES AND LAWS**

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

TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE EXAM : 01HR (Objective Type Online Examination)

PR. TEE EXAM : --

PT. EXAM : 20 MINUTES (Objective Type)

❖ RATIONALE:

The increase of internet use is leading towards the frauds/ illegal activities on the internet. It is need of time to understand the various cyber crimes and importance of Cyber Securities in order to protect personal, governmental, organisational property/ data/information systems. Also it is need to understand various cyber laws/ laws of internet, that are deals with crimes related to cyber space.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify different types of cyber organized crime.
2. Analyze the planning, risk events and concept of cyber attacks.
3. Identify the tools that used in cyber crimes.
4. Identify types of Cybercrimes related with mobile and wireless Devices.
5. Analyze the conceptual foundation of cyber security awareness.
6. Identify different laws and concepts of Cyber security .

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to Cyber Crime	1a. Choose the meaning of given term. 1b. Identify criminals, that are related with given cyber crimes. 1c. Identify a type of cybercrime done in given statements.	1.1 Cyber Crime: Definitions, An origin of the Word, cybercrime and information security, email bombing, mail bombs 1.2 Criminals in cybercrime, classification of cyber-crimes; cyber defamation, internet time theft 1.3 Hacking, online fraud, software piracy, 1.4 password sniffing, Identity theft	04
2. Planning of Cyber Attack	2a. Select type of cyber-attacks in given statement. 2b. Choose features of social engineering. from given statements. 2c. Select from given statements, that showing cyber stalking. 2d. Analyse given statements and Identify use of cloud computing in cybercrime.	2.1 Attacks: passive and active attacks, scamming/scrutinizing gathered information, attack access, Gaining/maintaining the system 2.2 Social engineering, classification of social engineering, 2.3 Cyber stalking: types of stalkers, stalking of cyber stalking, Real life incidents of cyber stalking, 2.4 Cloud computing: why cloud computing? types of services, cyber-crime and cloud computing..	06
3. Tools and Methods Used in Cyber Crime	3a. Analyse given statements and Identify role of proxy servers in cyber crimes. 3b. Identify strong passwords and weak passwords from given samples of password. 3c. Identify types of virus used for given cyber crimes. 3d. Identify used fishing method in given cyber crime.	3.1 Introduction proxy servers 3.2 Password cracking - online attacks, offline attacks, strong, weak and random password, random password, 3.3 Virus and worms, types of virus, Trojan horse and backdoors: backdoors, protection from Trojan horse, 3.4 Phishing –Definition, methods of phishing, types of phishing scams,	04

4. Cyber Crime: Mobile/Wireless Devices	4a. Identify technique used for given cyber crime. 4b. Select from given statements, that showing API security for mobile devices. 4c. Select from given statements that can be possibility of cybercrime for mobile devices. 4d. Identify measures for protecting data on lost devices from given statements.	4.1 Credit card/debit card fraud in mobile and wireless computing eratypes and technique of credit card fraud, 4.2 Mobile devices: Media player control security, networking API security for mobile devices 4.3 Applications and software :mobile viruses, Securities from mobile computing applications, hacking Bluetooth mobile devices, 4.4 A Threats through stolen devices, Protecting data on lost devices, device related security issues, organizational security policies and measures in mobile computing era.	06
5. Cyber Crimes and Need for Cyber-Security	5a. Analyze given statements and identify performed online cybercrime. 5b. Analyse given statements and select type of cybercrime related with given sector. 5c. Identify use of patents and trademarks from given statement. 5d. Analyze given statements and select importance/need of cyber laws from given options.	5.1 Online Scams: Charity scam, lottery Scam, Fake offer/fake job scam 5.2 Examples of cyber-crimes: Indian case of online gambling, banking related frauds 5.3 Intellectual Property in Cyber space, Patent copyright, trademark, domain name 5.4 The legal Scenario and perspectives - Introduction, cybercrime and the legal base for cybercrime around world, Importance and need cyber laws	06
6. Cyber Laws and Way Forward	6a. Analyze given statements and select feature relevant with IT Act 2000. 6b. Select from given options that denotes the various changes made in IT ACT. 6c. Identify challenges of Indian law and cybercrime in India, from given statements.	6.1 Cyber laws in INDIA:IT ACT-2000, Positive aspects of IT ACT 2000, Weak areas in IT ACT 2000 6.2 Amendments In cyber laws: changes made in IT ACT, state Government's power impacted by amendment in IT ACT 6.3 Challenges : challenges of Indian law and cyber-crime scenario in India, Information Technology ACT and its influence, digital signature and the Indian ACT,	06

	6d. Identify from given statements that denotes punishment for given Cybercrime.	6.4 Punishment: cybercrime and punishment, Information technology and students technology and students: An Indian Scenario	
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

	NIL		
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❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction	02(01)	02(00)	01(00)	05(01)
2	Planning of cyber Attack	01(00)	02(00)	02(01)	05(01)
3	Tools and methods used in Cyber crime	01(00)	01(00)	03(01)	05(01)
4	Cyber Crime: Mobile/wireless devices	01(00)	01(00)	03(01)	05(01)
5	Cybercrimes and need for Cyber-security	02(00)	01(00)	02(00)	05(00)
6	Cyber Laws and Way forward	01(00)	02(01)	02(00)	05(01)
	Total	08(01)	09(01)	13(03)	30(05)

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 R1 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 1 Marks

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

❖ **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	-	--	Journal	1, 2, 3,4,5,6
		Journal Writing		Assignments	-	--	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			

❖ **SCHEME OF PRACTICAL EVALUATION:**

	Nil	
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❖ **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	-	-	-
2	3	3	-	-	2	-	3	-	-	-
3	3	3	-	-	2	-	3	-	-	-
4	3	2	-	-	2	-	3	-	-	-
5	3	2	-	-	2	-	3	-	-	-
6	3	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	"Cyber Security" - Understanding Cybercrime, Computer forensic and legal perspective.	Nina Godbole, Sunil Belapure, Wiley India Pvt. Ltd Reprint, 2018	978-81-265-2179-1
2	"Cyber security Managing systems- Conducting, Testing and Investigating Intrusion",	Thomas J. Mowbray, Wiley India Pvt. Ltd Reprint, 2018	81-219-2440-5

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=KqSqyKwVuA8> accessed on 25th January 2022
- <https://www.youtube.com/watch?v=PIHnamdwGmw> accessed on 27th January 2022
- <https://www.youtube.com/watch?v=fQ3ESFfvchg&list=PLUtfVcbiqn834VGI9faVXGIGSDXZMGp8> accessed on 27th January 2022

❖ **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.A.R.Mahajan	Head of Department (I.T.Dept.).	Government Polytechnic, Nagpur.
2	Mr.L.L.Bhadekar	Lecturer in IT	Government Polytechnic, Nagpur.
3	Mrs.Shifa Mohammed Azharuddin	Lecturer in IT	Government Polytechnic, Nagpur.
4	Mr. Dipak Dhote, Industry Expert	Operations Manager, IT-Network Infosystems Pvt. LTD.	IT-Network Infosystems Pvt. LTD.
5	Dr. Rakesh Kadu, Member from Academics(External)	Assistant Professor, I.T., Ramdeobaba College of Engg. and Management, Nagpur.	Ramdeobaba College of Engg. and Management, Nagpur.
6	Mrs.V.A. Raje,MSBTE Nominee	Lecturer in C.O., G.P. Arvi	G. P. Arvi
7	Mr. L.D.Vilhekar, Member (Internal)	Lecturer in Information Tech.	Government Polytechnic, Nagpur.
8	Mrs.D.P.Chanmanwar, Member (Internal)	Lecturer in Information Tech.	Government Polytechnic, Nagpur.
9	Mr.M.N.Gawande, CDC In Charge and Member Secretary	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/EE/EC/CM/IT/MT/MC/PK/AE/TR/TX
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE206G
COURSE TITLE	: ENERGY WASTE MANAGEMENT**
TEACHING SCHEME	: TH:02; TU: 00;PR: 00(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 02 HRs (Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20 Min(MCQ)

❖ RATIONALE:

The objective of the course is to provide insight into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production. This course is designed to provide an understanding of the various aspect of waste to Energy. The various sources of waste generation is analyzed with a focus on its potential for energy production. The need for characterization of waste will be discussed along with the existing norms for waste utilization for alternate energy source. Case studies will be discussed to provide a better understanding of the concept of “Waste to Energy “in the Indian context.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify sources of waste energy in various field
2. Choose appropriate process of heat recovery from waste energy in various field
3. Apply the concept of waste to energy in various field of engineering
4. Analyze the present scenario of conventional and non conventional energy in India.
5. Identify the environment friendly technologies to manage waste energy
6. Analysis of case studies for understanding success and failures.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction	1a. Define Principle of waste management 1b. Describe 3-R Principle of waste management. 1c. List different sources of waste energy in different sector	1.1 Principle of waste management and waste utilization 1.2 3-R Principle of waste management, • Reduce • Reuse and • Recycle 1.3 Sources waste energy such as domestic, industrial, agriculture, post-consumer waste etc.	04
2. Conversion of Waste to Energy	2a. Describe biochemical conversion 2b. Explain Thermo chemical conversion 2c. Identify sources of heat recovery from boiler	2.1 Bio chemical Conversion, energy production from organic waste through anaerobic digestion and fermentation 2.2 Thermo chemical Conversion – Combustion incineration and heat recovery pyrolysis, gasification. 2.3 Waste heat recovery from boiler	06
3. Waste heat Recovery , Cogeneration and Trigeneneration	3a. State need of waste heat recovery of the given thermal power plant 3b. Illustrate with neat sketches working principle of cogeneration and trigeneration	3.1 Construction and working of thermal power plant and waste heat recovery in thermal power plant : need, opportunities and present practices 3.2 Cogeneration and Trigeneneration: need, opportunities and present practices	06
4. Renewable Sources of Energy	4a. List different sources of renewable energy. 4b. Compare energy consumption in India by conventional and non conventional energy	4.1 Introduction to renewable source of energy and different sources of renewable energy likesolar, wind, tidal, geothermal etc. 4.2 Present scenario of conventional and non conventional energy in India	06
5. Waste to Energy and Environmental Implication	5a. State standards for Environment standard 5b. List benefits of non renewable energy 5c. State importance of Carbon Credit	5.1 Environmental standards for waste to energy 5.2 Saving on non renewable fuel resources 5.3 Introduction to carbon credit	05

6. Case Study. (Scenario of Waste to Energy)	Case Studies –(on any one topic) 6a. Success/failures of Indian waste to energy Plants 6b. Global Best Practices in Waste to energy production distribution and use. 6c. Indian Scenario on Waste to Energy production distribution and use in India. 6d. Role of the Government in promoting 'Waste to Energy	6.1 Success/ failure waste to energy 6.2 Global based practices in waste to energy production, distribution and use 6.3 Indian Scenario on waste to energy 6.4 Role of government in promoting waste to energy (Case study on the basis of waste to energy)	05
Total Hrs			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS: Nil**❖ SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction.	00(00)	04(00)	00(00)	04(00)
2	Conversion of Waste to Energy	00(00)	03(00)	03(00)	06(00)
3	Waste Energy utilization in power plant	02(00)	04(00)	00(02)	06(02)
4	Renewable sources of Energy	00(01)	00(00)	04(00)	04(01)
5	Waste to Energy and Environmental Implication	00(00)	00(02)	05(00)	05(02)
6	Case Study.	00(00)	00(00)	05(00)	05(00)
	Total	02(01)	11(02)	17(02)	30(05)

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	U	1	1	A	1	1	U	1	1	U	1	1	U	1	30/35
	2	U	1	2	U	1	2	A	1	2	A	1	2	A	1	
	3	R	1	3	R	1	3	U	1	3	A	1	3	U	1	
	4	R	1	4	A	1	4	A	1	4	A	1	4	A	1	
	5	A	1	5	A	1	5	U	1	5	A	1	5	A	1	
	6	A	1	6	A	1	6	A	1	6	A	1	6	A	1	

