GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME**
PROGRAMME CODE	**04**
COURSE TITLE	**MECHANICAL ENGINEERING MATERIALS**
COURSE CODE	**MT31201**
PREREQUISITE COURSE CODE & TITLE	**SC11201 ENGINEERING CHEMISTRY**
CLASS DECLARATION COURSE	**NO**

I. LEARNING&ASSESSMENTSCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
1	MECHANICAL ENGINEERING MATERIALS	DSC	3	0	2	1	6	3	2 Hrs	30	70*#	100	20	25	10	25@	10	25	10	175

Total IKS Hrs for Term: Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

To meet current and future metal demands it is essential to get material knowledge for mechanical diploma technicians working in the metal working industry. Materials like ferrous and non-ferrous metals, polymers, ceramics and composites are widely used in a variety of engineering applications. This course deals with these materials along with advanced materials, their metallurgical considerations, heat treatment processes, structure-property relationship and applications.

III. COURSE-LEVELLEARNINGOUTCOMES(CO's)

Students will be able to achieve &demonstrate the following CO's on completion of course-based learning

CO1: Select suitable material(s) based on desired properties according to application.
CO2: Choose relevant alloy steel & Cast iron for mechanical components.
CO3: Select relevant non-ferrous & powder material components for the engineering application.
CO4: Select relevant non-metallic & Advanced material for the engineering application.
CO5: Use relevant heat treatment processes in given situations.

IV. THEORYLEARNINGOUTCOMESANDALIGNEDCOURSECONTENT

Sr.No	Theory Learning Outcomes(TLO'S) aligned to CoOs.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I BASICS OF ENGINEERING MATERIALS (CL Hrs-10, Marks- 14)				
1.	TLO 1.1. Interpret the crystal structure of specified materials TLO 1.2. Identify the microstructure of the given material with justification. TLO 1.3 Explain with sketches the procedure to prepare a given sample. TLO 1.4 Identify & Interpret the given equilibrium diagram & reactions with justification. TLO 1.5 Identify the given fields of steel on Iron carbon diagrams with justification. TLO 1.6 Choose a relevant hardness tester based on the given situation with justification.	1.1 Classification of Engineering Materials 1.2 Crystal structure (BCC, FCC & HCP only) Unit cell and space lattice 1.3 Microstructure, types of microscopes 1.4 Sample preparation, etching process, and types of etchants. 1.5 Properties of metals Physical Properties, Mechanical Properties. 1.6 Concept of phase, pure metal, alloy and solid solutions. 1.7 Iron Carbon Equilibrium Diagram of various phases. Critical temperatures and significance. Reactions on Iron carbon equilibrium diagram. (Eutectic, Eutectoid & Peritectic only) 1.8 Hardness testing procedure on Brinell and Rockwell tester.	Lecture Using Chalk-Board Model Demonstration & Video Demonstrations	CO1
UNIT-II STEEL & CAST IRON (CL Hrs-10, Marks- 14)				
2	TLO 2.1 Select relevant steel for the given application with justification. TLO 2.2 Select the relevant cast irons as white, and grey cast iron for the given job with justification. TLO 2.3 Interpret the given material designations. TLO 2.4 Identify the properties of the given composition of cast iron with justification.	2.1 Broad Classification of steels. i. Plain carbon steels: Definition, Types and Properties, Compositions and applications of low, medium and high carbon steels. ii. Alloy Steels: Definition and Effects of alloying elements on properties of alloy steels. iii. .Tool steels: Cold work tool steels. Hot work tool steels, High-speed steels (HSS) iv. Stainless Steels: Types and Applications v. Spring Steels: Composition and Applications. vi. Specifications of steels as per standard (BIS, ASME, EN only) 2.2. Steels for the following components: Shafts, axles, Nuts, bolts,	Lecture Using Chalk-Board Model Demonstration Presentations	CO2

Sr.No	Theory Learning Outcomes(TLO'S) aligned to CoOs.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		Levers, crankshafts, camshafts, Shear blades, agricultural equipment, household utensils, machine tool beds, car bodies, Antifriction bearings and Gears. 2.3. Types of cast irons as white. Grey, nodular, malleable, Specifications of cast iron. 2.5 Selection of appropriate cast iron for engineering applications. 2.6 Designation and coding (as per BIS, ASME, EN, DIN, TIS) of cast iron, plain and alloy steel. 2.7. Use of iron and steel in ancient India; Munda, Tiksna and Kanta types of iron and steel (IKS).		
UNIT-III NON-FERROUS MATERIALS AND POWDER METALLURGY (CL Hrs-10, Marks- 14)				
3	TLO 3.1 Describe the properties and applications of the given copper alloy & aluminium alloy. TLO 3.2 Describe the properties and applications of the given bearing material TLO 3.3 Select relevant non-ferrous material for the specified application with justification. TLO 3.4 Explain various powder manufacturing processes.	3.1 Copper and its alloys - brasses, bronzes Chemical compositions, properties and Applications. 3.2 Use of copper in ancient India and its mention in Rigveda (IKS) 3.3 Aluminum alloys -Y-alloy, Hindalium, duralium with their composition and Applications. 3.4 Bearing materials like white metals (Sn-based), aluminium, and bronze. Porous, Self-lubricating bearings. 3.5 Powder Metallurgy: Introduction, Advantages, limitations and applications. Preparation of Metal Powders, Basic Steps for Powder Metallurgy.	Model Demonstration Lecture Using Chalk-Board Presentations	CO3
UNIT- IV NON-METALLIC MATERIALS AND ADVANCED MATERIALS (CL Hrs- 08, Marks- 14)				
4	TLO 4.1 Distinguish between metallic and non-metallic materials based on given composition, properties and applications. TLO 4.2 Choose relevant non-metallic material for the given job with justification. TLO 4.3 Select relevant	**Unit - IV** 4.1 Polymeric Materials i. Polymers:- types, characteristics, ii. Properties and uses of Thermoplastics, Thermosetting Plastics and Rubbers. iii.Thermoplastic and Thermosetting Plastic materials 4.2 Characteristics and uses of ABS and acrylics. Nylons and Vinyls, Epoxides, Melamines and Bakelites	Lecture Using Chalk-Board Presentations Demonstration	CO4

Sr.No	Theory Learning Outcomes(TLO'S) aligned to CoOs.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	composite material for the given job with justification. TLO 4.4 Suggest relevant alternative materials for the given job with justification.	4.3 Rubbers: Neoprene, Butadiene, Buna and Silicons - Properties and applications. 4.4 Ceramics -types of ceramics, properties and applications of glasses and refractories 4.5 Composite Materials - properties and applications of Laminated and Fiber reinforced materials. 4.6 Advanced Engineering Materials: Properties and applications of Nanomaterials and smart materials (Piezoelectric Materials, Magneto-Rheological Fluids, Electro-Rheological Fluid only) Biomedical materials.		
UNIT –V HEAT TREATMENT PROCESSES (CL Hrs- 05, Marks- 12)				
5	TLO 5.1 Describe with sketches the specified heat treatment processes. TLO 5.2 Select the relevant heat treatment processes for the given material with justification. TLO 5.3 Explain with sketches the working principle of the given heat treatment furnace. TLO 5.4 Suggest the relevant heat treatment process for the given situation with justification. .	**Unit - -V** 5.1 Overview of heat treatment. 5.2 Annealing: Purposes of annealing, Annealing temperature range, Types and applications. 5.3 Normalizing: Purposes of Normalizing, temperature range. Broad applications of Normalizing. 5.4 Hardening: Purposes of hardening, Hardening temperature range, applications 5.5 Tempering: Purpose of tempering Types of tempering and its applications 5.6 Case hardening methods like Carburizing, Nitriding, and Cyaniding. 5.7 Heat treatment Furnaces - Muffle, Box type.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Presentations	CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/LaboratoryLearningOutcome(LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
1	LLO 1.1 Use the slitting machine to prepare a sample of a given dimension. LLO 1.2 Use a grinding machine & polishing papers to prepare the surface of a given sample.	*Specimen preparation of a given material for microscopic examination.	2	CO1
2	LLO 2.1 Use suitable etchant for microscopic examination of the	*Interpretation of microstructure of steels and alloy steels using a metallurgical	2	CO1

Sr. No	Practical/Tutorial/LaboratoryLearningOutcome(LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
	given sample. LLO 2.2 Use a metallurgical microscope to observe the micro structure of the given specimen. LLO 2.3 Interpret the microstructure of a given specimen.	microscope on standard specimens.		
3	LLO 3.1 Use Brinell Hardness Tester LLO 3.2 Determine the hardness of given sample.	*Hardness testing on Brinell Hardness tester of given sample material.	2	CO1
4	LLO 4.1 Use a Rockwell Hardness tester. LLO 4.2 Determine the hardness of the given sample.	Hardness testing on Rockwell Hardness tester of given sample material.	2	CO1
5	LLO 5.1 Choose the appropriate hardness tester for mild steel. LLO 5.2 Use an appropriate hardness tester for mild steel.	Hardness testing on relevant hardness testers of given untreated and heat-treated Mild Steels.	2	CO1
6	LLO 6.1 Choose the appropriate hardness tester for alloy steel. LLO 6.2 Use an appropriate hardness tester for alloy steel.	Hardness testing on relevant hardness testers of given untreated and heat treated Alloy Steels.	2	CO1
7	LLO 7.1 Use a metallurgical microscope LLO 7.2 Interpret the microstructure of Cast Iron.	*Microstructure of cast iron using a metallurgical microscope on standard specimens.	2	CO1 CO2
8	LLO 8.1 Choose appropriate hardness testers for copper & Brass. LLO 8.2 Use appropriate hardness testers for non-ferrous material.	Hardness testing on relevant hardness testers of given non-ferrous material (Copper, Brass aluminium specimens).	2	CO1 CO3
9	LLO 10.1 Use an appropriate peel tester LLO 10.2 Determine the adhesive strength of cellophane tape and duct tape.	*Adhesive strength determination of cellophane tape and duct tape using a relevant peel tester.	2	CO3
10	LLO 12.1 Perform flame tests. LLO 12.2 Identify different types of plastics. Identification of different types of plastics using flame tests.	*Identification of different types of plastics using flame tests.	2	CO3
11	LLO 13.1 Use a High-temperature oven or electrical current LLO 13.2 Identify the behavior of the shape-memory alloy.	*Identification of the behaviour of the shape-memory alloy as a function with regards to temperature using a High-temperature oven or electrical current.	2	CO4

Sr. No	Practical/Tutorial/LaboratoryLearningOutcome(LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
12	LLO 14.1 Use a muffle /box-type furnace LLO 14.2 Use various quenching mediums for mild steel. LLO 14.3 Compare the hardness of mild steel.	*Comparison of the hardness of mild steel using quenching mediums like oil, water & brine in a muffle /box-type furnace.	2	CO1 CO5
13	LLO 15.1 Use a muffle /box-type furnace LLO 15.2 Use various quenching mediums for alloy steel. LLO 15.3 Compare the hardness of alloy steel.	Comparison of the hardness of alloy steel using quenching mediums like oil, water & brine in a muffle /box type furnace.	2	CO1 CO5
14	LLO 16.1 List various ancient Indian material development processes. LLO 16.2 Compare Ancient Indian material development processes with recent processes.	Comparison of Ancient Indian material development processes with recent processes.	2	CO1 CO2 CO3 CO4 CO5

VI. SUGGESTEDMICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT(SELF-LEARNING)

Microproject:

1. Collect information related to Types, Properties and applications of smart materials from websites. Present the information in the form of a Chart.
2. Collect samples of various types of plastics, ceramics, and composites used in day-to-day applications and prepare charts containing properties, and applications of the samples.
3. Comparative study of various materials used in previous and current generation components mechanical engineering equipment like IC Engine, Compressor, turbine, pumps, refrigerator, water cooler, Lathe Machine, Milling Machine, Drilling Machine grinding machine (anyone) with proper justifications.
4. Preparation of a chart of comparison of hardness of various materials.
5. Prepare models showing various crystal structures.
6. Prepare a puzzle game on the Iron-carbon Equilibrium diagram.
7. Determine the microstructure of different metallic components (minimum 5) using a metallurgical Microscope and compare their microstructure in the given group.