T-Unit/Topic Number
R-RememberL- Level of Question
U-UnderstandM- 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)	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	--	--	--	--
		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	-
2	3	3	3	-	3	-	3	3	-
3	3	3	3	-	3	-	3	3	-
4	3	3		-	3	-	3	3	-
5	3	3	3	-	3	-	3	3	-
6	3	3	3	-	3	1	3	3	-

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

❖ **REFERENCE & TEXT BOOKS:**

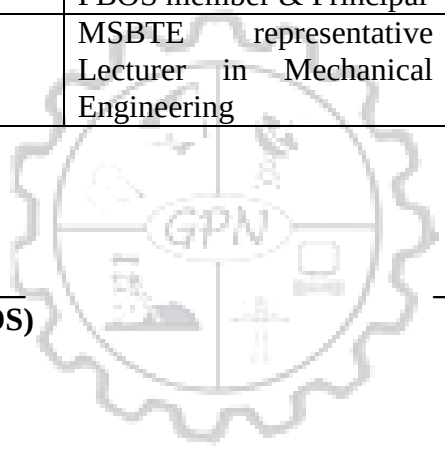
S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Integrated Waste Management in India. Status and Future Prospects for Environmental Sustainability.	Marimuthu Prashanthi, Rajakumar Sundaram.	978-3319272269
2	Solid Waste Management Present and future challenges	Jagbir Singh, AL. Ramanathan	978-9389447927
3	Solid Waste Management in Indian Cities: Status and Emerging Practices	Darshini Mahadevia, Jeanne M. Wolfe	978-818069522
4	Renewable energy sources and Emerging Technologies	D.P.Kothari, K.C. Singal, Rakesh Ranjan	978-9389347890
5	Thermal Engineering	R.S.Khurmi, J.K.Gupta	978-8121925730
6	Thermal Engineering	R.K.Rajput	978-8131808047

❖ **E-REFERENCES:**

- <https://www.youtube.com/watch?v=HA3pjuUMVY0>
- <https://www.youtube.com/watch?v=XHi7kV-ZMT0>
- <https://www.youtube.com/watch?v=DROZUstnsnw>
- <https://www.youtube.com/watch?v=1w9Qp61BsNg>
- www.teriin.org/projects/green/pdf/National-Waste.pdf

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

S.N.	Name	Designation	Institute / Industry
1	Dr. R. G. Choudhari	HOD, Mechanical Engineering	Government Polytechnic, Nagpur
2	Mr. T. K. Ghormade	Course Expert & Lecturer in Mechanical Engineering	Government Polytechnic, Nagpur
3	Dr. M. M. Pawde	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 Engineering	Govt. Polytechnic, Gondia



 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN CE/EE/EC/CM/IT/MT/MC/PK/AE/TR/TX
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE207G
COURSE TITLE	: TOTAL QUALITY MANAGEMENT**
TEACHING SCHEME	: TH:02; TU: 00;PR: 00(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 02 HRs (Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20 Min (MCQ)

❖ RATIONALE:

The success of any organization not only depends on quality of its products and services but also depends on the people working in it. Total quality management (TQM) is a philosophy, methodology aimed to create and maintain mechanism of organization's continuous improvement to achieve total quality. This course deals with the methods through which the needs and expectations of the customer and the objectives of the organization are satisfied in most efficient and cost-effective manner. After studying this course, the diploma technicians shall be able to improve and maintain the quality of products and services through ongoing refinements in the organization he/she serving.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement.
4. Discover the new decision of principle in real time projects.
5. Analyze the various types of techniques used to measure quality.
6. Apply the various quality systems in implementation of TQM.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to TQM	1a. Describe evolution of quality 1b. Identify concepts of TQM 1c. Illustrate barriers while implementing TQM	1.1 Introduction - Need for quality - Evolution of quality - Definition of quality 1.2 Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – 1.3 TQM Framework - Contributions of Deming, Juran and Crosby, Component of TQM, Obstacles to Quality	06
2. TQM Principles	2a. Describe leadership and quality aspects 2b. Describe roll of employee in TQM. 2c. Describe various continuous improvement processes. 2d. Describe the term supplier and justify how supplier rating.	2.1 Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – 2.2 Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal 2.3 Continuous process improvement – PDCA cycle, 5s, Kaizen 2.4 Supplier partnership – Partnering, Supplier selection, Supplier Rating.	05
3. TQM Tools and Techniques – I	3a Describe tools of quality. 3b Describe six sigma process. 3c State applications of Six sigma 3d Justify benchmarking and describe it.	3.1 The seven traditional tools of quality – New management tools. 3.2 Six-sigma – Concepts, methodology, applications to manufacturing, service sector. 3.2 Bench marking –Reason to bench mark, Bench marking process	05
4. TQM tools and Techniques – II	4a. Describe Quality circle, QFD, Taguchi quality loss function and TPM 4b. Describe performance measure and improvement needs 4c. State the Method of Fish Bone as decision making model 4d. Demonstrate problem solving with the use	4.1 Quality circles – Quality Function Deployment (Introduction) TPM Concepts (Introduction), 4.2 Quality improvement needs –JIT, Cost of Quality – Performance measures. 4.3 Various TQM tools: Cause-and-effect diagram (fishbone or Ishikawa diagram), Check sheet, Histogram, Pareto chart	05

	of quality tools		
5. Quality Systems	5a Justify need of quality system ISO 9000 5b Describe quality auditing QS 9000. 5c List factors responsible for TQM implementation in manufacturing and service sector.	5.1 Need for ISO 9000- ISO 9000-2000 Quality System, Eight principles of ISO 5.2 Quality auditing, QS 9000, ISO 14000 – Concepts, 5.3 Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors	05
6. Implementation of TQM	6a. State scope of total quality implementation. 6b. Describe achievements through TQM 6c. Describe need of multi skilled worker, YO-I-DON 6d. Justify importance of KANBAN system, in quality.	6.1 Road map for TQM Implementation. 6.2 Lean Manufacturing (Introduction), Productivity –Seven Deadly Wastes 6.3 Single unit production "YO-I-DON" & standardization, Need of multi-skilled worker. 6.4 Quality production through KANBAN system and KANBAN rules.	06
Total Hrs			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to TQM	00(00)	04(00)	00(00)	04(00)
2	TQM Principles	00(00)	03(00)	03(00)	06(00)
3	TQM tools and Techniques – I	02(00)	04(00)	00(02)	06(02)
4	TQM tools and Techniques - II	00(01)	00(00)	04(00)	04(01)
5	Quality Systems	00(00)	00(02)	05(00)	05(02)
6	Implementation of TQM	00(00)	00(00)	05(00)	05(00)
	Total	02(01)	11(02)	17(02)	30(05)

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	U	1	1	A	1	1	U	1	1	U	1	1	U	1	30/35
	2	U	1	2	U	1	2	A	1	2	A	1	2	A	1	
	3	R	1	3	R	1	3	U	1	3	A	1	3	U	1	
	4	R	1	4	A	1	4	A	1	4	A	1	4	A	1	
	5	A	1	5	A	1	5	U	1	5	A	1	5	A	1	
	6	A	1	6	A	1	6	A	1	6	A	1	6	A	1	

T-Unit/Topic Number

L- Level of Question

M- Marks

R-Remember

U-Understand

A-Analyze/ Apply

1 R 1 means Unit/Topic Number No- 1, Level of Question –Remember, Marks – 1 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)	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	--	--	--	--
		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
1	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	-
5	3	3	3	-	3	-	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	TQM-Total Quality Management	Arasu Senthil B, Paul Praveen I Scitech Publications (India) Pvt. Ltd., Chennai, 2015	ISBN: 978-81-8371-578-2
2	Quality Assurance and Total Quality Management (ISO-9000, QS-9000, ISO-14000)	Jain K C, Chitale A K Khanna Publishers, New Delhi, 2005,	ISBN: 9788174091741
3	TQM and ISO 14000	Arora K C S.K. Kataria & Sons, New Delhi 2014,	ISBN: 9788185749990
4	Quality Management for Organizational Excellence: Introduction to Total Quality, 8th Ed	Goetsch & Davis, Publisher: Prentice Hall	ISBN: 978-0-13-379185-3

❖ **E-REFERENCES:**

- <https://www.versesolutions.com/>
- <https://www.asq.org/learn-about-quality/total-qualitymanagement/overview/>
- <https://www.hgint.com/tqm-total-quality-management-software/>
- <https://www.books.google.co.in/books?isbn=817758412X>
- <https://www.www.educba.com> > Courses > Business > Management
- <https://www.managementhelp.org/quality/total-quality-management.htm>

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

S.N.	Name	Designation	Institute / Industry
1	Prof. 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. A.S. Bahendwar	Course Expert & Lecturer in Mechanical Engg	Government Polytechnic, Nagpur.
5	Mr.S. B. Bambole	Course Expert & Lecturer in Mechanical Engg	Government Polytechnic, Nagpur.
6	Er. Mr. A.M.Onkar	PBOS member & Chief Executive Officer	Onkar Furnitures, MIDC, Nagpur
7	Shri. G.F.Potbhare	PBOS member & Principal	NIT, Polytechnic, Nagpur
8	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/ME/CE/EE/PK/MT/TX/IT/CM/ MC/AI/EC/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE208G
COURSE TITLE	: ADDITIVE MANUFACTURING & 3D PRINTING**
TEACHING SCHEME	: TH:02; TU: 00;PR: 00(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: -
PT. EXAM	: 20 Min (Objective Type)

❖ RATIONALE:

Additive manufacturing is a comparatively recent and advanced manufacturing technique that is becoming a key area of interest in every industrial field. Additive Manufacturing (AM) is the process of joining materials to create components from computer aided design (CAD) model data, and typically layer by layer, as opposed to subtractive manufacturing methods. Additive manufacturing is sometimes referred to as 3D printing, additive manufacturing, or freeform manufacturing. Additive manufacturing is a revolutionary unique method of producing components directly from the digital CAD model using a layer-by - layer material build-up technique. This tool-less manufacturing method can manufacture completely dense metal parts in less time, with high precision and accuracy. Advantages of additive manufacturing are, including the freedom of part design, part complexity, light weighting, part consolidation and function design, which generate specific interest in metal additive manufacturing for aerospace, oil & gas, marine and automotive applications and many more.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify the Different 3D printing Technology and machines used in Additive manufacturing.
2. Select suitable Machine and Material for printing.
3. Describe the CAD Modeling.

4. Different applications of Additive manufacturing.
5. Select the different equipments in Additive manufacturing.
6. Describe the concept of Post processing.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to Additive Manufacturing and 3D Printing Technology	1a. Describe given trends shaping the evaluation of 3D printing. 1b. Describe the Technology improvement. 1c. Classify the Additive Manufacturing Systems on given basis with advantages and disadvantages.	1.1 Development of Additive Manufacturing 1.1.1 Major trends shaping the evaluation of 3D printing 1.1.2 Technology Improvement Process 1.2 Classification of Additive Manufacturing Systems 1.2.1 Advantages and Limitations: 1.2.2 Additive V/S Conventional Manufacturing Processes.	05
2. CAD for Additive Manufacturing	2a. Prepare the given CAD Models. 2b. Describe the STL File Manipulation and given Additional Software to Assist AM. 2c. Describe the given Additive Manufacturing File Forma.	2.1 Introduction 2.1.1 Preparation of CAD Models: The STL File 2.1.2 Problems with STL Files 2.1.3 STL File Manipulation 2.2 Additional Software to Assist AM 2.3 The Additive Manufacturing File Format	05
3. Materials in Additive Manufacturing	3a. Describe the methods for Choosing Materials for Manufacturing. 3b. Describe the given Composite Materials. 3c. Describe the Ceramics & the given Materials.	3.1 Choosing Materials for Manufacturing 3.1.1 Multiple Materials 3.1.2 Metal AM Processes & Materials 3.2 Composite Materials 3.2.1 Biomaterials, Hierarchical Materials & Biomimetics. 3.2.2 Ceramics & Bio-ceramics 3.3 3 D Printing & Bio-Active Materials	06
4. Applications and Examples	4a. Describe the given Material Relationship. 4b. Describe the Applications in the given Engineering field. 4c. Describe the Applications in given Industry.	4.1 Application - Material Relationship 4.1.1 Applications in Design 4.2 Applications in Engineering, Analysis and Planning 4.3 Applications in Manufacturing	06