The above is just a suggestive list of microprojects and assignments; faculty must prepare their bank of microprojects, assignments, and activities similarly. The faculty must allocate a judicial mix of tasks, considering the weaknesses and/or strengths of the student in acquiring the desired skills.
If a micro project is assigned, it is expected to be completed as a group activity.
SLA marks shall be awarded as per the continuous assessment record.
If the course does not have an associated SLA component, the above suggestive listings apply to Tutorials and may be considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Slitting machine Specifications: • Capacity: 18 gauge / 1.2mm • Throat Depth: 24 inch (600mm) • Motor: 1 Hp, 230V, 50 Hz. • Minimum Slitting Width: 1 inch (25.4mm)	1
2	Double Disk polishing machine. Two independent polishing units mounted on a common MS frame, Disc dia 200mm, made of Aluminum. Speed continuously variable up to 950 RPM. Rating - 0.25 HP single phase 220 Volt A.C. provided with sink and swing type laboratory water tap. Waterproof Formica table top.	1
3	Digital Brinell hardness Tester 1) Test loads - 500 to 3000 Kgf. in steps of 250 Kg. 2) Magnification of objective - 14 X 3) Maximum test height - 380 mm. 4) Least count - 0.001 mm. 5) Throat depth - 200 mm.	3,5,6,8,9,12,13
4	Digital Rockwell hardness Tester 1) Test loads - 60, 100 & 150 kgf 2) Minor load - 10 kg 3) Max test height - 230 mm 4) Throat depth - 133 mm along with essential accessories.	4,5,6,8, 12,13
5	Digital Peel Strength Tester: Make: XEEPL • Load capacity: 0 - 5 kg; Resolution: 1 gram. • Load Indicator: Microprocessor-based digital load indicator with memory facility of peak load. • Clear Distance between two plates: Maximum up to 250 mm. • Speed of testing: 300 mm/minute. • Motor: Synchronous Motor. • Grips: A pair of hard chrome plated grips for thin poly film samples would be supplied. • Paint: Powder coated. • Power requirement: Single phase 230 Volts, 50Hz.	9
6	Spring coil of Shape memory sample (NiTi alloy) Burner/ Lighter, Sample Holder	11
7	Laboratory box furnace Light weight with ceramic fibre wool insulation. The exterior is made of G.I. sheets powder coated. Temperature Controlled by microprocessor-based Autotune PID digital temperature controller with CR/AL Thermocouple. Temperature Range: 1100°C., Muffle Size (inside): Temperature Range: 1100°C., Muffle Size (inside): 6”x6”x12’’, Power: 3.5 KW.	12,13
8	Standard Samples of Metallurgical Microstructure Plain carbon steels, alloy steels and cast iron (before and after heat treatment): 03 Each • Aluminum, Copper and Brass/Bronze (before and after heat-treatment): 03 Each Total 36 Specimens	2
9	Trinocular Upright Metallurgical Microscope: Coaxial Body • Body: Trinocular Head inclined at 45 degrees. • Focusing: Both side co-axial focusing knobs. • Nosepiece: Quadruple revolving nosepiece with accurate centering & amp; positive click stops. Trinocular Inverted Metallurgical Microscope (Magnification 100X, 200X, 400X & 800X) Eyepieces - WF 10X, 20X (Paired) Objectives - M 5x, M 10x, M 20x and M 40x (SL) Stage - Built-in graduated mechanical stage of size 165mm.x180mm. is controlled by convenient low coaxial positioned knobs for easy and smooth scanning of the specimen.	2,7

VIII. SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS&ASSESSMENTPURPOSE

(SpecificationTable)

Sr.No	Unit	UnitTitle	AlignedCOs	LearningHours	R-Level	U-Level	A-Level	TotalMarks
1	I	Basics of Engineering Materials	CO1	10	4	4	6	14
2	II	Steel & Cast Iron	CO2	12	4	6	6	16
3	III	Non-Ferrous Materials & Powder Metallurgy.	CO3	10	4	4	6	14
4	IV	Non-Metallic Materials and Advanced Materials	CO4	8	4	4	6	14
5	V	Heat Treatment processes	CO5	5	2	4	6	12
		Grand Total		**45**	**18**	**22**	**30**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Formative assessment (Assessment for Learning) 1. For laboratory learning term work -25 Marks 2. For Self Learning 25 Marks 3. Two-unit tests of 30 marks and an average of two-unit tests.	Summative Assessment (Assessment of Learning) End semester assessment of 70 marks.

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes(COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 ProblemAnalysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 LifeLong Learning	PSO-1	PSO-2	PSO-3
CO1	**3**	**1**	-	**2**	-	**1**	**1**	-	2	-
CO2	**3**	**1**	-	**2**	-	**1**	**1**	-	2	-
CO3	**3**	**1**	-	**2**	-	**1**	**1**	-	2	-
CO4	**3**	**1**	-	**2**	-	**1**	**1**	-	2	-
CO5	**3**	**1**	-	**2**	-	**1**	**1**	-	2	-

Legends:-High:03,**Medium:**02,**Low:**01,**NoMapping:**-
*PSOs are to be formulated at the institute level.

XI.SUGGESTEDLEARNINGMATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dieter G.D.	Mechanical Metallurgy.	McGraw Hill Edu. New Delhi, 2017, ISBN.978-1259064791
2	Avner S.H	Introduction to Physical Metallurgy	McGraw Hill Edu. New Delhi,2017, ISBN. 978-0074630068
3	Rajput R.K S.	Engineering Materials And Metallurgy.	Chand and Company New Delhi,2006, ISBN 978-8121927093
4	Balasubramaniam R Callister's	Materials Science and Engineering.	Wiley, New Delhi, 2014, ISBN 978-8131518052
5	Parashivamurthy, K. I.	Material Science and Metallurgy.	Pearson Education India, 2012, ISBN. 978- 8131761625
6	Fulay, P.P., Askeland D.R	Essentials of Materials Science and Engineering	Cengage India Private Limited, 2012, ISBN 978-8131520703
7	Kodgire, V.D., Kodgire. S.V	Material Science and Metallurgy for Engineers.	Everest Publishing House, 2017, ISBN. 978-8176314008

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://www.youtube.com/watch?v=jn9cP6JJ7xA	Iron - Carbon Diagram
2.	https://www.youtube.com/watch?v=skQRLfU3plM	Heat Treatment Processes
3.	https://www.youtube.com/watch?v=E6oCdckcwYQ&list=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ&index=3	Crystal structure
4.	https://www.youtube.com/watch?v=c1ZbiBIY6Sc&list=PLxQzQgOy_JvYd32Y6XOwFOnVc4_Dkv7v6&index=38	Ceramics
5.	https://www.youtube.com/watch?v=04K0bLwCDdM	Composite materials
6.	https://vedicheritage.gov.in/vedic-heritage-in-present-context/metallurgy/	IKS
7.	https://www.youtube.com/watch?v=_eM49JlmFp0	Powder Metallurgy
Note: Teachers are requested to check the Creative Common license status/financial implications of the suggested online educational resources before use by the students		

Name & Signature:

(Dr.S.D.Dhobe)
Lecturer in Mechanical Engineering

(Shri.B.B.Dome)
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

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GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME**
PROGRAMME CODE	**04**
COURSE TITLE	**ENGINEERING METROLOGY AND MEASUREMENT**
COURSE CODE	**ME31204**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
1	ENGINEERING METROLOGY AND MEASUREMENT	DSC	4	--	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Term: 2 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

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2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

In the field of mechanical engineering, precision is paramount. A Diploma Mechanical Engineer must be adept in the use of a variety of measuring instruments to ensure that machined components meet exact specifications. This skill is crucial for the proper assembly of interchangeable parts. With advancements in technology, the realm of measurement has expanded to include electronic instrumentation and innovative techniques. Understanding the principles of instrumentation and transducers, as well as measuring non-electrical parameters like force and sound, is essential for modern engineers to maintain the high standards required in the industry.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Select a relevant linear measuring instrument for measurement.
CO2: Use different gauges and comparators for measurement of given components.
CO3: Use relevant instrument for the measurement of angular parameters, surface finish and screw thread parameters of given components
CO4: Select a relevant instrument for measuring the physical parameters of the system.

CO5: Use relevant instruments for measurement of operating parameters like speed, temperature, flow and miscellaneous quantities of the system.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		SECTION I		
		UNIT-I OVERVIEW OF METROLOGY AND LINEAR MEASUREMENT (CL Hrs-12, Marks-12)		
1.	TLO1.1 Define Metrology TLO1.2 Explain the characteristics of measuring instruments. TLO1.3 Explain different types of standards. TLO1.4 State working principle of Linear measuring instruments. TLO1.5 Identify errors in the given instrument. TLO1.6 Select a relevant measuring instrument for the given job with justification.	1.1 Definition of Metrology, objective and types of Metrology, Need of inspection, Methods of measurements. History of measurement systems in India (Indigenous systems) 1.2 Characteristics of instruments – Static characteristics: Least count (resolution), Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis, Dead Zone, Drift, Sensitivity, Threshold, Repeatability, Reproducibility, Linearity, Amplification, Magnification. 1.3 Dynamic characteristics: Speed of response, Fidelity, Overshoot. 1.4 Standards: Definition and characteristics of Line standard, End standard and Wavelength standard. 1.5 Linear measuring Instruments: Working principle of Vernier caliper, micrometer, height gauge and depth gauge. 1.6 Types of Errors and their sources in Measurements, Factors affecting accuracy. 1.7 Selection of instrument, Precautions while using an instrument for getting higher precision and accuracy	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration	CO1
		UNIT-II GAUGES AND COMPARATORS (CL Hrs- 12, Marks-12)		
2	TLO2.1 Explain the construction and working of given comparators. TLO2.2 Select gauges for a given job with justification. TLO2.3 Select slip gauges for building-specific dimensions.	2.1 Selective Assembly, Interchangeability 2.2 Comparators: Definition, Requirement of a good comparator, Classification, Use of comparators, Working principle (Merits and Demerits) of Dial indicator, Sigma Comparator and Pneumatic Comparator, 2.3 Gauges: Limit gauges. Taylor's principle of Gauge design, Plug, Ring Gauges, and snap gauges. 2.4 Slip gauges: Wringing of Slip Gauges (Numericals on the setting of slip gauges). Precautions and Accessories..		CO2

UNIT-III ANGULAR, SCREW THREAD, GEAR AND SURFACE FINISH MEASUREMENTS (CL Hrs- 8, Marks-11)				
3	TLO3.1 List Angular measuring instrument for the given component TLO3.2 Calculate screw thread parameters using the given method. TLO3.3 Explain the procedure of measuring the given parameters of gear. TLO3.4 Describe the procedure for examining the surface finish of the given component. TLO3.5 Explain the working of CMM.	3.1 Angle measurement: Angle Gauges (No Numerical), Bevel Protractor, Sine bar. Principle of Working of Autocollimator and Angle Dekkor. 3.2 Screw thread Measurements: Screw thread terminology, measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, and thread angle. Best wire size, Two-wire method, Working principle of floating carriage micrometer, Errors in threads. 3.3 Gear Measurement: Analytical and functional inspection, Parkinson Gear tester, Gear tooth Vernier, Profile projector, Errors in gears. 3.4 Surface Roughness Measurement: Meanings of surface texture and definitions, methods of surface measurement - Ra, Rz and RMS values (No Numerical), Taylors Hobsons Talysurf (2D and 3D Profiles of machined surfaces) 3.5 CMM: Introduction to Coordinate Measurement Machine (CMM) and its merits.	Lecture Using Chalk-Board Presentations, Video Demonstrations	CO3
SECTION II				
UNIT- IV GENERALIZED MEASUREMENT SYSTEM AND DISPLACEMENT MEASUREMENT (CL Hrs- 12, Marks-12)				
4	TLO4.1 Classify transducers for the given application. TLO4.2 Identify the given transducer with justification. TLO4.3 Select displacement measuring instrument in the given system with justification.	4.1 Generalized measuring system and its components. 4.2 Transducers: Classification of transducers- active and passive, contact, non-contact, Mechanical, Electrical, analog and digital. Applications of transducers. 4.3 Displacement Measurement: Specification, selection and application of displacement transducer, LVDT, RVDT, and Potentiometer.	Lecture Using Chalk-Board Presentations Video Demonstration	CO4
UNIT V TEMPERATURE AND FLOW MEASUREMENT (CL Hrs- 12, Marks-12)				
5	TLO5.1 Choose a relevant instrument to measure the temperature of the given system. TLO5.2 Select the relevant flow meter to measure flow in the given system with justification.	5.1 Temperature Measurement: Non-electrical methods- Bimetal and Liquid in glass thermometer. Electrical methods- RTD, Thermistor, Thermocouple. 5.2 Flow measurement: Types of flow meters. Selection criteria for flow meters. Variable area meter- Rotameter. Anemometer - hot wire and hot film. Electromagnetic flow meter, ultrasonic flow meter.	Lecture Using Chalk-Board Presentations Video Demonstration	**CO5**

UNIT –VI MISCELLANEOUS MEASUREMENTS (CL Hrs-8, Marks-11)				
6	TLO6.1 Select a relevant sound measuring device for the given system with justification. TLO6.2 Select the relevant humidity measuring device for the given system with justification. TLO6.3 Select the relevant force-measuring device for the given system with justification. TLO6.4 Choose speed speed-measuring instrument for a given system.	6.1 Acoustics Measurement: Sound characteristics - intensity, frequency, pressure, power, sound level meter. 6.2 Humidity Measurement: Hair hygrometer. 6.3 Force Measurement: Tool Dynamometer (Mechanical type), Load cell. 6.4 Speed Measurement: Tachometers: Eddy current Drag Cup Tachometer, Mechanical tachometers, slipping clutch tachometer, Inductive Pick Up, Capacitive Pick Up, Stroboscope.	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration	CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1.1 Correlates ancient measurement systems with existing measurement systems of length and weight.	*Collect information regarding the measurement of Length and weight in ancient India. (IKS)	2	IKS
2	LLO2.1 Measure dimensional parameters by using linear measuring instruments. LLO2.2 Operate different linear measuring instruments.	*Measurement of dimensions of a component using a vernier caliper, vernier height gauge, vernier depth gauge, micrometer and inside micrometer.	2	CO1
3	LLO3.1 Check the geometrical parameters of a component with the help of mechanical comparators. LLO3.2 Operate dial gauge for different applications.	*Roundness checking of the given component using dial indicator/dial gauge	2	CO2
4	LLO4.1 Use a Bevel Protractor and Sine bar for measurement of unknown angle. LLO 4.2 Operate Bevel Protractor and Sine bar for angle measurement.	*Measurement of unknown angle of a component using Bevel Protractor and verification by Sine bar.	2	CO3
5	LLO5.1 Use a floating carriage micrometer for measurement of the major, minor and effective diameter of screw threads. LLO5.2 Operate optical profile projector for checking thread profile.	*Measurement of the screw thread elements by using a floating carriage micrometer and verification by optical profile projector	2	CO3

6	LLO6.1 Measure the face width and tooth thickness of a gear by using a gear tooth vernier caliper. LLO6.2 Operate optical profile projector for measuring gear profile.	*Measurement of the gear tooth elements using gear tooth vernier caliper and verification by optical profile projector.	2	CO3
7	LLO7.1 Examine the machined surface using a surface roughness tester.	*Measurement of the surface roughness of machined surface by using a surface roughness tester.	2	CO3
8	LLO8.1 Use different optical flats for measurement of surface flatness. LLO8.2 Identify the types of observed fringe patterns of optical flats.	Measurement of flatness of given component by using optical flats.	2	CO3
9	LLO9.1 Use Autocollimator / Angle Dekkor for measurement of the angle or taper of the given component.	Measurement of the unknown angle of a given component by Autocollimator / Angle Dekkor	2	CO3
10	LLO10.1 Measure displacement of micrometer by using LVDT. LLO10.2 Use LVDT for measurement of linear displacement.	*Measurement of displacement by using a Linear Variable Displacement Transducer (LVDT).	2	CO4
11	LLO11.1 Measure the temperature of a system by using a thermometer. LLO11.2 Use Thermocouple for measurement of the temperature of a given system	Measurement of temperature by thermocouple and Verification by thermometer.	2	CO4
12	LLO12.1. Measure the flow rate of liquid by the rotameter.	Measurement of the flow rate of liquid by rotameter	2	CO4
13	LLO13.1 Measure given weights by using the Load Cell.	*Measurement of weight by using a load cell.	2	CO5
14	LLO14.1 Measure the relative humidity by using a sling hygrometer.	Humidity measurement using a sling hygrometer.	2	CO5
15	LLO15.1 Measure the speed of the rotating shaft by stroboscope or inductive pickup. LLO15.2 Use a stroboscope or inductive pick-up for measurement of the speed of the rotating shaft.	Measurement of the speed of the rotating shaft by stroboscope or inductive pick-up.	2	CO5
16	LLO16.1 Use a sound level meter to measure sound parameters.	Measurement of the sound of the rotating shaft of the engine or motor.	2	CO5
		Total	24	

Note: Out of the above suggestive LLOs – 12 practicals are mandatory.

- **'*' Marked Practicals (LLOs) Are mandatory.**
- **A minimum of 80% of the above list of lab experiments are to be performed.**
- **Judicial mix of LLOs is to be performed to achieve desired outcomes.**

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS

DEVELOPMENT (SELF-LEARNING)

Micro project:

1)Comparative study of various linear measuring instruments like steel rule, Inside-outside micrometer, Vernier caliper and Digital caliper with proper justification.

2)Comparative study of surface finish of various samples machined by various machining/finishing processes using surface roughness tester.

3)Prepare a report on the calibration procedure of the Vernier Caliper and Micrometer followed by NABL Lab. 4)Prepare a visit report on measurement systems used in nearby industries / SMEs / Workshops / Fabrication shops.

5)Perform a comparative study of different contact and non-contact type transducers/sensors.

6)Visit to Automobile service station, observe the different sensors used in cars and prepare a report of the same. (Name, Use, Location, Working, Applications)

Assignment: -

1)Prepare a report to interpret the effect of errors on the accuracy of instruments and measurements.

2)Visit any nearby shop or industry and list out different gauges used for inspection along with their purpose.

3)Prepare a comparative study of different screw threads measuring instruments based on their least count, accuracy, cost, ease of operation

4)Prepare a short report on different types of rotameters.

5)Prepare a set of procedures for sound measurement with a suitable instrument.

Note: The above is just a suggestive list of microprojects and assignments; faculty must prepare their bank of microprojects, assignments, and activities similarly. The faculty must allocate a judicial mix of tasks, considering the weaknesses and/or strengths of the student in acquiring the desired skills. If a micro project is assigned, it is expected to be completed as a group activity. SLA marks shall be awarded as per the continuous assessment record. If the course does not have an associated SLA component, the above suggestive listings apply to Tutorials and may be considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Vernier Calipers (0-200 mm)	2
2	Vernier Height Gauge and Depth Gauge. (0-300 mm)	2
3	Outside Micrometer (0-25mm, 25-50mm)	2
4	Inside Micrometer 0-25mm	2
5	Surface Plate-Granite (24 x 36 inch)	2,4,7
6	Dial indicator (0-25mm) with a magnetic stand.	3,4
7	Universal bevel protractor Graduation: 5 min (0 deg-90 deg -0 deg)	4
8	Sine bar, Sine Center (0-200mm)	4
9	Floating Carriage Micrometer: Least Count 0.001mm; Standard micrometer or electronic type; Non-rotary 8mm micrometer spindle; Indicator with 0.001 standard dial; admit between center 200mm; Max diameter capacity 100mm; Standard accuracy ± 0.005mm.	5

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
10	Floating Carriage Micrometer: Least Count 0.001mm; Standard micrometer or electronic type; Non-rotary 8mm micrometer spindle; Indicator with 0.001 standard dial; admit between center 200mm; Max diameter capacity 100mm; Standard accuracy ± 0.005mm.	5,6
11	Surface roughness Tester (Max Sampling length 0.8 mm) having profile printing facility.	7
12	Optical flats set range (0.2 µm) Diameter / Thickness 45/12mm and 60/15mm.	8
13	Angle Dekkor and Autocollimator (0 to 30')	9
14	Sensor–type K (Cr-AI) thermocouple, sensor assembly and water bath with heating arrangement Display 3.5-digit display.	11
15	Rotameter -Trainer -sensor – standard glass rotameter, process tank with motor pump display – flat position on a graduated scale.	12
16	Load cell – Force measurement range 5-50N – sensor 4 arm bridge with strain gauge capacity – 2Kg 3.5-digit display.	13
17	Sling Psychrometer: 10-100% RH (For DBT between 30 to 100oF) with an accuracy of ± 5%.	14
18	Multi Digital Stroboscope cum Tachometer for speed measurement – up to 5000 rpm.	15

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION I								
1	I	Overview of Metrology and Linear Measurement	CO1	12	2	4	6	12
2	II	Gauges and Comparators	CO2	12	2	4	6	12
3	III	Angular, Screw Thread, Gear and Surface Finish Measurements	CO3	08	2	4	5	11
SECTION II								
4	IV	Generalized Measurement System and Displacement Measurement	CO4	12	2	4	6	12
5	V	Temperature and Flow Measurement	CO5	12	2	4	6	12
6	VI	Miscellaneous Measurements	CO5	08	2	3	6	11
		Grand Total		**64**	**12**	**23**	**35**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Term work (Lab Manual), Self-Learning (Assignment) 2. Question and Answers in the classroom, quiz and groupdiscussion. Note: Each practical will be assessed considering 60% weightage to process-related and 40 % weightage to product-related.	1. Practical Examination 2. Theory Examination

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	2	2	-	-	2	-	-
CO2	2	2	3	3	2	-	2	-	3
CO3	2	2	2	3	-	-	2	-	3
CO4	2	2	2	3	-	-	2	-	3
CO5	2	2	2	3	2	-	-	-	3

Legends:- High:03, **Medium:**02, **Low:**01, **NoMapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	N.V. Raghvendra and L. Krishnamurthy	Engineering Metrology & Measurements	Oxford University Press, New Delhi, India ISBN-13: 978-0-19-808549-2. (2013)
2	Anand K Bewoor and Vinay A Kulkarni	Metrology & Measurements	Tata McGraw-Hill Education Private Limited, New Delhi, India ISBN (13): 978-0-07-014000-4 (2017)
3	R K Jain	Engineering Metrology	Khanna Publication, New Delhi, ISBN10:817409153X (2022)
4	R. K. Rajput	Engineering Metrology & Instrumentation	S.K. Kataria and Sons ISBN:9788185749822 (2009)
5	R K Jain	Mechanical and Industrial Measurements	Khanna Publication, New Delhi ISBN: 8174091912 (1995)
6	Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard·	Mechanical Measurements	Pearson Prentice Hall ISBN:9780136093763 (2013)

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://onlinecourses.nptel.ac.in/noc20_me94/preview	https://onlinecourses.nptel.ac.in/noc23_me09/preview
2.	https://onlinecourses.nptel.ac.in/noc23_me09/preview	NPTEL MOOCS course on Mechanical measurement systems.
3.	https://www.youtube.com/watch?v=Hi7NUJdznc0	Video Lecture on Engineering Metrology by IIT Madras.
4.	http://www.digimat.in/nptel/courses/video/112106179/L33.html	Video Lecture on Electrical and Electronic comparators, Optical comparators NPTEL Video Course: Metrology
5.	https://www.bing.com/videos/riverview/relatedvideo?&q=videos+on+CMM+measurement+IIT&&mid=6C0843737C0E8F2019006C0843737C0E8F201900&&FORM=VRDGAR	Video on Part inspection by using CMM
6	https://www.bing.com/videos/riverview/relatedvideo?q=videos+on+screw+thread+measurement+IIT&&view=riverview&mmscn=mtsc&mid=9850B2C61C0872810AC19850B2C61C0872810AC1&&aps=196&FORM=VMSOVR	Measurement of screw thread elements.
7	https://www.bing.com/videos/riverview/relatedvideo?&q=videos+on+displacement+measurement&&mid=53BAFCB5E8DA5553247253BAFCB5E8DA55532472&&FORM=VRDGAR	Potentiometer Working Principle
8	https://www.bing.com/videos/riverview/relatedvideo?&q=bimetallic+temperature+measurement+devices&&mid=3ADB81DF5F95342EE5B53ADB81DF5F95342EE5B5&&FORM=VRDGAR	How Bimetallic Temperature Gauges Works.
9	https://www.bing.com/videos/riverview/relatedvideo?&q=flow+measurement+devices+rotameter&&mid=145B5C41696FC6AFF30B145B5C41696FC6AFF30B&&FORM=VRDGAR	Flow Measurement Devices

Sr.No	Link/Portal	Description
10	https://www.bing.com/videos/riverview/relatedvideo?&q=carbon+microphone&&mid=B08AB66B421E46892B46B08AB66B421E46892B46&&FORM=VRDGAR	Build a carbon microphone with a soda can and a paper clip
11	https://www.bing.com/videos/riverview/relatedvideo?&q=hair+hygrometer+working+principle&&mid=20C836F03B5418F173D620C836F03B5418F173D6&&FORM=VRDGAR	Actual working of Hair Hygrometer

Note :
Teachers are requested to verify the Creative Commons license status and evaluate the financial implications of the recommended online educational resources before permitting student use.