	4d. Describe the Applications in given Arts and Architecture.	and Tooling 4.4 Applications in Aerospace Industry 4.4.1 Applications in Automotive Industry 4.4.2 Applications in Jeweler Industry 4.4.3 Applications in Arts and Architecture	
5. Additive Manufacturing Equipment	5a. Describe the given Process Equipment Design and process parameters. 5b. Describe given Bonding Mechanism. 5c. List Common Faults and Troubleshooting. 5d. State the given Process design.	5.1 Process Equipment- Design and process parameters 5.2 Governing Bonding Mechanism 5.3 Common Faults and Troubleshooting. 5.4 Process design	05
6. Post Processing	6a. Describe the given Support 6b. Material Removal process. 6c. Describe the process of given Improvements. 6d. Describe Property Enhancements using the given Techniques.	6.1 Support Material Removal 6.2 Surface Texture Improvements 6.2.1 Accuracy Improvements 6.2.2 Aesthetic Improvements 6.3 Property Enhancements Using Non-thermal Techniques 6.3.1 Property Enhancements Using Thermal Techniques.	05
Total			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Additive Manufacturing and 3D Printing Technology	02(00)	00(00)	02(00)	04(00)
2	CAD for Additive Manufacturing	01(00)	02(00)	03(01)	06(01)
3	Materials in Additive Manufacturing	02(00)	02(01)	02(00)	06(01)
4	Applications and Examples	00(01)	02(00)	02(00)	04(01)
5	Additive Manufacturing Equipment	00(00)	02(01)	02(00)	04(01)
6	Post Processing	02(00)	02(00)	02(01)	06(01)
	Total	07(01)	10(02)	13(02)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	R	1	1	A	1	1	A	1	2	R	1	30/35
	2	U	1	2	U	1	2	A	1	2	A	1	2	A	1	
	2	A	1	3	R	1	3	R	1	3	U	1	3	U	1	
	3	U	1	3	A	1	3	A	1	4	R	1	4	U	1	
	4	U	1	4	A	1	4	A	1	5	U	1	5	U	1	
	5	U	1	5	A	1	5	A	1	6	R	1	6	R	1	
	6	U	1	6	U	1	6	A	1	6	A	1	6	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	3	-	3
2	3	-	2	-	3	-	3	3	3
3	3	-	2	-	3	-	3	3	3
4	3	1	-	3	3	-	3	3	3
5	3	-	-	3	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	Additive Manufacturing and 3D Printing Technology: Principles and Applications	Dr. G.K. Awari, Dr. D.P.Kothari, Prof. Vishwjeet Ambade, Dr. C. S. Thorat, CRC Press, Taylor & Francis Group	9780367436223
2	Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Ian Gibson , David Rosen , Brent Stucker, Springer New York Heidelberg Dordrecht London	ISBN 978-1-4939-2112-6 ISBN 978-1-4939-2113-3 (eBook) DOI 10.1007/978-1-4939-2113-3
3	Additive Manufacturing Innovations, Advances, and Applications	T.S. Srivatsan , T.S. Sudarshan, CRC Press, Taylor & Francis Group	13: 978-1-4987-1478-5 (eBook - PDF)
4	Understanding Additive Manufacturing Rapid Prototyping · Rapid Tooling · Rapid Manufacturing	Andreas Gebhardt, Hanser Publishers, Munich Hanser Publications, Cincinnati	ISBN-13: 978-1-56990-507-4 (hardcover) ISBN-10:1-56990-507-X (hardcover)
5	Additive Manufacturing of Metals: The Technology, Materials, Design and Production	Li Yang •, Keng Hsu , Brian Baughman Donald Godfrey , Francisco Medina Mamballykalathil Menon Soeren Wiener, Springer Series in Advanced Manufacturing	ISBN 978-3-319-55127-2 ISBN 978-3-319-55128-9 (eBook) DOI 10.1007/978-3-319-55128-9

❖ **E-REFERECNES:**

- <https://www.youtube.com/watch?v=ICjQ0UzE2Ao>
- <https://www.youtube.com/watch?v=SfFIY0clCCA>
- <https://www.youtube.com/watch?v=PTcffCr19XY>
- <https://www.youtube.com/watch?v=5EMQdvfP7qs>
- <https://www.youtube.com/watch?v=o5sE2wn4qdw>
- https://www.youtube.com/watch?v=VyLHtaMDX_k

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

S.N.	Name	Designation	Institute / Industry
1	Dr.G K Awari	Head of Automobile Engineering	Government Polytechnic, Nagpur.
2	Mr.S.D. Thakre	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
3	Dr.K.S.Dixit	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
4	Mr.S A Telang	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
5	Mr.R.B.Tirpude	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
6	Mr.Syed J.M.	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.

 (Member Secretary PBOS)

 (Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	:	DIPLOMA IN ME/CE/EE/PK/MT/TX/IT/CM/ MC/AI/EC/TR
COURSE CATEGORY:	:	OPEN ELECTIVE
COURSE CODE	:	OE210G
COURSE TITLE	:	RENEWABLE ENERGY SOURCES FOR MOBILITY**
TEACHING SCHEME:	:	TH: 02; TU: 00; PR: 00(CLOCK HRs.)
TOTAL CREDITS	:	02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEEXAM	:	01 HRs (Objective Type Online Examination)
PR. TEEXAM	:	--
PT. EXAM	:	20 Min (Objective Type)

❖ **RATIONALE:**

World energy consumption steadily increases due to enhancement of quality of life, increase in transportation etc. Most of the energy demand can be fulfilled with the help of fossil fuels. Reservoirs of these fuels are limited. The aim of inclusion of this subject in the curriculum is to develop the ability in the student to develop the renewable energy sources so as to reduce the dependability on the nonrenewable power sources and improvements in engine performance and emission concern and their material compatibility concern. By using the renewable energy sources for vehicles can further reduce pollution and their overall carbon footprint by lowering greenhouse gas emissions from the vehicles.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify the renewable energy sources.
2. Select suitable bio-fuels for SI Engine vehicles.
3. Select suitable bio-fuels for CI Engine vehicles.
4. Analyze effect of blending of bio-fuels on performance and emission characteristics of the engines.

5. Compare the performance of Electric Vehicle with Conventional Engine driven vehicles.
6. Compare the performance of Fuel cells and solar operated vehicle with Conventional Engine driven vehicles.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Global Energy Review	1a. Compare global energy scenario with India on the basis of given points. 1b. Describe the given biomass conversion technologies. 1c. Describe the layout, applications, construction and working of given type of renewable energy sources.	1.1 Introduction to Energy Sources. Global Energy Sources and the Present Energy Situation. 1.2 Renewable Energy Sources, Biomass Energy and Biomass Conversion Technologies a. Layout, Applications, 1.3 Construction and working. • Hydropower • Geothermal Energy • Wind Energy • Solar Energy • Bio-hydrogen	05
2. Alternative Fuels for SI Engines	2a. Describe the Properties and modifications required in SI Engines to use given type of alternate Bio-Fuels (Alcohol Fuels). 2b. Describe the effect on Engine performance and emission Characteristics in SI Engines to use given type of alternate Biofuels (Gaseous Fuels).	2.1 Properties, Material Compatibility, effect on Engine performance and Emission Characteristics and Modifications required in SI Engines to use alternate Bio-Fuels (Alcohol Fuels): • Methanol • Ethanol • Propane • Butanol • Dimethyl Carbonate 2.2 Properties, Material Compatibility, effect on Engine performance and emission Characteristics and modifications required in SI Engines to use alternate Biofuels(Gaseous Fuels): • Producer Gas • Biogas • Bio-Syngas • Hydrogen	07

3. Alternative Fuels for a CI Engines	3a. Describe the Properties and modifications required in CI Engines to use given type of alternate Bio-Fuels. 3b. Describe effect of blending of the given type of bio- fuels on emission and performance of the CI Engines.	3.1 Properties, Material Compatibility, effect on engine performance and emission Characteristics and modifications required in CI Engines to use alternate Biofuels: Biodiesel Fischer-Tropsch Diesel Dimethyl Ether DiEthyl Ether 3.2 Blending of Bio-fuels and its effect on engine performance and emissions.	05
4. Bi-Fuel Vehicles	4a. Describe the given type of Bi-fuel vehicle layout, construction and working. 4b. Compare Bi-Fuelled Vehicles with Non-renewable Energy fuel Vehicles on the basis of given parameters. 4c. Draw the layout and describe the construction and working of given dual fuel vehicles. 4d. Compare Dual-Fuelled Vehicles with conventional Vehicles on the basis of given parameters.	4.1 Bi-Fuel Vehicles: Layout construction and working. 4.2 Comparison of Bi-Fuelled Vehicles with Non-renewable Energy fuel Vehicles and Conventional Vehicles. 4.3 Dual-Fuel Vehicles: Layout construction and working. 4.4 Comparison of Dual-Fuelled Vehicles with Non-renewable Energy fuel Vehicles and Conventional Vehicles.	05
5. Electrical and Hybrid Vehicles	5a. Draw the layout of given type of Electrical Vehicles and describe its construction and working. 5b. Compare the Hybrid vehicle with Conventional vehicles on the basis of given parameters.	5.1 Electric Vehicles: Layout, Components, construction, working advantages and disadvantages. 5.2 Hybrid Vehicle: Layout, Components, construction, working advantages and disadvantages.	05
6. Fuel Cell and Solar Operated Vehicles	6a. Compare fuel cell operated vehicle with conventional vehicle on the basis of given parameters. 6b. Draw a layout of given type of solar operated vehicles and describe its working principle. 6c. Justify the modifications required in conventional engine vehicle to implement the given type of renewable	6.1 Fuel Cell Vehicles: Types of Fuel Cells, Layout, Components, Working Principle of Fuel Cells, advantages and disadvantages. 6.2 Solar Operated Vehicles: Layout, Components, Working Principle of solar Vehicles, advantages and disadvantages.	05

	energy sources.	6.3 Modifications required in conventional vehicles to implement Fuel cell and solar renewable energy sources.	
Total			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Global Energy Review	02(00)	00(00)	00(00)	02(00)
2	Alternative Fuels for a SI Engines	01(00)	02(00)	05(01)	08(01)
3	Alternative Fuels for a CI Engines	01(00)	01(01)	02(00)	04(01)
4	Bi-Fuel Vehicles	00(01)	02(00)	02(00)	04(01)
5	Electrical and hybrid vehicles	00(00)	02(01)	02(00)	04(01)
6	Fuel Cell and Solar operated vehicles	03(00)	03(00)	02(01)	08(01)
	Total	07(01)	10(02)	13(02)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	R	1	2	R	1	2	U	1	2	U	1	30/35
	2	A	1	2	A	1	2	A	1	2	A	1	2	A	1	
	2	A	1	3	R	1	3	U	1	3	U	1	3	A	1	
	3	A	1	4	R	1	4	U	1	4	U	1	4	A	1	
	4	A	1	5	U	1	5	U	1	5	U	1	5	A	1	
	5	A	1	6	R	1	6	R	1	6	U	1	6	U	1	
	6	U	1	6	R	1	6	A	1	6	A	1	6	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	-	-	-	3	-	3
2	3	-	2	-	3	-	3	3	3
3	3	-	2	-	3	-	3	3	3
4	3	1	-	3	3	-	3	3	3
5	3	-	-	3	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	Alternative Fuels Guide book Properties, Storage, Dispensing, and Vehicle Facility Modifications	Richard L. Bechtold, RE, Society of Automotive Engineers, Inc. Warrendale, 1 st Edition, 2000	0-7680-0052-1
2	Biofuels and Bioenergy Processes and Technologies	Sunggyu Lee and Y. T. Shah, CRC Press Taylor & Francis Group , 1 st Edition, 2013	13: 978-1-4200-8956-1
3	Electric and Plug-In Hybrid Vehicles Advanced Simulation Methodologies	Bogdan Ovidiu Varga, Florin Mariasiu, Dan Moldovanu, Calin Iclodean, Springer-Verlag London Limited, 2015	978-3-319-18639-9
4	Alternative fuels and advanced vehicle technologies for improved Environmental performance Towards zero carbon transportation	Richard Folkson, Woodhead Publishing (Elsevier), 2 nd Edition, 2013	978-0-85709-742-2
5	Alternative Fuels for Transportation	Arumugam S. Ramadhas, CRC Press Taylor & Francis Group, 2013	13: 978-1-4398-1958-6
6	Alternative Transportation Fuels Utilization in Combustion Engines	York M. K. Gajendra Babu , K. A. Subramanian, CRC Press Taylor & Francis Group, 1 st Edition, 2013	13: 978-1-4398-7282-6
7	Biodiesel A Realistic Fuel Alternative for Diesel Engines	Ayhan Demirbas, Springer-Verlag London Limited, 2008	13: 9781846289941

8	Handbook of Alternative Fuel Technologies	Sunggyu Lee James G. Speight Sudarshan K. Loyalka, CRC PressTaylor & Francis Group 2013	13: 978-0-8247-4069-6
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❖ **E-REFERECNES:**

- https://www.youtube.com/watch?v=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk dated 16th February 2022.
- https://www.youtube.com/watch?v=rK6Bey_loiw&list=PLdzIIxVTz4AsglVyHhZJ6Jj7tnpa3NL0n dated 16th February 2022.
- <https://www.youtube.com/watch?v=F2sZgWgvTAg> dated 16th February 2022.
- https://www.youtube.com/watch?v=wsz-LEFuLdc&list=PLLy_2iUCG87A7TdFpl6_xdgo-aYskxjXb dated 16th February 2022.
- <https://www.youtube.com/watch?v=L2VSOccUrSk> dated 16th February 2022.
- https://www.youtube.com/watch?v=QLN_6jPJgv0 dated 16th February 2022.
- <https://www.youtube.com/watch?v=LsWHqyjaD00> dated 16th February 2022.

❖ **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.G.K.Awari	Head of Automobile Engineering	Government Polytechnic, Nagpur.
2	Mr.S.D.Thakre	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
3	Dr.K.S.Dixit	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
4	Mr.S.A.Telang	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
5	Dr.R.B.Tirpude	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
6	Mr.Syed J.M.	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN AE/ME/CE/EE/PK/TX/IT/CM/MC/AI/EC/TR
COURSE CATEGORY: OPEN ELECTIVE COURSES
COURSE CODE : OE211G
COURSE TITLE : SELECTION OF MATERIALS**
TEACHING SCHEME: TH:02; TU:00;PR:00(CLOCK HRs.)
TOTAL CREDITS : 02 (1 TH/TU CREDIT=1 CLOCK HR.,1 PR CREDIT = 2 CLOCK HRs.)
TH. TEE : 01 HR (Objective Type Online Examination)
PR. TEE : --
PT. : 20 Min (Objective Type)

❖ RATIONALE:

Introducing a new engineering product or changing an existing model involves making designs, reaching economic decisions, selecting materials, choosing manufacturing processes, and assessing its environmental impact. These activities are interdependent. and materials and processes used in making the product can have a large influence on its design, cost, and performance in service. . Industries now emphasis on manufacturing products and goods locally, & how products affect the environment, and society. The aim of the subject is to enable judicious selection of material based upon the relationship between technical and economic facts.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Utilize different Material selection charts for various applications.
2. Interpret factors for selection process of different materials
3. Select materials for industrial applications depending on their properties
4. Select suitable biomaterials and magnetic materials for different applications.

❖ **COURSE DETAILS:****A.THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction	1a. State Principles involved in the selection of materials. 1b. Illustrate Selection criteria for required materials. 1c. Identify different material properties. 1d. Employ Material selection charts for various applications. 1e. Illustrate Factors affecting material prices, material substitution. 1f. Relate Strength vs. density & Young's modulus vs. density selection charts. 1g. Select material for various applications depending on the properties.	1.1 Principles involved in the selection of materials 1.2 Selection Criteria : Availability, Economics, Properties 1.3 Selection process, determination of performance requirements, Evaluation of alternatives 1.4 Material Properties: Chemical, Physical and Mechanical, properties in detail and limits on properties 1.5 Factors affecting material prices, material substitution 1.6 Material selection charts 1.7 Strength vs. density 1.8 Young's modulus vs. Density.	08
2. Functional Requirement of Engineering Materials	2a. State functional requirement of engineering materials. 2b. Select proper material required for different applications. 2c. Illustrate selection of materials for toughness. 2d. Assess toughness of different materials with suitable examples. 2e. Describe Creep Curve. 2f. Describe effect of stress and temperature on Creep. 2g. Select suitable non ferrous materials for given application. 2h. Draw Creep curve.	2.1 Selection of material for strength, resistance to corrosion – temperature -wears with practical examples 2.2 Materials selection for stiffness : Stiffness of engineering materials, Importance of stiffness, material selection criterion for stiffness with examples 2.3 Materials selection for toughness Toughness, Selection of materials for toughness, assessment of toughness of different materials with examples 2.4 Material selection for fatigue strength: Mechanisms, evaluation of fatigue life of different materials. 2.5 Material selection for creep : Mechanism, evaluation of creep resistance, Creep curve, Effect of	08

	2i. Recommend corrosion resistant materials for a given application .	stress and temperature, development of creep resistant alloys, selection criterion. 2.6 Selection of non ferrous materials.	
3. Selection of Materials for Different Applications	3a. Describe Tool steel & corrosion resistant steels. 3b. Identify properties required for materials for different applications. 3c. Define weldability, formability, and forgeability. 3d. Select proper materials for tools and components for various industrial applications. 3e. Select tool materials for various ore-dressing equipments. 3f. Recommend materials for various industrial and metallurgical applications.	3.1 High strength, heat resistant alloys, corrosion resistant steels required for good weldability, formability, forgeability, 3.2 Tool steels required for cutting, cold-working dies, hot working dies 3.3 Selection of materials and processes for tools and components of : a) automobile engines b) machine tools, c) foundry d) metal-working equipment, e) Testing machine,, f) ore-dressing equipment.	08
4. Magnetic Materials & Biomaterials	4a. Describe different properties of Magnetic materials. 4b. List various biomaterials. 4c. Compare different Biomaterials. 4d. State properties of Biomaterials. 4e. State applications of 4f. Magnetic materials . 4g. Select different Bio materials in various applications. 4h. Select Magnetic material for given application.	4.1 Introduction to magnetic materials 4.2 Types of Magnetic materials 4.3 Concept of Diamagnetism, paramagnetism and Ferromagnetism 4.4 Applications of Magnetic materials 4.5 Introduction to Biomaterials 4.6 Concept of Biocompatibility 4.7 Classification and applications of biomaterials	08
Total Hrs.			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	Introduction	01(00)	03(00)	04(00)	08(00)
2	Functional requirement of engineering materials	02(00)	02(00)	04(01)	08(01)
3	Selection of materials for different applications	02(00)	02(02)	04(02)	08(04)
4	Introduction to magnetic materials & Biomaterials	01(00)	02(00)	03(00)	06(00)
	Total	06(00)	09(02)	15(03)	30(05)

❖ **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	1	1	R	1	1	U	1	1	U	1	2	R	1	30/35
	2	U	1	2	U	1	2	A	1	2	A	1	2	A	1	
	3	R	1	3	U	1	3	A	1	3	A	1	3	A	1	
	3	A	1	3	A	1	4	R	1	4	U	1	4	U	1	
	4	A	1	4	A	1	4	A	1	5	A	1	5	A	1	
	5	U	1	5	U	1	5	U	1	5	A	1	5	A	1	
	6	R	1	6	U	1	6	A	1	6	A	1	6	A	1	

T- Unit/Topic Number
R-RememberL- Level of Question
U-UnderstandM- 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)	15	--	Test Answer Scripts	1, 2, 3,4,5,6
		Class Room Assignments		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO
	1	2	3	4	5	6	7	1	2	3
1	3	3	3	3	3		3			
2	3	3	3	3	3		3			
3	3		3	3	3		3			
4	3	4	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	Materials Selection in Mechanical Design	Mike Ashby, Butterworth-Heinemann, New Edition, 2011	9781856176637
2	Engineering Materials – Properties and Selection	Kenneth G. Budinski, Prentice-Hall of India, 1998	13:9780139047152
3	Materials and Process Selection for Engineering Design,	Mahmoud M. Farag Third Edition CRC Press, 2013	1466564091, 9781466564091
4	Mechanical Metallurgy	George E. Dieter, McGraw-Hill Education; 3 rd Edition, 1986	978-0070168930

❖ **E-REFERENCES:**

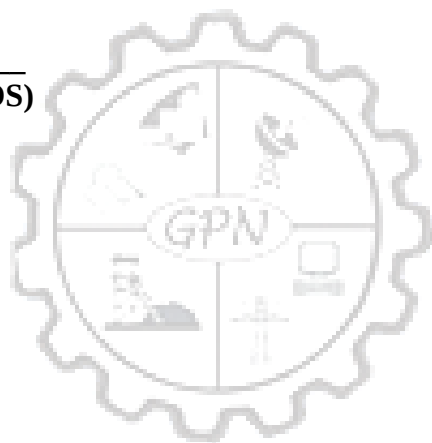
- <http://www.nptel.ac.in/courses/112104122/> , accessed on 14th July, 2021
- <https://www.youtube.com/watch?v=85HxmnLEkwM> , accessed on 14th July, 2021
- <https://www.youtube.com/watch?v=vnFNl1oVJNY>, accessed on 14th July, 2021
- <https://www.youtube.com/watch?v=P-tg52VRzZU> , accessed on 14th July, 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	Shri.K.L.Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2	Miss.V.C.Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	Prof.YY.Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
4	Shri.S.B.Varadpande	Managing Director	Orange city alloys Pvt. Ltd Nagpur
5	Shri.Y.K.Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

(Member Secretary PBOS)



(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : DIPLOMA IN ME/CE/EE/PK/TX/IT/CM/MC/AI/EC/TR/AE
COURSE CATEGORY: OPEN ELECTIVE COURSES
COURSE CODE : OE212G
COURSE TITLE : NON DESTRUCTIVE TESTING
TEACHING SCHEME: TH:02; TU:00;PR:00(CLOCK HRs.)
TOTAL CREDITS : 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE : 01 HR (Objective Type Online Examination)
PR. TEE : -
PT. : 20 Min (Objective Type)

❖ RATIONALE:

Metallurgical engineering is a discipline that mainly deals with various metallic materials on the earth for the benefit of mankind. For that it is required to assess soundness of metallic materials during various stages of their formation. non Destructive Testing is essential to control and correlate various manufacturing parameters and also to decide suitability and predict probable behavior of metallic materials in practice. With the knowledge of non destructive testing procedures, students conduct various tests like ultrasonic, dye penetrant , magnetic tests, etc. and comment on soundness of materials

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Compare various NDTs .
2. Make use of DP and visual examination for crack detection.
3. Inspect metal products for defects using ultrasonic test.
4. Prepare sample for different NDT's to be carried out.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Scope of Testing	1a. State the need for NDT 1b. Discuss Different types of Types of non-destructive test. 1c. Select suitable NDT for proper application. 1d. Classify NDT methods.	1.1 Concept of non destructive testing Need of Non- destructive test 1.2 Introduction to NDT 1.3 Types of non-destructive test 1.4 Comparison of NDT with Destructive testing	05
2. Visual Examination, Dye Penetrant Tests	2a. State the need for visual Testing method. 2b. Select dye penetrant tests for crack detection. 2c. Enlist various types of developers used in DPT. 2d. Conduct DPT methods. 2e. Prepare Sample for conducting DPT. 2f. Select suitable developer for DPT.	2.1 Methods of Examination for defects: Visual examination, Hammer tests etc. 2.2 Penetrant tests, 2.3 Visual Optical methods, Dyepenetrant testing, Basic principle, Types of dye and methods of application, Developer application and Inspection.	09
3. Ultrasonic Testing	3a. Describe Ultrasonic testing in brief . 3b. Enlist types of transducers 3c. Discuss various probes used in UT. 3d. Conduct ultrasonic testing on metals. 3e. Prepare Sample for conducting UT.	3.1 Ultrasonic Testing: Fundamentals, Equipments, procedure and applications. Interpretation of results. 3.2 Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes,Ultrasonic transducers	09
4. Magnetic Particle Method	4a. Describe Magnetic analysis method of testing. 4b. Discuss yoke type magnetic particle testing.	4.1 Method based on magnetic analysis, yoke type , probe type magnetic crack detector 4.2 Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection.	09