Name &Signature:	
Mr.V.J.Deshpande Lecturer in Mechanical Engineering (Course Experts)	for **Mrs.V.G.Talkit** Lecturer in Mechanical Engineering
Name & Signature: **Dr.V.R.Jaware** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME**
PROGRAMME CODE	**04**
COURSE TITLE	**PRODUCTION DRAWING**
COURSE CODE	**ME31201**
PREREQUISITE COURSE CODE & TITLE	**ME-21201 ENGINEERING DRAWING**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
1	PRODUCTION DRAWING		3	-	4	1	8	4	4	30	70	100	40	50	20	--	--	25	10	175

Total IKS Hrs for Term: Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Production drawing is essential for communicating ideas in the manufacturing industry as well as other engineering applications. Production drawings illustrate a set of instructions to manufacture a product, providing information about dimensions, materials, finishes, tools required, methods of assembly and so on. Therefore, this course has been developed for interpretation and preparation of the production drawing.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Interpret curves of intersection for given solids.
CO2: Construct an auxiliary view of the given object.
CO3: Use convention for representation of material and mechanical components.

CO4: Draw production drawing.
CO5: Prepare assembly/details drawing using the given data.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I INTERSECTION OF SOLIDS (CL Hrs- 12, Marks-14)				
1.	TLO 1.1 Interpret the intersection for the given solids. TLO 1.2 Draw curves of intersection of the given solid combination.	1.1 Curves of the intersection of surfaces - Prism with Prism (Triangular, Square), Cylinder with the cylinder. 1.2 Curves of the intersection of surfaces - SquarePrism with Cylinder when – i. Axes are at 90º and bisecting. ii. Axes are at 90º and offset. 1.3 Curves of the intersection of surfaces – Cylinder with Cone: when the axis of the cylinder is parallel to both the reference planes and cone resting on base on HP with the axis intersecting and offset from the axis of the cylinder.	Model Demonstration Video Demonstrations Hands-on of intersecting solids	CO1
UNIT-II AUXILIARY VIEW (CL Hrs- 08, Marks-14)				
2	TLO 2.1 Construct an auxiliary view of a given object. TLO 2.2 Construct an incomplete principal view from the given auxiliary view.	2.1 Auxiliary planes and views. 2.2 Draw Auxiliary view from the given orthographic views. 2.3 Complete the partial view from the given auxiliary and other principal view.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations	CO2
UNIT-III CONVENTIONAL REPRESENTATION (CL Hrs- 06, Marks- 14)				
3	TLO 3.1 Use IS SP-46 codes for preparing production drawings. TLO 3.2 Prepare production drawings using standard conventions.	3.1 Engineering Material Conventions 3.2 Conventional breaks in pipes, rods and shaft 3.3 Conventional representation of common features like slotted head, radial rib, knurling, serrated shaft, splined shaft, ratchet and pinion, repeated parts, square on a shaft, holes on circular pitch, internal and external threads 3.4 Conventional representation of standard parts like ball and roller bearings, gears, springs 3.5 Pipe joints and valves 3.6 Counter sunk and counterbored holes 3.7 Tapers	Lecture Using Chalk-Board Model Demonstration Video Demonstrations	CO3
UNIT- IV PRODUCTION DRAWING (CL Hrs- 07, Marks-14)				

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
4	TLO4.1 Calculate tolerances on the given machine components. TLO4.2 Identify the type of fit between mating parts of machine components based on given tolerance values. TLO4.3 Prepare production drawings using suitable conventions and codes.	4.1 Limits, Fits and Tolerances: Definitions, introductions to ISO system of Tolerance. Dimensional tolerances: Terminology, selection and representation of dimensional tolerance- number and grade method. Definitions concerning Tolerancing and Limits system, unilateral and bilateral tolerance, Hole and shaft basis systems, Types of fits-clearance, transition and Interference, and Selection of fit for engineering applications. Calculation of limit sizes and identification of the type of fit from the given sizes like 50 H7/s6, 30 H7/d9 etc. 4.2 Geometrical Tolerances: Types of geometrical tolerances, terminology for deviation, representation of geometrical tolerance on drawing. 4.3 General welding symbols, length and size of weld, surface contour and finish of weld, all round and site weld, symbolic representation in Engineering practices and its interpretation. 4.4 Machining symbol and surface texture: Indication of machining symbol showing the direction of lay, sampling length, roughness grades, machining allowances, and manufacturing methods. Representation of surface roughness on drawing.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations	CO4
UNIT –V ASSEMBLY AND DETAILS OF MACHINE COMPONENTS (CL Hrs-12, Marks-14)				
5	TLO 5.1 Identify various components in the given detail drawings. TLO 5.2 Identify the sequence of assembling it. TLO 5.3 Prepare assembly drawing from the given detailed drawing. TLO 5.4 Prepare bill of material. TLO 5.5 Interpret various components in given assembly drawings. TLO 5.6 Identify the sequence of dismantling in the given assembly drawing. TLO 5.7 Prepare the detailed	5.1 Introduction to assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing, Bill of Material (BOM). Couplings: Oldham & Universal couplings. Bearing: Foot Step & Pedestal Bearing. Lathe: Single (pillar type) and square tool Post. Bench Vice & Pipe Vice. Screw-jack Drill Jig 5.2 Basic principles and process of dismantling the above (a to f) assemblies into components.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations	CO5

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	drawing from the given assembly drawing.			

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Draw the intersection of Solids as per the given situation.	*Draw problems on the intersection of solids when intersecting solids are Prism with Prism, Cylinder with cylinder. Square Prism with Cylinder Cylinder with square prism. when : Axes are at 90º and bisecting. Axes are at 90º and offset. (Sheet-1: 2 Problems)	8	CO1
2	LLO 1.2 Draw the intersection of solids as per the given situation.	Draw problems on the intersection of solids when intersecting solids are cylinder with cone and the axis of the cylinder is parallel to both the reference planes and cone resting on base on HP When: Axes are at 90º and bisecting. Axes are at 90º and offset. (Sheet 2: 2 Problems)	6	CO1
3	LLO 2.1 Draw an auxiliary view	* Draw an auxiliary view considering given other views. (Sheet 3: 1 Problem)	6	CO2
4	LLO2.2 Complete given partial drawing considering auxiliary views.	Complete the given partial drawing, considering the given auxiliary and other views. (Sheet 3: 2 Problems in continuation with Serial No. 3)	8	CO2
5	LLO 3.1 Draw various conventional representations	*Draw various conventional representations as per ISSP-46 (Sheet 4)	4	CO3
6	LLO 3.2 Draw various conventional representations and specify various symbols and tolerances.	Draw Dimensional and Geometrical Tolerances, Welding Symbols, Surface Roughness and Machining Symbols on the given figures. (Sheet 4 Continued)	4	CO3
7	LLO4.1 Develop Production drawing of machine components	*Develop Production drawings of machine components showing dimensional and geometrical	10	CO4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
		Tolerance, surface finish etc. (Sheet 5)		
8	LLO5.1 Draw Assembly drawing from the given detailed Drawing	*Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions (Sheet 6)	10	CO5
9	LLO 5.2 Draw detailed drawings from the given assembly drawing	*Draw a detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (Sheet 7)	10	CO5
			60	

Note: Out of the above suggestive LLOs -
'*' Marked Practicals (LLOs) Are mandatory.
A minimum of 80% of the above list of lab experiments are to be performed.
Judicial mix of LLOs is to be performed to achieve desired outcomes.

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:

- Prepare assembly drawing/detailed drawing of machine vice/ lathe tail stock/ tool post etc. by visiting the Institute's workshop.
- Prepare a report on various types of welding symbols used for fabrication work by Visiting a nearby fabrication workshop.
- Any other micro-projects suggested by subject faculty on a similar line.
- Prepare detailed drawings of Various IC Engine components using proper measuring instruments by visiting the Institute's Power Engineering Lab or any other.
- Students should collect Production drawings from nearby workshops/industries and establish item reference numbers on that drawing for a convention or tolerance value. Prepare a report showing item reference numbers and their meaning.
- Prepare a report representing the conventional representation of various piping joints by visiting nearby process industries like sugar factories, chemical industries, water treatment plants, etc.

Note :

- The above is just a suggestive list of microprojects and assignments; faculty must prepare their bank of microprojects, assignments, and activities similarly.
- The faculty must allocate a judicial mix of tasks, considering the weaknesses and/or strengths of the student in acquiring the desired skills.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have an associated SLA component, the above suggestive listings apply to Tutorials and may be considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Models/ Charts of Intersection of Solids.	1
2	Models/ Charts of Auxiliary Views.	2
3	Models/ Charts of Conventional representation and Production drawing.	3,4
4	Models/ Charts of Assembly and details of various machine components.	5

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Intersection of Solids	CO1	12			14	14
2	II	Auxiliary View	CO2	8		14		14
3	III	Conventional representation	CO3	6	14			14
4	IV	Production Drawing	CO4	7		6	8	14
5	V	Assembly and Details of machine components	CO5	12		6	8	14
Grand Total					**14**	**26**	**30**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. continuous assessment based on laboratory performance	1. End term exam- Theory

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	**1**	**2**	**1**	-	-	-	-	-	1
CO2	**2**	**2**	**1**	-	-	-	-	-	2
CO3	**3**	**3**	**1**	-	-	-	-	-	2
CO4	**3**	**3**	**1**	-	-	-	-	-	2
CO5	**3**	**2**	**1**	-	-	-	-	-	3

Legends:- High:03, **Medium:**02, **Low:**01, **NoMapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bureau of Indian Standards.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	October 2003, ISBN: 81-7061-091-2
2	Bhatt, N.D.	Engineering Drawing	Charotar Publishing House, 2011, ISBN:978-93-80358-17-8
3	Bhatt, N.D.; Panchal, V.M	Machine Drawing	Charotar Publishing House, 2011, ISBN:978-93-80358-11-6
4	Narayan, K. L. Kannaiah, P. Venkata Reddy, K.	Production Drawing	New Age International Publications, 2011, ISBN: 978-81-224-2288-7
5	Sidheswar, N. Kannaiah, P. Sastry, V.V.S.	Machine Drawing	Tata McGraw Hill Education Private Ltd, New Delhi, 2011, ISBN-13: 978-0-07-460337-6