	4c. Discuss Various Magnetization methods. 4d. Conduct MPT methods. 4e. Prepare Sample for conducting MPT.		
Total Hrs.			32

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Scope Of Testing	01(00)	02(00)	03(01)	06(01)
2	Visual examination , Dye Penetrant tests	02(00)	02(00)	04(00)	08(00)
3	Ultrasonic Testing	02(00)	02(02)	04(01)	08(03)
4	Magnetic particle method	01(00)	03(00)	04(01)	08(01)
	Total	06(00)	09(02)	15(03)	30(05)

R – Remember

U – Understand

A – Analyze / Apply

❖ **QUESTION PAPER PROFILE FOR THEORY PAPER:**T-Unit/Topic Number
R-RememberL- Level of Question
U-UnderstandM- Marks
A-Analyze/ Apply

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	
Q 01 To Q 35	1	R	1	1	R	1	1	U	1	1	U	1	1	R	1	30/35
	1	U	1	2	U	1	2	A	1	2	A	1	2	U	1	
	2	R	1	2	U	1	2	A	1	2	U	1	2	U	1	
	2	U	1	3	R	1	3	R	1	3	U	1	3	U	1	
	3	U	1	3	A	1	3	A	1	3	U	1	3	A	1	
	3	U	1	4	U	1	4	U	1	4	R	1	4	R	1	
	4	R	1	4	U	1	4	A	1	4	A	1	4	A	1	

❖ **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	--	--	Journal	
		Journal Writing		Assignments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO
	1	2	3	4	5	6	7	1	2	3
1	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		

❖ **REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year of Publication	ISBN Number
1	Testing of materials	Prof. A.V.K. Suryanarayana. BS Publications/BSP Books , 2nd Edition, 2013	13 : 978-81-7800-134-0
2	The Testing of Engineering materials,	H. E. Davis, G. E. Troxell , Mcgraw Hill Publishing Company, Fourth Edition,1982	81-7409-026-6
3	Mechanical Metallurgy	George Dieter, Mc Graw Hill, Third edition , March 2013	0-07-084453-4
4	Nondestructive Testing, Nondestructive Evaluation and Quality Control,	Louis Cartz, ASM International ASM Handbook, Vol. 17.	

❖ **E-REFERENCES:**

- <http://www.nptel.ac.in/courses/112106141/https://www.youtube.com/> accessed on 11th August, 2021
- <https://www.youtube.com/watch?v=D8U4G5kcpcM> , accessed on 11th August, 2020
- <https://www.youtube.com/watch?v=EeiwCbtJWyI> , accessed on 11th August, 2021
- <https://www.youtube.com/watch?v=dGT233GsqHE> , accessed on 11th August, 2021
- <https://www.nde-ed.org> , accessed on 04/01/2022
- <https://documents.pub/document/appreciation-to-ndt-31ppt.html>, accessed on 04th Jan 2022

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

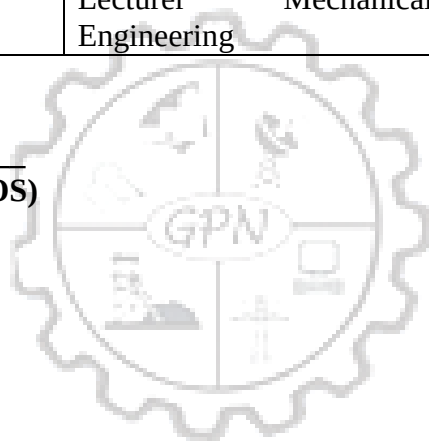
Nil.

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

S.N.	Name	Designation	Institute / Industry
1	Mr.K.L.Meshram	HOD Metallurgical Engineering	Government Polytechnic, Nagpur.
2	Miss.V.C. Humney	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur.
3	Mr.S.M.Waikar	Lecturer Metallurgical Engineering	Government Polytechnic, Nagpur
4	Mr.Y.Y.Mahajan	Assist. Professor , Metallurgy & Material Science	VNIT Nagpur
5	Mr.S.B.Varadpande	Managing director	Orange city alloys Pvt. Ltd Nagpur
6	Mr.Y.K.Gaiky	Lecturer Mechanical Engineering	Government Polytechnic, Sakoli

(Member Secretary PBOS)

(Chairman PBOS)



GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/AI/CE/CM/EC/IT/MC/ME/ MT/PK/TX/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE215G
COURSE TITLE	: RENEWABLE ENERGY TECHNOLOGIES **
TEACHING SCHEME	: TH:02; TU: 00;PR: 00(CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: -
PT. EXAM	:20 Min (Objective Type)

❖ RATIONALE:

Renewable energy is crucial in improving climate on earth . Renewable technologies will also yield a pollution-free environment . All the world is now focusing on the generation of energy through renewable sources . This course is designed for diploma students to explore possibility of harnessing electrical energy from renewable sources such as Solar Thermal, Solar Photovoltaic, Wind, Biomass, other renewable sources .

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Predict potential of renewable energy sources.
2. Apply various methods of solar energy harvesting.
3. Identify different parts of Wind power Plant.
4. Describe process of generation of electrical energy from Bio-Mass.
5. Compare Hydrogen Energy and Fuel cell with other sources of energy.
6. Describe principle of energy generation using different Renewable Energy Sources .

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction	1a. Estimate reserve of given conventional sources of energy. 1b. Describe effects of usage of given conventional energy sources on environment. 1c. Predict potential of given renewable energy in world and India.	1.1 World Energy Use; Reserves of Energy Resources like coal, petroleum 1.2 Environmental Aspects of Conventional Energy Utilization 1.3 Renewable Energy Scenario in India and around the World, Potentials of Renewable Energy in world and India	04
2. Solar Energy	2a. Describe given terms related to Solar Radiation. 2b. Compare flat plate collectors and evacuated type collectors on given factors. 2c. Identify given type of solar panel . 2d. Justify need of Stand alone PV System.	2.1 Solar Radiation related terms and their meaning. 2.2 Working of Solar Water Heating System and types -Flat Plate and Evacuated Type 2.3 Definition of PV Cell ,Module, Array, Panel 2.4 Stand alone Solar PV System-Block Diagram and working	06
3. Wind Energy	3a. Compare types of Wind Turbine on given points. 3b. Identify given parts of a Wind Turbine. 3c. Select site for given type of Wind Turbine.	3.1 Wind Turbine -HAWT and VAWT 3.2 Working of Wind Power Plant 3.3 Site Selection for Wind Power Plant	06
4. Bio Energy	4a. Identify type of given biomass. 4b. Describe given terms related to gasifier. 4c. Identify given part of KVIC Biogas Plant. 4d. Select materials used in Ethanol production. 4e. Apply various steps in preparation of	4.1 Biomass and its types 4.2 Biomass Gasifier Definition and meaning of Dehydration, Pyrolysis, Combustion, Gasification 4.3 Working of KVIC Biogas Plants 4.4 Ethanol Production Method 4.5 Bio Diesel Production Method- Transesterification Method	04

	Biodiesel using given material.		
5. Hydrogen Energy and Fuel Cells	5a. Compare Hydrogen Fuel with given conventional energy source. 5b. Describe working of given components in Fuel Cells. 5c. Compare given types of Fuel Cells .	5.1 Hydrogen Energy -Advantages and Applications 5.2 Working of H ₂ O ₂ fuel cell 5.3 Compare types of Fuel Cell- PEM,AFC,PAFC,MCFC,SOFC,DM FC on operating temperature , power, efficiency , applications	06
6. Other Renewable Energy Sources	6a. Describe working of given Tidal Power Plant. 6b. Describe how electric power is generated from waves . 6c. Identify given type of Hydro Power Plant. 6d. Organize components of Micro Hydro Power Plant in a correct sequence.	6.1 Tidal Power Plant Block Diagram and Working 6.2 Energy Generation from waves – Block Diagram and Working 6.3 Block Diagram and Working of Hydropower Generation Types depending on rating -Large, Medium, Small, Mini, Micro on rating 6.4 Micro Hydro Power Project Layout and working	06
		Total Hrs	32

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Nil

❖ 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	Solar Energy	01(00)	02(00)	05(01)	08(01)
3	Wind Energy	01(00)	01(01)	02(00)	04(01)
4	Bio Energy	00(01)	02(00)	02(00)	04(01)
5	Hydrogen Energy and Fuel Cells	00(00)	02(01)	02(00)	04(01)
6	Other Renewable Energy Sources	03(00)	03(00)	02(01)	08(01)
	Total	07(01)	10(02)	13(02)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	R	1	2	R	1	2	U	1	2	U	1	30/35
	2	A	1	2	A	1	2	A	1	2	A	1	2	A	1	
	2	A	1	3	R	1	3	U	1	3	U	1	3	A	1	
	3	A	1	4	R	1	4	U	1	4	U	1	4	A	1	
	4	A	1	5	U	1	5	U	1	5	U	1	5	A	1	
	5	A	1	6	R	1	6	R	1	6	U	1	6	U	1	
	6	U	1	6	R	1	6	A	1	6	A	1	6	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO
	1	2	3	4	5	6	7	1	2	3
1	3				3		3			
2	3				3	1	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	Renewable Energy Technologies- A Practical guide for beginners	Chetan Singh Solanki, PHI Learning Pvt. Ltd., First, 2008.	978-81-203-3434-2
2	Solar Energy: Principles of Thermal Collection and Storage	S.P. Sukhatme, McGraw-Hill Education (India), 3rd Edition, 2009	10: 0070142963 13: 978-0070142961
3	Solar Photovoltaic: Fundamentals, Technologies & Application	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 3rd Edition, 2015	8120351118, 978-81-203-5111-0
4	Wind Power Plants and Project Development	Joshua Earnest , Tore Wizelius, PHI Learning Pvt. Ltd., 2nd Edition, 2015	978-81-203-5127-1
5	Renewable Energy Sources and Emerging Technologies	D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd., 2nd Edition, 2015	978-81-203-4470-9
6	Solar Photovoltaic Technology and System: A Manual for Technicians, Trainers and Engineers	Chetan Singh Solanki, PHI Learning Pvt. Ltd., 5th Edition, 2016	978-81-203-4711-3

❖ **E-REFERENCES:**

- https://www.youtube.com/watch?v=Giek094C_l4&ab_channel=SmileandLearn-English, accessed on 6th November, 2021
- https://www.youtube.com/watch?v=4vPyA_wDM5c&ab_channel=A1ADVENTURE accessed on 6th November, 2021
- https://www.youtube.com/watch?v=3UafRz3QeO8&ab_channel=BioConstruct accessed on 6th November, 2021
- https://www.youtube.com/watch?v=qSWm_nprfqE&ab_channel=Lesics , accessed on 6th November, 2021
- https://www.youtube.com/watch?v=0oK_VQnPDuY&ab_channel=DeepakumarYadav , accessed on 6th November, 2021
- https://www.youtube.com/watch?v=iPheEg-K2qc&ab_channel=RealEngineering accessed on 6th November, 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	Mr.A.M.Arekar	HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur.
2	Dr.G.V.Gotmare	HoD, Electrical Engg. Deptt.	Government Polytechnic, Gondia
3	Mr.M.N.Gawande	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur
4	Smt.A.A.Alegaonkar	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 AE/AI/CE/CM/EC/IT/MC/ME/ MT/PK/TX/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE216G
COURSE TITLE	: ENERGY CONSERVATION OPPORTUNITIES**
TEACHING SCHEME	: TH:02; TU: 00; PR: 00(CLOCK Hrs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20 Min (Objective Type)