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://youtu.be/rerGFp3V6W8	Intersection of solids
2.	https://youtu.be/599ThWCvMVA	Auxiliary View
3.	https://youtu.be/5Pj7vkcolXk	Introduction to working drawing.
4.	https://youtu.be/FqzplEaE4Z0	Details to Assembly
5.	https://youtu.be/VRi2LMm6jHU	Assembly to details

Name &Signature:

Shri. A.M. Joshi
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Shri. Madhukar Mundhe
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

Dr. V.B.Jawale
(Programme Head)

Name & Signature:

Shri.S.B.Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME / MT**
PROGRAMME CODE	**04/ 05**
COURSE TITLE	**COMPUTER AIDED DRAFTING**
COURSE CODE	**ME31206**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
	COMPUTER-AIDED DRAFTING	SEC	-	-	4	-	4	2	-	-	-	-	-	50	20	50@	20	-	-	100

Total IKS Hrs for Term: Nil Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Computer-aided 2D drafting (CAD) has revolutionized the field of design and engineering. By providing tools for the precise and efficient creation of technical drawings, CAD systems enhance productivity and ensure consistency across project documentation. The ability to quickly modify designs and iterate on ideas without the need for manual redrawing saves time and resources. Moreover, CAD's compatibility with other digital tools streamlines the design process, fostering innovation and collaboration, especially in remote settings. As a result, CAD has become a fundamental component in the modern design and engineering toolkit, underpinning the development of complex projects across various industries.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Use basic commands in CAD software
CO2: Modify complex 2D geometric figures using CAD software
CO3: Use layers and blocks for creating digital drawings using relevant software.
CO4: Create Isometric drawings using a CAD software
CO5: Plot existing drawing using the plot command

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I FUNDAMENTALS OF CAD DRAWING (CL Hrs-NIL, Marks- NIL)				
1.	TLO1.1 Explain the use of computers in drafting TLO1.2 Use the AutoCAD workspace and interface. TLO1.3 Apply different object selection methods in a given situation. TLO1.4 Open, save and close new and given drawings/ templates	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Software for Computer Aided Drafting. 1.2 Co-ordinate System- Cartesian and Polar Absolute, Relative mode, UCS, WCS. 1.3 CAD initial setting commands- Snap, grid, Ortho, Osnap, Limits, Units, Object tracking. 1.4 Object Selection methods- picking, window, crossing, fence, last and previous. 1.5 Opening, saving and closing a new and existing drawing/template	Video - Demonstration Hands-On	CO1,
UNIT-II DRAWING AND FORMATTING COMMANDS (CL Hrs-NIL, Marks- NIL)				
2	TLO 2.1 Apply formatting commands. TLO 2.2 Draw simple 2D entities using given Draw commands. TLO 2.3 Determine coordinates, distance, area, length, and centroid of the given 2D entity.	2.1 Draw Command - Line, Polyline, arc, circle, rectangle, polygon, ellipse, spline, block, hatch. 2.2 Formatting commands - Layers, block, line type, line weight, colour.2.3 Enquiry commands – distance, area.	Video - Demonstration Hands-On	CO1, CO2, CO3
UNIT-III MODIFY AND EDIT COMMANDS (CL Hrs-NIL, Marks- NIL)				
3	TLO3.1 Draw given complex 2D entities using Modify commands. TLO3.2 Use the grip command to manipulate the given 2D entity .	3.1 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode,align. 3.2 Editing Objects by Using Grips – Moving, Rotating, Scaling, Mirroring and Stretching	Video - Demonstration Hands-On	CO1, CO2
UNIT- IV ISOMETRIC DRAWING COMMANDS (CL Hrs-NIL, Marks- NIL)				
4	TLO4.1 Draw isometric entities. TLO4.2 Draw an isometric object from given orthographic views. TLO4.3 Use Layers for 2D drawings. TLO4.4 Draw and modify blocks for given 2D entities. TLO4.5 Use blocks in the same and another given file.	4.1 Isometric drafting- Isometric grid & snap, Isometric axis & plane, Polyline,Isocircle. 4.2 Dimensioning Isometric Drawings. 4.3 Layer, Layer properties and applications. 4.4 Blocks: create, modify and use in the same file and another file.	Video- Demonstration Hands-On	CO1, CO4

UNIT –V DIMENSIONING AND PLOT COMMANDS (CL Hrs-NIL, Marks- NIL)				
5	TLO 5.1 Use various dimensioning styles to draw 2D entities. TLO 5.2 Apply Geometric and dimension tolerance symbols on the given entity. TLO 5.3 Write text on a given 2D entity. TLO 5.4 Insert table in the drawing TLO 5.5 Prepare a new template for drawing as per requirement. TLO 5.6 Plot given 2D entities using proper plotting parameters.	5.1 Dimensioning commands: Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 5.2 Text commands - dtext, mtext command. 5.3 Insert table: table, table style command. 5.4 Template Drawing- Standard template, loading template, create a new template. 5.5 Plotting a drawing: adding plotter/printer, page setup, and plot style commands.	Video-Demonstration Hands-On	CO1, CO2, CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1.1 Prepare template of A4 size with title block	*Preparation of Template	02	01
2	LLO2.1 Use basic commands for drawing 2-D entities LLO2.2 Draw basic entities using CAD software	*Drawing of 2-D Entities (Line, Circle, Polygon, Redraw figure etc)	02	01
3	LLO3.1 Use basic commands for drawing 2-D entities LLO3.2 Draw basic entities using CAD software	Drawing of 2-D Entities using a complex command (Polygon + Circle, Circle+ Line etc.)	04	01,02
4	LLO4.1 Use basic commands for drawing 2-D entities LLO4.2 Draw basic entities using CAD software	*Drawing of Complex object (Any 4 objects)	04	01,02
5	LLO5.1 Use basic commands for drawing 2-D entities LLO5.2 Draw orthographic Projections using CAD software	*Drawing of Orthographic Projections (Any 3 Problems) using the first angle method of Projections	04	01,02,03
6	LLO 6.1 Use basic commands for drawing 2-D entities. LLO6.2 Draw orthographic projections using CAD software	Drawing of Orthographic Projections (Any 3 Problems) using the Third angle method of Projections	04	01,02,03
7	LLO 7.1 Use basic commands for drawing 2-D entities. LLO 7.2 Draw orthographic projections using CAD software.	Drawing of Sectional Orthographic Projections (Any 2 Problems) using the first angle of Projections	04	01,02,03
8	LLO 8.1 Use basic commands for drawing 2-D entities LLO 8.2 Draw orthographic projections using CAD software	*Drawing of Sectional Orthographic Projections (Any 2 Problems) using the Third angle of Projections	04	01,02,03
9	LLO 9.1 Use basic commands for drawing 2-D entities	*Drawing of Simple Isometric Projections (any 4 Problems)	04	01,02,03, 04

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
	LLO 9.2 Draw isometric projections using CAD software			
10	LLO10.1 Use basic commands for drawing 2-D entities LLO10.2 Draw isometric projections using CAD software	Drawing of Complex Isometric Projections (any 4 Problems)	04	01,02,03 04
11	LLO11.1 Use basic commands for drawing 2-D entities LLO11.2 Use different commands for drawing assembly	*Drawing an assembly of Cotter Joint/Knuckle Joint/Universal Coupling (Any One) drawing from the given detailed drawing showing assembly dimensions, part number and bill of Material.	06	01,02,03
12	LLO12.1 Use basic commands for drawing 2-D entities LLO12.2 Use different commands for drawing assembly	*Drawing working drawings from Practical No. 11 showing conventional representation, dimensions, geometrical tolerances and machining symbols.	06	01,02,03
13	LLO13.1 Use basic commands for drawing 2-D entities LLO13.2 Use different commands for drawing assembly	Drawing an assembly of Screw Jack/Bench Vice/Steam Stop Valve/Toggle Jack (Any One) drawing from the given detailed drawing showing assembly dimensions, part number and bill of Material.	06	01,02,03
14	LLO14.1 Use basic commands for drawing 2-D entities LLO14.2 Use different commands for drawing assembly	Drawing working drawings from Practical No. 12 showing conventional representation, dimensions, geometrical tolerances and machining symbols.	06	01,02,03
15	LLO 15.1 Use of plotter for plotting given drawing	*Plot the drawing from Sr.No 2 to 14 using a plotter	04	05

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:

NOT APPLICABLE

Assignment: -

NOT APPLICABLE

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Latest version of Computer Aided Drafting software with License (1+50)	All
2	CAD workstation with the latest configurations for each student.	All
3	Plotter/Printer with latest versions.	All
4	LCD projector and Screen/ Interactive board.	All

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of CADD drawing	1	-	-	-	-	-
2	II	Drawing and Formatting Commands	1,2,3	-	-	-	-	-
3	III	Modify and Edit Commands	1,2	-	-	-	-	-
4	IV	Isometric drawing Commands	1,4	-	-	-	-	-
5	V	Dimensioning and Plot Commands	1,5	-	-	-	-	-
Grand Total				-	-	-	-	-

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Term work	1. End Semester Practical Examination

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)								
	PO-1 Basic and Discipline-Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**
CO1	**3**	-	-	**3**	-	-	**2**	3	-
CO2	**3**	-	-	**3**	-	-	**2**	3	-
CO3	**2**	-	-	**3**	-	-	**2**	3	-
CO4	**3**	-	-	**3**	-	-	**3**	3	-
CO5	**3**	-	-	**3**	-	-	**3**	3	-

XI. SUGGESTED LEARNING MATERIALS /B OOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sankar Prasad Dey	AutoCAD 2014 for Engineers Volume 1	Publisher: Vikas, 21 December 2021, ISBN-13: 978-9325983373
2	Kulkarni D.M	Engineering Graphics with AutoCAD	Publisher: Prentice Hall India Learning Private Limited, 1 January 2010, ISBN-10: 8120337832, ISBN-13: 978-8120337831
3	Dr.Sharad K. Pradhan, K K Jain	Engineering Graphics, AICTE Prescribed Textbook	Khanna Book Publishing; First Edition, 1 January 2023, ISBN-10 9391505503, ISBN-13 978-9391505509

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://ocw.mit.edu/courses/mechanical-engineering/	Lectures, assignments and projects covering topics such as engineering design, CAD/CAM, and product development.
2.	https://www.engineering.com/LearningCenter/CAD.aspx	Tutorials, articles, and videos covering CAD software, simulation tools, and engineering design concepts.
3.	https://www.youtube.com/watch?v=QuR-VKis3jU	2D mechanical drawings in AutoCAD, including drawing parts, adding dimensions, annotations and creating detailed technical drawings.
4.	https://www.youtube.com/watch?v=PHSmwXQriIc	Isometric drawings in AutoCAD
5.	https://www.cadtutor.net/	Tutorials, articles, forums and downloadable resources covering various CAD software application

Name &Signature: **Mr. S. S. Harip** Lecturer in Mechanical Engineering **Mr. R. S. Solanke** Lecturer in Mechanical Engineering (Course Experts)	
Name & Signature: **Dr.V.B.Jaware** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN ME**
PROGRAMME CODE	**04**
COURSE TITLE	**THEORY OF MACHINES AND MECHANISM**
COURSE CODE	**ME31205**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
1	THEORY OF MACHINES AND MECHANISMS	DSC	4	--	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: **02** Hrs

Abbreviations: **CL**-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. INDUSTRY EXPECTED OUTCOME

- Select different mechanisms and power transmission components for different mechanical machines

III. RATIONALE:

In today's era, it is necessary for a technician working in a factory to know the basic mechanism of a machine to understand its functioning. The technician also must know the no. of links transferring the forces and motion that will comprise the mechanism.

This course deals with the geometry of the mechanism, as well as the velocity and acceleration of links, inversions of kinematic chains, and different power drives. The scope of course is kinematics and dynamics of machines, the role of friction, flywheel and Governor, power transmission and applications of cams

IV. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Apply knowledge and skills related to different mechanisms and their motion in a given situation.

CO2: Determine velocity and acceleration for the given mechanism.