❖ **RATIONALE:**

Energy conservation is a scientific and basic tool to make balance in different forms of energies. This course imparts the awareness, knowledge and practical skills/ techniques of energy conservation in various sectors. To maintain the growth of development, electricity generation will be required to be increased by proper utilization of renewable and non-renewable sources of energy. After completion of this course diploma engineering students must use various techniques and methods of energy conservation. Also they should be able to perform energy audit and its implementation.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Identify role of different Government Bodies in energy conservation.
2. Suggest measures for energy conservation after energy audit.
3. Propose measures to conserve energy in mechanical systems.
4. Apply measures to conserve energy in electrical systems.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs
1. Introduction	1a. Estimate energy requirement in world and India per year. 1b. Justify need of Energy Conservation Act 2003. 1c. Identify role of given government bodies in energy conservation. 1d. Identify stars on given appliance. 1e. Identify type of given building as per ECBC.	1.1 Energy scenario: Energy Demand and Supply in world and India 1.2 Energy Conservation Act 2003 1.3 Roles of MNRE, MEDA, BEE 1.4 Star Labelling-Meaning, Purpose 1.5 Energy Conservation Building Codes-Purpose, Building Classification	06
2. Energy Audit	2a. Select suitable measuring instrument for given application. 2b. Calculate Pay Back Period for given system. 2c. Describe various steps in Energy Audit.	2.1 Energy audit , Energy audit instruments and their use, Questionnaire for energy audit projects, Energy flow diagram 2.2 Simple payback period meaning and simple calculation 2.3 Energy Audit procedure -walk through audit and detailed audit.	06
3. Energy Conservation in Mechanical Systems	3a. Summarize different factors on which performance of given pump depends. 3b. Assess opportunities for saving energy in given mechanical systems. 3c. Implement measures for saving energy in fans and blowers. 3d. Describe effect of different parameters on efficiency of given compressor.	3.1 Factors affecting pump performance, Efficient Pumping system operation, Energy conservation opportunities in Pumping systems 3.2 Fan types, flow control strategies, Fan performance Assessment, Energy ,Conservation opportunities in Pumping systems 3.3 Measures for energy saving in fans and blowers 3.4 Classification of Compressors, Pneumatic System components, Effect of various parameters on efficiency of Compressor	08
4. Energy Conservation in Electrical Systems	4a. Suggest different measures for conserving energy in given electrical appliances. 4b. Select suitable energy	4.1 Measures for Energy conservation in -Refrigerators -Air conditioners -Electric Furnace -TV, Computers -Geysers	12

	conservation in technique in given condition for a lighting system. 4c. Justify need of energy conservation in given transformers and induction motors. 4d. Describe advantages of Cogeneration on given points. 4e. Describe how energy can be conserved by using given tariff system.	4.2 Energy Conservation in Lighting by -Replacing Lamp sources -Using energy efficient luminaries -Using light-controlled gears -Installation of separate transformer / servo stabilizer for lighting -Periodic survey and adequate maintenance programs 4.3 Need for energy conservation in induction motor and transformer 4.4 Cogeneration-Meaning, Advantages 4.5 Tariffs for energy conservation	
		Total Hrs	32

B. LIST OF PRACTICALS / LABORATORY EXPERIENCES / ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction	01(00)	01(00)	01(01)	03(01)
2	Energy Audit	01(00)	03(00)	03(01)	07(01)
3	Energy Conservation in Mechanical Systems	01(00)	03(00)	04(01)	08(01)
4	Energy Conservation in Electrical Systems	02(00)	04(01)	06(01)	12(02)
	Total	05(00)	11(01)	14(04)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	U	1	1	A	1	1	A	1	2	R	1	30/35
	2	U	1	2	U	1	2	U	1	2	A	1	2	A	1	
	2	A	1	2	A	1	3	R	1	3	U	1	3	U	1	
	3	U	1	3	A	1	3	A	1	3	A	1	3	A	1	
	3	A	1	4	R	1	4	R	1	4	U	1	4	U	1	
	4	U	1	4	U	1	4	U	1	4	A	1	4	A	1	
	4	A	1	4	A	1	4	A	1	4	A	1	4	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO
	1	2	3	4	5	6	7	1	2	3
1	3				3		3			
2	3	3			3	2	3			
3	3	3			3		3			
4	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	Generation and Utilisation of Electrical Energy	D. Srilatha S. Sivnagraju M. Balasubbareddy, Pearson, New Delhi 2010	8131798771, 9788131798775 978-81-317-6774-O
2	India – The Energy Sector	P.D. Henderson, World Bank Publication, Oxford University Press, 1975.	0-19-521598-2-
3	Energy Management Handbook	W.C Turner, John Wiley and Sons Wiley Press Eighth Edition, 2015	10: 142008870X
4	Efficient Use and Management of Electricity in Industry.	B.G. Desai, J.S. Rana, A.V. Dinesh, R. Paraman, Devki Energy Consultancy Pvt. Ltd, 4th Edition, 2016	-

❖ **E-REFERENCES:**

- <https://legislative.gov.in/sites/default/files/A2001-52.pdf> , accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=d0Bh3TQ_oEU&ab_channel=ErgoELearning by Dr.Sonal Desai accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=sB0foj6GTi8&ab_channel=AMOLPARKHE accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=ZKUzm5vh3qc&ab_channel=J%C3%A4mtkraftAB accessed on 24 Dec 2021
- https://www.youtube.com/watch?v=lovqoSrQI_w&ab_channel=ClassgoEducation accessed on 24 Dec 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	Mr.A.M.Arekar	HoD, Electrical Engg.Deptt.	Government Polytechnic, Nagpur
2	Dr.G.V.Gotmare	HoD, Electrical Engg. Deptt.	Government Polytechnic, Gondia
3	Mr.M.N.Gawande	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur
4	Smt.A.A.Alegaonkar	Lecturer in Electrical Engg.	Government Polytechnic, Nagpur

(Member Secretary PBOS)

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GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

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

COURSE CATEGORY: OPEN ELECTVIVE COURSE

COURSE CODE : OE217G

COURSE TITLE : ELECTRIC VEHICLES**

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

TOTAL CREDITS : 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)

TH. TEE : 01 HR (Objective Type Online Examination)

PR. TEE : --

PT. : 20 Min (Objective Type)

❖ RATIONALE:

Automobile engineering technicians, being a professional who deals with a motor vehicle related activities during its life cycle should be thoroughly conversant with different Auto. Transmission system & all sub Systems associated. This is Advance Technology course that deals with construction and working of transmission system in general and its sub systems in particular that equip AET to deal with them satisfactorily. The course aims to impart basic skills and understanding of automobile transmission systems basic components their working principle, classification and performance characteristics.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Apply the knowledge of Electric vehicle system.
2. Select various EV layouts and different types of drives.
3. Identify the various systems of EV and their parts.
4. Disassemble & assemble the components of EV.
5. Service EV modern cars and bikes.
6. Diagnose faults in battery, gear boxes, differential and the wheels.

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to Electrical Vehicles	1a. Define given term of EV. 1b. Describe given layout of EV. 1c. Describe various FEMA regulations.	1.1 Introduction: 1.1.1 Electric Vehicles - Need, Types – Cost and Emissions – End of life. 1.1.2 EV's general layout / differences compared to IC engine vehicles and Hybrids 1.1.3 FEMA Regulations.	04
2.EV Layout	2a. Describe the layout of given EV 2b. Classify different layouts in EV. 2c. State the Functions of given parts.	2.1 Two wheeler Electric Vehicle– layouts, cables, components and Controls and Functions of above parts. 2.2 Four wheeler Electric Vehicle – layouts, cables, components and Controls and Functions of above parts.	04
3. EV Motors and Drives	3a. Describe the construction and working of given motors used in EV. 3b. Classify EV motors on the given basis. 3c. Identify faults in EV electric motor based on symptoms and suggest remedy.	3.1 Electric Vehicle Motors – Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. 3.2 Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating 3.3 Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. 3.3.1 Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design 3.3.2 Parts of a typical hub mounted BLDC traction motor- Specifications construction, working and testing.	06
4. EV Motor Control Unit	4a. State the necessity of Motor control unit in given EV.	4.1 Traction Motor Controller : Basic Functionalities of Motor Control Unit	06

	4b. Identify components of High voltage circuit in given EV. 4c. Describe construction and working of the given EV motor inverter.	4.2 High voltage circuit in EV car and Low voltage Circuit in EV car, Multiple CAN network, Torque delivery, Launch control, On the fly power levels, DC-DC Converter, Power distribution modules. 4.3 Motor invertors – Need, construction, types, specifications and working and testing.	
5. EV Battery and Its Management System	5a. Describe Construction of given battery pack. 5b. Describe battery management system. 5c. Describe General recycling methods of recycling of EV batteries.	5.1 Battery Pack And Battery Management System 5.1.1 Selection of battery for EVs & HEVs, Traction Battery Pack design, 5.1.2 Requirement of Battery Monitoring, Battery State of Charge Estimation methods 5.1.3 Battery Cell equalization problem, 5.1.4 Energy storage system and management system 5.1.5 Battery thermal control, protection interface, SOC Estimation, Energy & Power estimation, 5.2 Parts: Power Module, Battery, DC/DC Converter, load, communication channel, 5.3 Battery Pack Safety and Battery Standards 5.3.1 Thermal Runway: High discharge rates, Short circuits, charging and discharging. 5.3.2 General recycling methods of recycling of EV batteries.	06
6. EV Charging	6a. State given Electric Vehicle supply system. 6b. Classify EV charging system pressure on given basis. 6c. Enlist EVSE Standards and their	6.1 Electric Vehicle Supply Equipment (EVSE) classification - Rapid fast charging, Battery swapping, Range extension (RE) systems and Wireless charging on following parameters : • By EVSE output - AC	06

	application.	or DC • By EVSE power rating – levels 1, 2, 3 • By charging speed – slow, fast or ultra-fast • By charging communication and connector type – CCS, GB/T, CHAdeMO 6.2 EVSE safety standards : IEC 61140, IEC 61000-6-2 AC charging and connectors: IEC-62196-2 (normal + high power), IEC 60309-1, SAE J 1772 (Type 1) etc DC Charging and Connectors: IEC-62196-3 (normal + high power), GB/T 20234.3- 2015	
Total Hrs.			32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Electrical Vehicles	01(00)	01(00)	01(01)	03(01)
2	EV Layout	01(00)	03(00)	03(01)	07(01)
3	EV Motors and Drives	01(00)	03(00)	04(01)	08(01)
4	EV Motor Control Unit	02(00)	02(01)	02(01)	06(02)
5	EV Battery and its management System	00(00)	02(00)	02(00)	04(00)
6	EV Charging	00(00)	00(00)	02(00)	02(00)
	Total	05(00)	11(01)	14(04)	30(05)

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			Options
Q 01 To Q 35	1	R	1	1	U	1	1	A	1	1	A	1	2	R	1	30/35
	2	U	1	2	U	1	2	U	1	2	A	1	2	A	1	
	2	A	1	2	A	1	3	R	1	3	U	1	3	U	1	
	3	U	1	3	A	1	3	A	1	3	A	1	3	A	1	
	3	A	1	4	R	1	4	R	1	4	U	1	4	U	1	
	4	U	1	4	A	1	4	A	1	4	A	1	5	U	1	
	5	U	1	5	A	1	5	A	1	6	A	1	6	A	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	2	3	-	3	-	-	3	3	3
2	3	-	-	3	3	-	3	2	3
3	2	3	2	-	-	-	3	2	2
4	3	3	-	-	3	-	3	3	3
5	3	-	-	3	3	-	3	3	3
6	3	3	2	-	-	-	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	Electric Vehicles: Modern Technologies and Trends	Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer Nature, 25-Nov-2020	97881801419669
2	Electric Cars: The Ultimate Guide for Understanding	Book by Brad Durant, Createspace Independent Pub, 31 May 2014	978-1507849774
3	Electric and hybrid vehicles: fundamentals	Iqbal Husain, CRC Press, 16 August 2010	143981175X, 978-1439811757
4	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, CRC Press, 28 March 2018	1498761771, 978-1498761772

❖ **E-REFERENCES:**

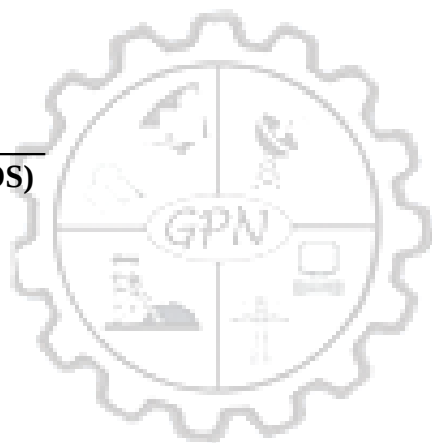
- <https://batteryuniversity.com>, dated 12 th February 2022
- <https://www.youtube.com/watch?v=3SAxXUIre28> 12 th February 2022
- <https://www.youtube.com/watch?v=tJfERzrG-D8> 12 th February 2022
- https://www.youtube.com/watch?v=j3-gbhi_nds 12 th February 2022

❖ **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.G.K.Awari	Head of Automobile Engineering	Government Polytechnic, Nagpur.
2	Mr.S.D.Thakre	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
3	Dr.K.S.Dixit	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
4	Mr.S.A.Telang	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
5	Mr.R.B.Tirpude	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.
6	Mr.Syed J.M.	Lecturer in Automobile Engineering	Government Polytechnic, Nagpur.

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GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/CE/EC/MC/ME/MT/PK/TX/TR/EE/CM
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE218G
COURSE TITLE	: ARTIFICIAL INTELLIGENCE**
TEACHING SCHEME	: TH:02;TU:00;PR:00(CLOCK Hrs.)
TOTALCREDITS	: 02(1TH/TUCREDIT=1CLOCK HR., 1 PR CREDIT=2 CLOCK HR.)
TH. TEE EXAM	: 01HR (Objective Type Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20Min (Objective Type)

❖ RATIONALE:

This course will introduce and define the meaning of Intelligence and explore various paradigms for knowledge encoding in computer systems. The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms problem, problem space: Search, Knowledge representation, inference, logic, and learning.

❖ COURSE OUTCOMES:

After completing this course students will be able to–

1. Identify the need of AI and its applications in real life.
2. Analyze and illustrate how search algorithms play vital role in problem solving.
3. Analyze the different types of intelligent agents.
4. Build knowledge of reasoning and knowledge representation for solving real world problems.
5. Illustrate various types of learning of AI.
6. Analyze the expert system tools and applications.

❖ **COURSE DETAILS:****A. THEORY:**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction	1a. Justify the given concepts of AI. 1b. Choose correct types of AI on the basis of given point. 1c. Compare AI with given topic with justification.	1.1 Definitions – Artificial Intelligence History of AI, Evolution of AI -Applications of AI 1.2 Meaning of intelligence, turning test, Intelligent Decision, Types of AI 1.3 Artificial Intelligence Vs Machine learning, Topics in AI	04
2. State Space Search	2a. Select suitable search technique on the basis of given point. 2b. Compare search method with given point. 2c. Compare heuristic search on basis of given point.	2.1 Generate and test, Simple search 2.2 Depth First search(DFS), Breadth First search(BFS) 2.3 Comparison of DFS and BFS, Quality of solution, Heuristic search	06
3. Intelligent Agents	3a. Identify the types of given intelligent agents. 3b. Justify need of AI with example.	3.1 Types of AI Agents, Agents in AI, Agents environment 3.2 Turning Tests in AI, Applications of AI-Artificial intelligence, Importance of AI	06
4. Knowledge Representation	4a. Describe issues and approaches related to given knowledge representation. 4b. Select appropriate knowledge representation technique to represent given fact.	4.1 Approaches to Knowledge representations, Issues in Knowledge representations , Frame Problem 4.2 Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Planning, partial order planning	06
5. Subset of AI	5a. Classify types of learning on basis of given point. 5b. Compare given main two types of learning on basis of given point. 5c. Illustrate the concepts of given learning.	5.1 Meaning of learning, Types of learning-Narrow AI, strong AI, general AI, super AI machine learning, deep learning 5.2 Supervised and unsupervised learning, Robotics ,Machine vision, Speech Recognition	04

6. Expert System	6a. Justify need of given Expert system on basis of its given characteristics. 6b. Identify components of given expert system on basis of given point.	6.1 Introduction to Expert Systems- Need of expert system, Characteristics of expert system 6.2 Components of expert system, Limitations, Application: NLP(natural language processing)	06
		Total	32

B. LIST OF PRACTICALS /LABORATORY EXPERIENCES/ASSIGNMENTS:NIL

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction	01(00)	02(00)	01(00)	04(00)
2	State space search	01(00)	02(00)	02(01)	05(01)
3	Intelligent Agents	01(00)	02(00)	03(01)	06(01)
4	Knowledge Representation	02(00)	00(01)	03(00)	05(01)
5	Subsets of AI	00(00)	03(01)	03(00)	06(01)
6	Expert Systems	01(00)	00(00)	03(01)	04(01)
	Total	06(00)	09(02)	15(03)	30(05)

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	Bit1			Bit2			Bit3			Bit4			Bit5			Bit6			Options
Q.No.1 to Q.No.35	1	R	1	1	U	1	1	U	1	1	A	1	2	R	1	2	U	1	30/35
	2	U	1	2	A	1	2	A	1	2	A	1	3	R	1	3	U	1	
	3	U	1	3	A	1	3	A	1	3	A	1	3	A	1	4	R	1	
	4	R	1	4	A	1	4	A	1	4	A	1	4	U	1	5	U	1	
	5	U	1	5	U	1	5	A	1	5	A	1	5	A	1	5	U	1	
	6	R	1	6	A	1	6	A	1	6	A	1	6	A	1				

❖ **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	--	--	Journal	
		Journal Writing		Assignments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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)							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	-	-	-
6	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	Artificial Intelligence A Modern Approach	S.Russell and P.Norvig., Pearson Education, 4 th edition, 2020	13:978-0-13-604259-4
2	First Course in AI	Deepak Khemani, McGraw Hill, 2013	13:978-93-832-8678-2 10:93-832-8678-4
3	Artificial Intelligence	E. Rich and K. Knight and Shivashankar B. Nair., 3 rd edition, Tata McGraw Hill	13:978-007-008-770-5
4	Introduction to Artificial Intelligence & Expert Systems	Dan W. Patterson, PHI., 1990 Learning, 1st ed. 2011	9789332551947

❖ **E-REFERENCES:**

- <https://www.javatpoint.com/types-of-ai-agents>, accessed on 25 Jan. 2022
- http://www.dkriesel.com/en/science/neural_networks, accessed on 25 Jan. 2022
- https://www.youtube.com/results?search_query=artificial+intelligence, accessed on 25 Jan 2022
- <https://www.youtube.com/watch?v=s-s9ilkMVj8>, accessed on 25 Jan. 2022

❖ **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.A.R.Mahajan	Head of Department (I.T.Dept.)	Chairman, Course Expert
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.L.D.Vilhekar	Lecturer in Information Tech.	Member(Internal)
6	Mrs.D.P.Chanmanwar	Lecturer in Information Tech.	Member(Internal))
7	Mr.M.N.Gawande	Lecturer in Electrical Engg.	CDC In Charge and Member Secretary
8	Mrs.Isha L.Sangolkar	Lecturer in Information Tech.	Course Expert

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/ME/CE/EC/MT/PK/EE/TX/AI/CM/IT/TR
COURSE CATEGORY:	OPEN ELECTIVE COURSE
COURSE CODE	: OE222G
COURSE TITLE	: MECHATRONICS**
TEACHING SCHEME:	TH:02; TU: 00;PR: 00(CLOCK HRs.)
TOTAL CREDITS	: 02(1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20 min Objective Type)

❖ **RATIONALE:**

Mechatronics is multi disciplinary field that focuses on the integration of mechanical, electronics and electrical engineering system. It includes a combination of robotics, electronics, computer science, telecommunications, control and product engineering. This subject develops skills in students about to produce a design solution that unifies each of these various subfields. A mechatronics engineer unites the principles of subfields to generate a simpler, more economical and reliable system.

❖ **COURSE OUTCOMES:**

After completing this course students will be able to–

1. Use various control systems for suitable applications.
2. Troubleshoot problems in various sensors and transducers.
3. Select a particular motor depending upon the system design requirements.
4. Develop a program to perform a task using different instructions in PLC.

❖ **COURSE DETAILS:**

A. THEORY :

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Introduction to Mechatronics	1a. Use given mechatronics system. 1b. Describe given components of given system architecture. 1c. Classify given types of control system. 1d. Use application of given water level controller. 1e. Utilize controllers for given applications.	1.1 Introduction to Mechatronics, Importance of Mechatronics. 1.2 Mechatronics system architecture - Sensors, Signal conditioners, PLC/ Embedded controllers, Pneumatic, Hydraulic and electrical actuators. 1.3 Control systems – open and closed loop systems, Basic elements of Closed-loop control System. 1.4 Automatic water level controller. Sequential controllers-washing machine. 1.5 Advantages and disadvantages of Mechatronics.	06
2. Sensors and Transducers	2a. Describe functions of given sensors and transducers. 2b. Categorize given performance terminology. 2c. Describe troubleshooting procedure of given displacement sensors. 2d. Describe given sensors for suitable application. 2e. Select suitable temperature sensor for given application.	2.1 Introduction to Sensors and Transducers. Selection criteria of Sensors. 2.2 Performance terminology – Range and span, Error, Accuracy, Sensitivity, Hysteresis error, Repeatability. 2.3 Displacement sensors:- LVDT, RVDT. Position sensors:- Hall effect sensor, Eddy current . 2.4 Proximity sensors:- Capacitive and Inductive, Optical encoder, Force Sensors. 2.5 Temperature Sensors:- Thermocouple, RTD.	10
3. Actuation Systems	3a. Describe various components of given actuation system. 3b. Use given bearings for given application. 3c. Classify various components of given electrical actuation system. 3d. Select a particular	3.1 Mechanical Actuation Systems - Types of motion, Freedom and constraints, Loading, GearTrains, Pawl & Ratchet, Belt and Chain drives. 3.2 Bearings –Types of bearings and applications. 3.3 Electrical Actuation Systems - Switches & Relays, Solenoids, Introduction of D.C. Motors and	08

	motor depending upon the given system design requirements. 3e. Classify given types of servomotor. 3f. Maintain given systems on the basis of component faults.	A. C. Motors. 3.4 Stepper Motors - Specifications and Control of stepper motors. 3.5 Servomotors - D.C. Servomotor and A.C Servomotor. 3.6 Pneumatic & Hydraulic Systems - Power supplies, DCV, PCV, cylinders.	
4. Programmable Logic Controller (PLC)	4a. Describe structure of given system. 4b. Develop the given ladder logic for given instructions of PLC. 4c. Develop a program to perform a given task using different instructions in PLC. 4d. Use given components of PLC. 4e. Select appropriate PLC for given application.	4.1 Definition, Basic block diagram and structure of PLC, Input/Output processing. 4.2 Types of PLC Programming, Ladder diagram, its logic functions. 4.3 Latching and Sequencing, PLC mnemonics. 4.4 Timers, Internal relay and Counters, Shift registers, Master and Jump Controls. 4.5 Data handling, analog input/output, Selection of PLC.	08
		Total Hrs	32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Nil

❖ **SPECIFICATION TABLE FOR THEORY PAPER:**

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Introduction to Mechatronics	01(00)	03(01)	03(00)	07(01)
2	Sensors and Transducers	01(00)	04(00)	03(01)	08(01)
3	Mechanical and Electrical Actuation Systems	01(00)	04(00)	03(01)	08(01)
4	Programmable Logic Controller (PLC)	01(00)	03(01)	03(01)	07(02)
	Total	04(00)	14(02)	12(03)	30(05)

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
Q. 01 To Q. 35	1	R	1	1	U	1	1	U	1	1	U	1	1	A	1	1	A	1	30/35
	2	R	1	1	U	1	1	A	1	2	U	1	2	U	1	2	U	1	
	3	R	1	2	U	1	2	A	1	2	A	1	2	A	1	2	A	1	
	4	R	1	3	U	1	3	U	1	3	U	1	3	U	1	3	A	1	
	3	A	1	3	A	1	3	A	1	4	U	1	4	U	1	4	U	1	
	4	U	1	4	A	1	4	A	1	4	A	1	4	A	1				