CO3: Use knowledge and skills related to flywheels, Brakes, clutches, balancing of masses and vibration for

various applications

CO4: Develop a Cam profile for a given type of Follower and its motions in the given situation.

CO5: Select the suitable power transmission devices for the given field/industrial application

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I FUNDAMENTALS AND TYPES OF MECHANISM (CL Hrs- 12, Marks- 14)				
1.	TLO1.1 Define kinematic links and pairs in the given mechanism. TLO1.2 Explain various types of motion in the given pair. TLO1.3 Explain various kinematic chains in the given configuration. TLO1.4 Estimate the degree of freedom for a given configuration. TLO1.5 Explain different inversion of mechanism. TLO1.6 Select suitable inversion of mechanism for different application	1.1 Kinematics of Machines: - Definition of statics, Dynamics, Kinematics, Kinetics, Kinematic link and its types, Kinematic pair and its types, constrained motion and its types 1.2 Kinematic chain (locked chain, constrained chain and unconstrained chain with equation), Degree of freedom (Kutzbach equation) 1.3 Mechanism and Inversion: Mechanism and Inversion of Mechanism, Difference between machine and structure. 1.4 Inversion of Kinematic Chain a) Inversion of four bar chain: Beam engine, Coupling rod of Locomotive, Watt's indicator mechanism. b) Inversion of single slider Crank chain: Reciprocating I.C. engine, Whitworth quick return mechanism, Rotary Engine, Oscillating cylinder engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism c) Inversion of Double Slider Crank Chain: Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling	Classroom Lecture Model Demonstration Video Demonstrations Hands-on Presentations	CO1
UNIT-II VELOCITY AND ACCELERATION IN MECHANISMS (CL Hrs- 10, Marks- 12)				
2	TLO 2.1 Describe velocity and acceleration in the mechanism. TLO 2.2 Draw velocity and acceleration diagram/polygon by relative velocity/ Klein's construction method following standard procedure. TLO 2.3 Determine linear and angular velocities of links in the given mechanism. TLO 2.4 Determine linear and angular acceleration of links in the given mechanism.	2.1 Concept of relative velocity and acceleration of a point on a link, Inter-relation between linear and angular velocity and acceleration. 2.2 Drawing of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanisms: four bar chain and single slider crank chain (Limited up to 4 Links). 2.3 Determination of velocity and acceleration of a point on the link by relative velocity method (Excluding Coriolis component of acceleration). 2.4 Klein's construction to identify the velocity and acceleration of different links in a single slider crank mechanism (When the crank rotates with uniform velocity only).	Lecture Using Chalk-Board Video Demonstrations	CO2

UNIT-III FLYWHEEL, GOVERNOR, CLUTCHES, BRAKES, BALANCING AND VIBRATIONS (CL Hrs- 18, Marks- 20)				
3	TLO 3.1 List the different drives for power transmission. TLO 3.2 Select a suitable drive for a particular application. TLO 3.3 Calculate various quantities like velocity ratio, belt tensions, angle of contact, and power transmitted in belt drives. TLO3.4 Enlist advantages and disadvantages of chain drive. TLO3.5 Differenciate gear trains. TLO3.6 Compare belt drive, chain drive and gear drive for given parameters. TLO 3.7 Explain the concept of balancing. TLO 3.8 Find the balancing mass and position of the plane analytically and graphically in a single plane. TLO 3.9 Explain the basic vibrating system with causes and remedies. TLO3.10 Describe the needs, functions and applications of the given clutches TLO3.11 Explain various parts of the given clutch with their functions and constructional details	3.1 Introduction and Difference between 3.1.1 Flywheel and Governor 3.2 Clutches- 3.2.1 Uniform pressure and Uniform Wear theories. Introduction to Clutch - Types, Functions and Applications, 3.2.2 Construction and principle of working of i) Single-plate clutch, ii) Multi-plate clutch, iii) Centrifugal Clutch iv) Cone clutch 3.3 Introduction to Brakes- 3.3.1 Types ,functions and applications(No numericals on Brakes) 3.3.2 Construction and principle of working of i) shoe brake ii) band brake iii) internal expanding shoe brake iv) disc brake v) hydraulic brake 3.4 Balancing of Masses and Vibration 3.4.1 Balancing of Rotating Masses: Concept of balancing: Need and types of balancing, Balancing of single rotating mass. 3.4.2 Analytical and Graphical methods for balancing several masses revolving in the same plane and different planes (Numerical on the single plane only). 3.4.3 Vibration: Fundamentals of Vibration: Definition and Concept of Free, Forced, Undamped, and Damped Vibrations. (no numerical) 3.4.4 Advantages and Disadvantages of Vibration, Causes and Remedies of Vibration, Vibration isolators. Forced vibrations of longitudinal and torsional systems (Concepts only, No numerical and No derivation on vibration).	Lecture Using Chalk-Board Presentations Video Demonstrations Case Study	CO3
UNIT- IV CAMS AND FOLLOWERS (CL Hrs- 10, Marks-12)				
4	TLO 4.1 Define Cam and its terminology with field application. TLO 4.2 List the type of motion of the Follower. TLO 4.3 Classify Cams and Followers. TLO 4.4 Draw Cam profile as per the given condition of Follower	4.1 Introduction to Cams and Followers, definition and applications of Cams and Followers, Cam terminology. 4.2 Classification of Cams and Followers. 4.3 Different follower motions and their displacement diagrams - Uniform velocity, simple harmonic motion, uniform acceleration and retardation. 4.4 Drawing of the profile of radial Cam with knife-edge and roller Follower	Lecture Using Chalk-Board Model Demonstration Video Demonstrations Presentations	CO4

UNIT-V POWER TRANSMISSION (CL Hrs- 10, Marks-12)				
	TLO5.1 define the terms related different drives for power transmission. TLO5.2 Select a suitable drive for a particular application. TLO5,3Calculate various quantities like velocity ratio, belt tensions, angle of contact, and power transmitted in belt drives. TLO5.4 Enlist advantages and disadvantages of chain drive. TLO5.5 Explain the constructional features of the different types of gear trains. TLO5.6 Compare belt drive, chain drive and gear drive for given parameters.	5.1 Belt Drive: a) Type of belts, flat belt, V-belt & its applications, material for flat and V-belt, Selection of belts b) Angle of lap, length of belt (No derivation), Slip and creep, Determination of velocity ratio of tight side and slack side tension, Power transmitted by belt. (numerical on power transmission by belt) 5.2 Chain Drives: Types of chains and sprockets, Advantages & Disadvantages of chain drive over other drives (No numerical on Chain drive). 5.3 Gear Drives: a) Classification of gears, Law of gearing, Concept of Conjugate profile (Involute only) Spur gear terminology. b) Types of gear trains, Train value & velocity ratio for simple, compound, reverted and epicyclic gear trains. (No numerical on Gear drive). Compare	Lecture Using Chalk-Board Model Demonstration Video Demonstrations Presentations	CO5

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Identify different mechanisms available in laboratories/institute premises LLO 1.2 Sketch the identified mechanism.	Identification of Mechanisms in the different laboratory and institute premises.	2	CO1
2	LLO 2.1 Identify the number of links and pairs of a given mechanism LLO 2.2 Identify the input link and its motion. LLO 2.3 Identify the output link and its motion	*Estimation of kinematic data for mechanism available in the laboratory (anyone from Group A and anyone from Group B) **Group A:** i) Beam Engine ii) Coupling rod of Locomotive, iii) Watt's indicator mechanism. **Group B:** i) Reciprocating engine ii) Whitworth quick return mechanism. iii) Rotary Engine iv) Crank and slotted lever quick return Mechanism Hand Pump mechanism	2	CO1
3	LLO 3.1 Identify the number of links and pairs of a given mechanism. LLO 3.2 Identify the input link and its motion. LLO 3.3 Identify the Output link and its motion.	Estimation of kinematic data for mechanism available in the laboratory (anyone from Group A and anyone from Group B) **Group A:** i) Elliptical trammel, ii) Scotch Yoke Mechanism, iii) Oldham's Coupling	2	CO1

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
		Group B: i) Bicycle free wheel sprocket mechanism ii) Geneva mechanism iii) Ackerman's steering gear mechanism iv) Foot-operated air pump mechanism		
4	LLO 4.1 Determine the degree of freedom of the given mechanism	*Degree of Freedom of given mechanism by using Kutzbach equation. (Any five mechanisms available in the Laboratory)	2	CO1
5	LLO 5.1 Measure the ratio of time of the cutting stroke to the return stroke in the shaping operation.	*Quick return mechanism used in a shaper machine	2	CO1
6	LLO 6.1 Draw velocity and acceleration polygon of four bar chain. LLO 6.2 Calculate angular velocity and linear velocity of a link using given data.	Velocity and Acceleration of four bar chain by relative velocity method. (Two Problems on A2 size Sheet.)	2	CO2
7	LLO 7.1 Draw the velocity and acceleration polygon of a single slider crank chain. LLO 7.2 Calculate angular velocity and linear velocity of a link using given data.	*Velocity and Acceleration of single slider crank chain by relative velocity method. (Two Problems on A2 size Sheet.)	2	CO2
8	LLO 8.1 Draw a space diagram of a single slider crank mechanism LLO 8.2 Measure the velocity and acceleration of links using Klien's construction method.	Velocity and Acceleration of Slider Crank Chain by Klien's Construction Method.	2	CO2
9	LLO 9.1 Measure the speed of the driving and driven shaft LLO 9.2 Measure the output torque LLO 9.3 Calculate Output Power	*Measure the Power transmission capacity of single plate clutch	2	CO3
10	LLO 10.1 Measure the torque avilable LLO 10.2 Calculate Power absorbed by band brake	*Measure Power absorbed by band brake	2	CO3
11	LLO 11.1 Construct a balanced system for rotating masses.	*Balancing of rotating unbalanced system	2	CO3
12	LLO 12.1 Generate a cam profile for the given follower to obtain the desired follower motion	Cam profile for knife edge Follower. (Two problems on the A2 size sheet, at least one problem on offset follower)	2	CO4
13	LLO 13.1 Generate a cam profile for the given follower to obtain the desired follower motion	Cam Profile for roller follower. (Two Problems on A2 size sheet, at least one problem on offset follower)	2	CO4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
14	LLO 14.1 Identify displacement of follower with cam rotation	*Measurement of follower displacement with Cam rotation for knife edge follower and roller follower	2	CO4
15	LLO 15.1 Measure the angular speed using a tachometer. LLO15.2 Compute the length of the belt and slip	*Estimation of slip, length of belt, and angle of contact in an open and cross belt drive.	2	CO5
16	LLO 16.1 Identify the type of gear and gear train.	Identification of gears and gear train in Lab and Machine shop.	2	CO5
17	LLO 17.1 Identify the type of gear and gear train. LLO 17.2 Construct gear train for desirable velocity ratio	*Preparation of different Gear trains from the given gears.	2	CO5
18	LLO 18.1 Compare machines and mechanisms used in ancient Indian industry and Modern Industry	*Collect information on different manual machines and mechanisms used the ancient India	2	**IKS**

Note: Out of the above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- A minimum of 12 of the above list of lab experiments are to be performed out of 17.
- Judicial mix of LLOs is to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:-

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practicals performed in the laboratory.

b. Prepare charts of different clutches, Brakes, Dynamometers and chain drive

c. Compile information from the internet related to various mechanisms/elements like piston, crank, connecting rod, cam, clutch, brake, flywheel, governor, or animation of mechanism etc., along with functions and areas of application of each.

d. List the mechanisms which you are using in your day-to-day life. Sketch any three from these.

e. List the different mechanisms used in a typical car.

f. Identify and measure the dimensions of the Flywheel used in automobile engines, generators, punching and riveting machines.

g.Identify the type of clutches used in different automobiles and the type of brakes in automobiles and bicycles.

h. Visit the market and collect the data of items used in any mechanisms. Data includes specifications, cost, applications, etc. Also, name the mechanism/s in which such item/s is/are used.

‘

VIII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Working Model of Beam Engine, Coupling rod of Locomotive, Watt's indicator mechanism, Reciprocating engine, Whitworth quick return mechanism, Rotary Engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism	1,2,4
2	Working Models of Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling, Bicycle free wheel sprocket Mechanism, Geneva mechanism, Ackerman's steering gear Mechanism, Foot operated air pump mechanism	1,4,5
3	Working models of various Cam follower arrangements for demonstration (Radial cam with knife edge and Roller follower models are mandatory)	4,12,13,14
4	Working models of Flat belt and V belt arrangement for demonstration	4,15
5	Shaper machine available in institute workshop	1,2,4,5
6	Tachometer: optical type of tachometer (digital Tachometer) Range speed minimum 0 to 2000 rpm or more	11,15
7	The belt drive test bench comprises the following pulleys, belts, electrical motor, arrangement for adjusting belt tensions and regulating the speed of the driving motor and a suitable mounting frame	15
8	Static & Dynamic Balancing Machine Single phase motor connected to a shaft, containing 4 rotating masses. Each rotating mass has a facility to insert. Pulley is provided to add weights to balance the unbalanced shaft	11
9	Working Model of Gear Trains: i) Simple Gear Train ii) Compound Gear Train iii) Reverted Gear Train iv) Epicyclic Gear Train	16,17
10	Different types of Gears with different modules: at least 5 quantities of each gear Spur gear helical gear (Single /Double)Spiral gear bevel gear	16,17
11	Experimental cam follower set up: The machine consists of a camshaft driven by a D.C. motor/Manual operated. The shaft runs in a double ball bearing. At the free end of the camshaft, a cam can be easily mounted. The follower is properly guided in bushes and the type of the follower can be changed to suit the cam under test. A graduated circular protractor is fitted coaxial with the shaft and a dial gauge can be fitted to note the follower displacement for the angle of cam rotation. A spring is used to provide controlling force to the follower system.	14
12	Experimental set-up to arrange gears and shaft such that desired gear train can be obtained for given velocity ratio.	17

IX. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals and Types of Mechanisms	CO1	12	6	4	4	14
2	II	Velocity and Acceleration in Mechanism	CO2	10	2	4	6	12
3	III	Flywheel, Governor, Clutches, Brakes, Balancing and Vibrations	CO3	18	4	6	10	20
4	IV	Cam and Follower	CO4	10	4	4	4	12
5	V	Power transmission (Belt, Chain and Gear)	CO5	10	4	4	4	12
Grand Total				**60**	**20**	**22**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Laboratory Performance and Term work, Class Test 2. Term work (Lab Manual and drawing sheet), Questions and Answers in the classroom as well as at the time of Practical. Note: Each practical will be assessed considering 60% and 40 % weightage.	1. End Semester Board exam- Theory 2. Summative End-Term Examination

XI. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)		
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	-	2	-	-	2	2	-	
CO2	3	2	2	-	-	-	-	2	-	
CO3	3	2	-	-	2	2	2	2	-	
CO4	3	2	3	2	-	2	2	2	-	
CO5	3	2	2	2	2	2	2	2	-	

Legends:- High:03, **Medium:**02, **Low:**01, **NoMapping:** -
*PSOs are to be formulated at the institute level

XII. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Rattan S.S.	Theory of Machines	Tata McGraw-HillEducation,1986 ISBN 9780070591202
2	Khurmi R.S., Gupta J.K.	Theory of Machines	S.Chand Publications, New Delhi,2015 ISBN 9788121925242
3	Beven Thomas	Theory of Machines	Pearson Education India,1986,3/e ISBN 9788131729656
4	Ballaney P.L.	Theory of Machines and Mechanisms	Khanna Publisher,2003 Edition 23, ISBN 9788174091222
5	Bansal R.K.,Brar J.S.	A textbook of Theory of Machines	Laxmi Publications, New Delhi,2004, ISBN 9788170084181
6	Joseph E. Shigley	Theory of Machines and Mechanisms	OXFORD UNIVERSITY PRESS, fifth edition, ISBN 9780190264482

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mechanalyzer.com/downloads.html	Mech Analyzer is a free software developed to simulate and analyze the mechanisms
2	https://www.youtube.com/watch?v=oTcC_xXfdrA	Coupling Rod Locomotive
3	https://www.youtube.com/watch?v=8shK6kbu7Xk	Piston cylinder animation showing application of cam and gear train
4	https://www.youtube.com/watch?v=yHHeicPbEzg	Simple Beam Engine
5	https://www.youtube.com/watch?v=yHHeicPbEzg	Knife edge follower and Radial Cam
6	https://www.youtube.com/watch?v=Rib-_ZK8KfE	Roller follower with Radial Cam
7	https://www.youtube.com/watch?v=AODiJYtxuSw	Grear train animation
8	https://www.youtube.com/watch?v=klVYeSlxucU	Types of Belt drives
9	https://www.udemy.com/course/theory-of-machines- determine-de grees-of-freedom-in-a-system/	Degree of freedom
10	https://archive.nptel.ac.in/courses/112/106/112106270/	Online NPTL lectures on Theory of machines
11	https://play.google.com/store/apps/details?id=com.pinjara_imran5290.Belt_Length_Calculator&hl=en&gl=US&pli=1	Belt length calculator Application (Play Store app)
14	https://opac.library.iitb.ac.in/	Digital Central Library

Name & Signature: **Mr. R R Godbole** Lecturer in Mechanical Engineering	**Mr. Swapnil S Hatwalane** Lecturer in Mechanical Engineering
(Course Experts)	
Name & Signature: **Dr. Vasudev B Jaware** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA in ME/MT**
PROGRAMME CODE	**04/05**
COURSE TITLE	**BASIC ELECTRONICS TECHNOLOGY**
COURSE CODE	**ET21201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
	BASIC ELECTRONICS ENGINEERING	AEC	2	--	2	--	4	2	--	--	--	--	--	25	10	25 @	10	--	--	50

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate does not secure minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **"Detained"** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.*Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Most consumer appliances are based on electronic circuits and devices in today's world. The foundation for working on a computer or any of its peripherals is based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course, students will develop an insight to identify, build and troubleshoot simple electronic circuits.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the competency mentioned below

CO1 –Use suitable electronic components for the given Mechanical Engineering application

CO2 – Plot characteristics of semiconductor diode and use them for a given application

CO3 – Plot characteristics of the transistor and use them for a given application

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ELECTRONIC COMPONENTS AND SIGNALS (CL Hrs-08, Marks- Nil))				
1.	TLO 1.1 Differentiate between the given active and passive components. TLO 1.2 Determine the value of the given resistor and capacitor using colour codes. TLO 1.3 Differentiate between an ideal and practical signal source TLO 1.4 Explain the given signal parameters with sketches. TLO 1.5 Identify the given type of ICs based on the IC number.	1.1 Electronic Components: Passive and Active components: Resistor, Capacitor, Inductor, symbols colour codes, specifications 1.2 Voltage and current sources (Ideal and Practical) 1.3 Signals: Waveform (Sinusoidal, triangular and square) 1.4 Time and frequency domain representation of signals. Amplitude, frequency, phase, wavelength 1.5 Integrated Circuits - Analog and Digital.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO1**
UNIT-II DIODES AND ITS APPLICATION (CL.Hrs-12, Marks- Nil)				
2	TLO 2.1: Differentiate between intrinsic and extrinsic semiconductor TLO 2.2: Plot VI characteristics of diode TLO2.3: Plot VI characteristics of Zener diode TLO 2.4: Describe the working principle of LED TLO 2.5 Describe the working of a given type of rectifier TLO 2.6: Describe the working of the DC-regulated power supply.	2.1. Semiconductor Theory- Intrinsic and Extrinsic Semiconductor 2.2 P-N junction diode: symbol, construction, forward and reverse biasing, VI characteristics of Diode 2.3 Zener diode: Symbol, Construction, Working, Avalanche and Zener Breakdown, VI Characteristics of Zener diode 2.4LED: symbol, construction, working 2.5 Rectifier: Definition, Classification of rectifier, half wave, Centre tapped full wave and bridge rectifier, working, input-output waveforms, comparison 2.6 Block diagram of Regulated power supply.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO2**

UNIT-III- TRANSISTORS (CL.Hrs-10, Marks -Nil)				
3	TLO 3.1 Identify terminals of the transistor. TLO 3.2: Plot input and output characteristics of transistor in CB configuration. TLO 3.3 Plot input and output characteristics of transistor in CE configuration. TLO3.4: Compare configurations of the transistor. TLO 3.5: Describe the working of BJT as a Switch. TLO 3.6: Describe the working of BJT as an amplifier.	3.1 Types: PNP and NPN transistor and their symbol. 3.2 Construction and Operating principle 3.3 Configurations: CB, CE and CC, input and output characteristics, Operating regions: Cut-off, saturation Active Region 3.4 Comparison of Transistor Configuration 3.4 Application: Transistor as a switch and amplifier	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO3**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL /TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1.	LLO 1.1 Identify various active electronic components in a given circuit.	*Passive Electronic component	2	CO1
2	LLO 2.1 calculate series resistance and measures its value using a Multimeter LLO 2.2calculate Parallel resistance and measure its value using a Multimeter	*Connection of resistors in series and parallel on breadboard	2	CO1
3	LLO 3.1 Connect the capacitors in series combination on a breadboard to measure their value using a Multimeter. LLO 3.2 Connect the capacitors in parallel combination on bread board to measure their value using a Multimeter.	Connection of Capacitors in Series and Parallel	2	CO1
4	LLO 4.1: Use an LCR meter to measure inductance and capacitance	*Measure the value of the inductor and capacitor using an LCR meter	2	CO1
5	LLO 5.1: Use a Multimeter to measure the value of the given resistor	*Calculate the values of different resistors by the colour-coding method	2	CO1
6	LLO 6.1 Identifies various active electronic components in a given circuit.	Active Components	**2**	CO2
7	LLO 7.1: Plot the V-I characteristics of the PN junction diode and determine the cut-in voltage. LLO 7.2 Calculate the static and Dynamic resistance of the diode.	*Test the performance of the P-N junction diode	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
8	LLO 8.1: Plot V-I characteristics of the Zener Diode and determine Zener breakdown voltage.	Test the performance of the Zener diode	2	CO2
9	LLO 9.1: Build the circuit for the Half Wave Rectifier using PN junction Diode LLO 9.2 Plot Output Waveform for sinusoidal input. And Measure the DC output voltage	*Construct and test Half wave rectifier	2	CO2
10	LLO 10.1: Build the circuit for centre tapped Full Wave Rectifier using the P-N junction Diode LLO 10.2: Plot Output Waveform for sinusoidal input And Measure DC output voltage	*Construct and test Centre tapped Full wave rectifier	2	CO2
11	LLO 11.1: Build the circuit for the Bridge Rectifier using the P-N junction Diode LLO 11.2 Plot Output Waveform for sinusoidal input. And Measure the DC output voltage	Construct and test the Bridge Rectifier	2	CO2
12	LLO12.1 Identify terminals of transistor	Transistor identification	3	CO3
13	LLO 12.1: Plot input and output characteristics of BJT in common base configuration	Input and output characteristics of transistor in CB configuration	3	CO3
14	LLO 13.1: Plot input and output characteristics of BJT in common emitter configuration	*Input and output characteristics of transistor in CE configuration.	3	CO3
15	LLO 14.1: Plot input and output characteristics of BJT in common collector configuration	Input and output characteristics of transistor in CC configuration.	3	CO3
16	LLO 15.1: Identify Cutoff and saturation regions	Transistor as a switch	3	CO3
17	LLO 16.1: Build a single-stage Common emitter amplifier. LLO 16.2 Plot frequency response for Common emitter amplifier.	*Common Emitter Transistor amplifier	3	CO3
18	LLO 17.1 Identify different blocks of the Instrumentation System	*Block schematic of instrumentation system	3	CO3

A minimum of 12 for 2 LL Hrs./Week or 24 for 4 LL hrs./Week are to be performed.
'*' Marked Practicals (LLOs) Are Mandatory
A judicial mix of LLOs is to be performed to complete the minimum requirement of 12 / 24 as applicable.