❖ **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
		Class Room Assignments		Assignments	05	--	Assignment Book	1, 2, 3,4
	TEE (Term End Examination)	End Exam	Students	End of the Course	30	12	Theory Answer Scripts	1, 2, 3,4
				Total	50	20		
Direct Assessment Practical	CA (Continuous Assessment)	Continuous Assessment of Practical	Students	End of Every Practical	--	--	Journal	--
		Journal Writing		Assignments	--	--	Journal	--
				Total	--	--		--
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	--
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)							Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	1	2
1	3	-	-	3	-	-	-	2	-
2	3	2	-	3	1	-	2	2	2
3	3	2	2	3	-	2	2	-	-
4	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	Mechatronics	W. Bolton, Pearson Education, India, Fourth Edition, 2008	8131762572 9788131762578
2	Mechatronics (Integrated Mechanical Electronics System)	K.P. Ramchandran, G. K. Vijayraghavan, M.S. Balsundaram, Wiley India Pvt. Ltd., First Indian Edition, 2008	8126518375 9788126518371
3	Mechatronics : An Introduction	Robert Bishop, CRC press, 2008	0849363586
4	Mechatronics	J. Paulo Davim, Wiley India Pvt. Ltd. 2011	1848213085 9781848213081
5	Robotics	Appu Kuttan K. K., I. K. International Pvt. Ltd., First Edition, 2010	8189866389 9788189866389

❖ **E-REFERENCES:**

- nptel.ac.in/courses/112103174 , accessed on 30th August, 2021
- nptel.ac.in/courses/pdf/mod7 , accessed on 30th August, 2021
- video_demos.colostate.edu/mechatronics , accessed on 30th August, 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.R.V.Yenkar	Head of Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
2	Dr.V.H.Mankar	Head of Electronics & Telecomm Engineering	Government Polytechnic, Nagpur.
3	Mrs.U.P.Potdar	Lecturer in Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
4	Mrs.J.A.Raut	Lecturer in Electronics & Telecomm Engineering	Government Polytechnic, Nagpur
5	Mr.S.V.Darvhekar	Director	Beta Computronics Pvt. Ltd.Nagpur
6	Mrs.Gazala Ali	Head of Electronics & Telecomm Engineering,	Ajuman Polytechnic, Nagpur.
7	Mr.K.S.Pachpor	Lecturer in Electronics,	Government Polytechnic, Achalpur.

(Member Secretary PBOS)

(Chairman PBOS)

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

COURSE CURRICULUM

PROGRAMME	: DIPLOMA IN AE/CE/EC/EE/MC/ME/MT/PK/TX/TR
COURSE CATEGORY	: OPEN ELECTIVE COURSE
COURSE CODE	: OE223G
COURSE TITLE	: TECHNOLOGICAL EVOLUTION IN COMPUTER**
TEACHING SCHEME	: TH: 02; TU: 00;PR: 00 (CLOCK HRs.)
TOTAL CREDITS	: 02 (1 TH/TU CREDIT = 1 CLOCK HR., 1 PR CREDIT = 2 CLOCK HR.)
TH. TEE EXAM	: 01 HR (Objective Type Online Examination)
PR. TEE EXAM	: --
PT. EXAM	: 20 Min (Objective Type)

❖ **RATIONALE:**

The course is designed for students to cover the concepts of Technological evolution in computers and to understand technological developments in the field of Information Technology. This course also highlights the students to know how developments in the field of software evolved as the technology advancements.

❖ **COURSE OUTCOMES :-**

After completing this course students will be able to–

1. Identify the concepts, terminology and Generation of Computers their features and applications.
2. Interpret the importance of Chipsets and their functions.
3. Summarize the types of Processors, Storage devices and Ports used in Computers.
4. Apply the Knowledge of Operating System and Identify its types based on technological evolution.
5. Identify the Role and Functions of I/O devices used in Computers.
6. Analyze the case studies of super computer based on the tools i.e. Questionnaire, Survey .

❖ **COURSE DETAILS:****A. THEORY :**

Units	Specific Learning Outcomes (Cognitive Domain)	Topics and Subtopics	Hrs.
1. Evolution of Computers	1a. Describe the history of computers w.r.t given data. 1b. Identify the ongoing generation of computers from the given data. 1c. Select important features of computers from the given data. 1d. Determine the applications of computers on the basis of the given points.	1.1 Introduction, History of Computers • Abacus • Napier's Bones • Pascaline • Stepped Reckoner or Leibnitz wheel • Difference Engine • Analytical Engine • Tabulating Machine • Differential Analyzer • Mark I 1.2 Generation of Computers 1.3 Features of Computers (Characteristics) 1.4 Applications of Computers • Home • Medical Field • Entertainment • Industry • Education • Government • Banking • Business	04
2. Introduction to Chipsets	2a. Determine the concept of chipset from the given data. 2b. Identify the chipset used in computers based on evolution. 2c. Determine the concept of Mobile chipset from the given data. 2d. Select the chipsets on the basis of their given functions.	2.1 Basic Concepts of Chipset 2.2 Types of Chipset – (Concepts and Features) • 80286 • 386 • 486 • 586 • Pentium II,III,IV,V • Celeron, Dual Core • Core 2 Duo • Intel i3,i5 & i7 2.3 Mobile chipset (Concepts) • A15 Bionic • Dimensity 9000 Plus • Snapdragon 8 Plus Gen 1 • Exynos 2200 2.4 Functions of chipset used in computers	05

3. Processors, Storage and Ports	3a. Identify the processors based on their given evolution. 3b. Select the primary and secondary storage devices on the basics of their given functions. 3c. Select ports used in computers based on different given output devices.	3.1 Processor : Basic concepts of processors – Starting from 8085 to latest i9 3.2 Storage Memory devices – - Types of RAM, ROM, - Secondary Storage Devices (HDD,SSD, Pen drive and Memory cards) 3.3 Basic of ports : - VGA - Serial/Parallel port - USB - HDMI	05
4. Operating System	4a. Identify the function of Operating System. 4b. Select the OS used in computer and mobile system from the given. 4c. Identify the commands used in Single user and Multiuser OS modes on the basis of the given points. 4d. Select the type of OS from the given data for GUI based OS.	4.1 Concepts of Operating System (OS) 4.2 Type of OS : - Batch OS - Multiprogramming OS - Time Sharing OS - Multiprocessor OS - Distributed OS - Real Time System - Mobile OS (Androids and IOS) 4.3 Command Line based OS : - DOS and UNIX 4.4 Graphical use Interface (GUI) based OS - Windows and Linux	06
5. I/O Devices	5a. Select the I/O devices with their functions from the given data. 5b. Analyze the types of Input devices used in computers from the given data. 5c. Identify the types of Output devices used in computers from the given data.	5.1 Basics of I/O Device - Role / Function of I/O Devices 5.2 Input devices – - Keyboard - Point and draw (Mouse and Track ball) - Data Scanning Devices - Digitizers - Speech Recognition devices - Vision based devices 5.3 Output Devices – - Monitor - Printer - Plotter - Screen Image Projects and Voice respond system	06
6. Case Studies of Super- Computers	6a. Compare the concept of ARPANet, Distributed computing and cloud computing on the basis of given points.	6.1 Concepts of ARPANet - Distributed computing - Cloud computing - Virtualization 6.2 Concept of Super Computer - What is a supercomputer	06

	6b. Analyze the concept of Super Computers from the given data. 6c. Select the super Computers based on given parameters.	- How supercomputers work (Brief) - Differences between general-purpose computers and supercomputers 6.3 Various Super Computer – (Brief introduction) - Param (India) - Tianhe-2 (China) - Sunway Taihulight (China) - Sierra (US) - Summit (US) - Fugaku (Japan)	
		Total Hrs.	32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS: Nil

❖ SPECIFICATION TABLE FOR THEORY PAPER:

Unit No.	Units	Levels from Cognition Process Dimension			Total Marks
		R	U	A	
1	Evolution of Computers	01(00)	01(00)	00(00)	02(00)
2	Introduction to Chipsets	02(00)	02(00)	02(01)	06(01)
3	Processors, Storage and Ports	01(00)	02(00)	04(01)	07(01)
4	Operating System	01(00)	01(01)	03(00)	05(01)
5	I/O Devices	00(00)	02(00)	03(01)	05(01)
6	Case studies of Super-Computers	01(00)	01(01)	03(00)	05(01)
	Total	06(00)	09(02)	15(03)	30(05)

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			Options
Q 01 To Q 35	1	R	1	2	R	1	1	U	1	6	A	1	2	R	1	30/35
	2	U	1	2	U	1	6	A	1	6	A	1	2	A	1	
	2	A	1	2	A	1	3	R	1	3	U	1	3	A	1	
	3	U	1	3	A	1	3	A	1	3	A	1	3	A	1	
	4	R	1	4	U	1	4	U	1	4	A	1	4	A	1	
	4	A	1	5	U	1	5	U	1	5	A	1	5	A	1	
	5	A	1	5	A	1	6	R	1	6	U	1	6	U	1	

❖ **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		Assign-ments	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	--	--	Journal	
		Journal Writing		Assign-ments	--	--	Journal	
				Total	--	--		
	TEE (Term End Examination)	End Exam	Students	End of the Course	--	--	Practical Answer Scripts	
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	PSO	PSO
	1	2	3	4	5	6	7	1	2	3
1	3	3	3	-	-	-	-	3	-	-
2	3	3	-	-	-	-	-	3	-	-
3	3	-	-	-	-	-	-	3	-	-
4	3	3	3	-	-	-	-	-	-	-
5	3	3	3	-	-	-	-	3	-	-
6	-	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	The Evolution of Computer Technology (Evolving Technology)	Haq Kamar Britannica Educational Pub 15 August 2018	ISBN-10 : 1538302837 ISBN-13 : -978 1538302835
2	Chipset (The Homeland Connection Book 4)	Lior Samson Gesher Press - Kindle Edition (15 December 2012)	---
3	Fundamentals of Computers	E Balagurusamy McGraw Hill Education (24 June 2009)	ISBN-10 : 9780070141605 ISBN-13 : -978 0070141605
4	Computer Fundamentals	Pradeep K Sinha & Priti Sinha Sixth Edition BPB Publication	---
5	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin & Greg Gagne Wiley; 9th edition (December 17, 2012) 9th Edition	ISBN-10 : 1118063333 ISBN-13 : -978 1118063330
6	A Practical Guide to Building I/O Devices	John Hyde Intel Press, 2001 John Hyde Intel Press, 2001 2, illustrated	0970284659, 9780970284655

7	The Architecture of Supercomputers: Titan, a Case Study	Daniel P. Siewiorek & Philip John Koopman Jr. Academic Press (April 7, 2015)	ISBN-10 : 1483246590 ISBN-13 : -978 1483246598
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❖ **E-REFERENCES:**

- https://www.brainkart.com/article/Case-Studies-of-Top-Supercomputer-Systems_11327 accessed date 01/08/2022
- https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/13_IOSystems.html accessed date 03/08/2022
- https://en.wikipedia.org/wiki/List_of_Intel_chipsets accessed date 04/08/2022
- <https://www.giznext.com/mobile-chipsets> accessed date 04/08/2022

❖ **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.M.V.Sarode	Head of Department (Computer Engg.Dept.)	Government Polytechnic Nagpur
2	Mr.M.A.Rahman	Lecturer in Computer Engineering	Government Polytechnic Nagpur
3	Mr.A.A.Uike	Lecturer in Computer Engineering	Government Polytechnic Nagpur
4	Mr.P.S.Thakre	Lecturer in Computer Engineering	Government Polytechnic Nagpur
5	Mr.Dipak Dhote	Operations Manager,	IT-Network Infosystems Pvt LTD, Nagpur
6	Dr.Rakesh Kadu	Assistant Professor, I.T.	Ramdeobaba College of Engg, and Management, Nagpur.
7	Mrs.V.A.Raje	System Analyst	MSBTE,RO Nagpur

(Member Secretary PBOS)

(Chairman PBOS)