VI. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Analog Multimeter& Digital Multimeter	All
2	CRO 20/30/100 MHz Frequency Dual Channel External Trigger CT mode facility or any other better specifications	9,10,11,16
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude	All
4	Variable DC Power supply 0-30V with display for voltage and current, 2Amp SC protection	All
5	Different types of cables and connectors	All

VII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Term Work	1. End Term Exam

VIII. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	1	2	2	2	-	-	-	-	-
CO2	1	2	3	2	-	-	-	-	-
CO3	1	2	3	2	-	-	-	-	-

Legends:-High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

IX. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1.	Albert Malvino	Basic Electronics	Tata McGraw Hill,2015, ISBN10:1259200116
2.	J.S.Katre	Basic Electronics	Techmax Publishers, ISBN-10: 9350779641
3.	V.K. Mehta	Principles of Electronics	S.Chand New Delhi, edition-2008,ISBN-13: 978- 8121927833
4.	Sedha, R.S.	A Textbook of Applied Electronics	S.Chand (G/L) & Company Ltd; ISBN-13 978-8121904209

X. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://nptel.ac.in/courses	Basic Electronics and Lab, IIT Madras Prof. T.S. Natarajan 2
2.	https://archive.nptel.ac.in/courses	Basic Electronics, IIT Bombay 3 4
3.	https://learn.sparkfun.com/tutorials/transistors	Transistor basics
4.	https://www.multisim.com	Online multi-sim software

Name & Signature: **Smt. V.G.Mahendra** Lecturer in Electronics and Telecommunication **(Course Experts)**	
Name & Signature: **Dr.V.B.Jaware** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE/EE/ET/ME/MT/CM/IT/DDGM**
PROGRAMME CODE	**01/02/03/04/05/06/07/08**
COURSE TITLE	**INDIAN CONSTITUTION: CORE CONCEPTS AND VALUES**
COURSE CODE	**HU21203**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory Practical				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
	INDIAN CONSTITUTION: CORE CONCEPTS AND VALUES	VEC	1	--	--	1	2	1	--	--	--	--	--	--	--	--	--	50	20	50

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

1. **FA-TH** represents an average of two class tests of 30 marks each conducted during the semester.
2. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
3. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Introducing a course on the Indian Constitution can provide students with a comprehensive understanding of the country's legal framework and democratic principles. Such a course could cover the historical context of its creation, the structure and functions of the government it establishes, and the fundamental rights and duties of citizens. It could also explore the significant amendments and judicial interpretations that have shaped its evolution over time. This foundational knowledge is not only for fostering informed and engaged citizens who can contribute to the nation's democratic processes but also enriches the educational experience by fostering a sense of national identity and ethical responsibility among future engineers. Furthermore, embedding Electoral Literacy and Voter Education in diploma engineering programs strategically empowers these future professionals with an awareness of their electoral privileges and the workings of democracy.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Foster comprehension of the fundamental principles and goals embedded in the Indian constitution.
CO2: Elaborate on the core rights and duties conferred upon Indian citizens by the Constitution.
CO3: Comprehend the distribution of legislative, executive, and financial powers between the Union and the States.
CO4: Understand the functioning of Indian democracy, encompassing its frameworks and mechanisms at local, state, and national levels.
CO5: Cultivate the skills and perspectives required for active participation in electoral processes, the conscientious exercise of voting rights, and the promotion of informed democratic participation within society.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I INTRODUCTION TO INDIAN CONSTITUTION(CL Hrs-03, Marks-NIL)				
1.	**TLO 1.1** Understand the historical context and events leading to the drafting of the Indian Constitution. **TLO 1.2** Comprehend the essential features and understand the significance of the Indian Constitution in shaping India's democratic governance and societal ethos. **TLO 1.3** Analyze the vision and ideals articulated in the Preamble and their relevance in contemporary Indian society.	1.1 Historical background and making of the Indian Constitution 1.2 Salient features and significance of the Indian Constitution 1.3 Preamble: Vision and Ideals of the Indian Constitution	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO1**
UNIT - II FUNDAMENTAL RIGHTS, FUNDAMENTAL DUTIES AND DIRECTIVE PRINCIPLES (CL Hrs-04, Marks-NIL)				
2	**TLO2.1** Understand the introduction and structure of Fundamental Rights in Part Ill of the Indian Constitution. **TLO2.2** Understand the principles of the Right to Equality, Right to Freedom, and Right to Life.	**2.1** Fundamental Rights: Introduction & its Scheme under Part -III **2.2** Right to Equality (Article 14-18) **2.3** Right to Freedom (Article 19-22) **2.4** Right to Life (Article 21) **2.5** Fundamental Duties and their Significance under Part IV-A **2.6** Directive Principles of State Policy under Part – IV: importance and	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO2**

	TLO2.3 Identify fundamental duties in general and in particular with the engineering field. **TLO2.4**: Grasp the significance and practical application of Directive Principles of State Policy outlined in Part IV of the Indian Constitution.	implementation.		
UNIT- III UNION AND STATE EXECUTIVE(CL Hrs-03, Marks-NIL)				
3	**TLO 3.1** 3.1: Gain insight into the structure and functions of the Union executives and the jurisdiction of the Supreme Court. **TLO 3.2** 3.2: Understand the organization and responsibilities of the State Executives and the functions of the State Judiciary(High Courts).	**3.1** Union Government, Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions), Prime Minister of India (with Powers and Functions), Union Judiciary (Supreme Court), Jurisdiction of the Supreme Court. **3.2** State Government, State Legislature (Legislative Assembly/ Vidhan Sabha, Legislative Council / Vidhan Parishad), Powers and Functions of the State Legislature, State Executive, Governor Of the State (with Powers and Functions), The Chief Minister Of the State (With Powers and Functions) State Judiciary (High Courts).	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO3**
UNIT-IV AMENDMENTS AND EMERGENCY PROVISIONS(CL Hrs-03, Marks-NIL)				
4	**TLO 4.1** Comprehend the meaning and significance of constitutional amendments, as well as the procedural rules detailed in Article 368 of the Indian Constitution. **TLO 4.2** Recognize the roles of various branches of government in the amendment process, **TLO 4.3** Examine the significant procedures and historical context of major constitutional amendments	**4.1 Introduction to Constitutional Amendments:** Definition and significance of constitutional amendments. Constitutional provisions governing the amendment procedure (Article 368). **4.2 Types of Amendments:** Simple majority amendments, Special majority amendments, Amendments requiring ratification by states. **4.3 Role of the Executives Amendments**: Role of Parliament: Lok Sabha and Rajya Sabha, Role of President: Assent to amendments, Role of State Legislatures: Ratification of certain amendments. **4.4 Major Constitutional**	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO4**

		Amendment procedures: Major Constitutional Amendment procedures - 1st, 7th,42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd		
UNIT –V ELECTORAL LITERACY (CL Hrs-02, Marks-NIL)				
5	**TLO5.** Electoral Literacy: Develop understanding and proficiency in electoral processes, voter registration, rights and responsibilities of voters, electoral reforms, and initiatives promoting electoral literacy.	**5.1 Understanding the Electoral Process :** Overview of the electoral process: registration, voting, counting, and declaration of results, Role and functions of the Election Commission of India Types of elections: Lok Sabha, Rajya Sabha, State Legislative Assembly, Local Body elections **5.2 Voter Registration and Electoral Rolls:** Importance of voter registration Eligibility criteria for voter registration Process of voter registration: online, offline, and special drives Checking and updating voter details in electoral rolls **5.3 Rights and Responsibilities of Voters:** Understanding fundamental rights related to elections Responsibilities of voters towards ensuring free and fair elections Consequences of electoral malpractices and non-participation **5.4 Electoral Reforms and Initiatives:** Overview of electoral reforms aimed at enhancing transparency, inclusivity, and integrity of elections Role of technology in improving electoral processes: Voter Verifiable Paper Audit Trail (VVPAT), Online voter registration, e-voting Initiatives by the Election Commission and civil society organizations to promote electoral literacy	Presentations Case Studies and Analysis Role-Playing and Simulations Project-Based Learning	**CO5**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

NOT APPLICABLE

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

i) Case Study Analysis: Select a few landmark Supreme Court cases related to Fundamental Rights (e.g., Kesavananda Bharati v. State of Kerala, Maneka Gandhi v. Union of India) and analyze the court's interpretation and impact on these rights.

ii) Comparative Analysis: Compare the provisions of the Right to Equality under Articles 14-18 with similar provisions in the constitutions of other countries. Highlight similarities, differences, and the reasoning behind them.

iii) Public Awareness Campaign: Design a public awareness campaign to educate citizens about their Fundamental Rights and Duties. Create informative posters, social media content, and interactive workshops to engage people in discussions about constitutional rights and responsibilities.

iv) Write a reflective essay discussing the historical context and debates surrounding the inclusion of Fundamental Rights in the Indian Constitution.

v) Create a visual timeline depicting the evolution of laws related to equality in India, from independence to the present day. Include major legislative reforms and judicial decisions.

vi) Conduct a comparative analysis of the implementation of Directive Principles in different states of India, identifying successful initiatives and areas needing improvement.

vii) **Case Study Analysis:** Choose a recent constitutional or political issue that has been debated in Parliament. Analyze the roles played by the Loksabha and Rajya Sabha in addressing the issue and the impact of their decisions.

viii) Case Study Analysis: Analyze a landmark constitutional amendment in India (e.g., the 42nd Amendment) and its impact on governance, fundamental rights, and the balance of power between different branches of government.

ix) **Infographic Creation:** Create an infographic illustrating the process of amending the Indian Constitution as outlined in Article 368. Highlight key steps and requirements for different types of amendments.

x**) Timeline Project:** Create a timeline highlighting major constitutional amendments in India, such as the 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, and 102nd amendments. Include key provisions and the political context surrounding each amendment.

xi) **Debate:** Organize a debate on the topic "Should the President have the power to refuse assent to constitutional amendments?" Encourage students to research and present arguments from legal, political, and ethical perspectives.

xi**) Campaign Design:** Design a social media campaign to raise awareness about the importance of voter participation and responsible voting. Create visually engaging posters, infographics, and videos highlighting the consequences of electoral malpractices and non-participation.

xii) **Online Tutorial:** Create a step-by-step tutorial video or guide demonstrating the voter registration process, both online and offline. Include instructions for checking and updating voter details in electoral rolls.

xiii**) Survey Project:** Conduct a survey to assess the awareness and accessibility of voter registration

facilities among different demographic groups in your locality. Analyze the results and propose strategies to improve voter registration rates.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NOT APPLICABLE

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

NOT APPLICABLE

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Assignment, Self-learning and Terms work Seminar/Presentation	—

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	--	--	--	--	2	--	2		
CO2	--	--	--	--	3	--	2		
CO3	--	--	--	--	3	--	2		
CO4	--	--	--	--	3	--	2		
CO5	--	--	--	--	3	--	2		

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	M. Laxmikanth	"Indian Polity"	McGraw Hill Education: ISBN-13: 978-9352603633
2	D. D. Basu	Introduction to the Constitution of India	LexisNexis: ISBN-13: 978-8180386477
3	Subhash C. Kashyap	Our Constitution: An Introduction to India's Constitution and Constitutional Law	National Book Trust, India ISBN-13: 78-8123748462
4	Arun K. Thiruvengadam	The Constitution of India: A Contextual Analysis	Oxford University Press ISBN-1 3:978-0199467078
5	Oxford University Press	The Making of India's Constitution	Oxford University Press Oxford University Press

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://prsindia.org/.	In-depth analysis of parliamentary affairs, legislative processes, and policy Issues in India.
2	https://awmin.gov.in	Official repository providing access to the full text of the Indian Constitution.
3	https://constitution.org.in	Interactive platform offering the text of the Constitution along with annotations and historical context.
4	https://indiankanoon.org	Legal search engine offering a vast database of Indian case law, including constitutional judgments.
5	https://nptel.ac.in	Offers video lectures and course materials on studies of law and the constitution.

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Name & Signature: **Dr.V.B.Jaware** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)