GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMAINME
PROGRAMME CODE	04
COURSE TITLE	ADVANCED MANUFACTURING TECHNOLOGY
COURSE CODE	WS51201
PREREQUISITE COURSE CODE & TITLE	

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	
WS51201	ADVANCED MANUFACTURING TECHNOLOGY	SEC	4	--	4	--	8	4	3	30	70	100	40	25	10	25#	10	--	--	150

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 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.

I. RATIONALE:

Mechanical technologists (diploma holders) work with men, machines and materials. With the advancements, newer difficult-to-machine materials and complex shapes with high surface finish are the demand of the manufacturing sector. To machine these materials and the complex geometries with very high surface finish, the student must know non-conventional machining processes like EDM, ECM, LBM, PAM, WJM, EBM, WEDM and CNC. This course is aimed at making them achieve the various outcomes required for the given jobs.

II. INDUSTRY EXPECTED OUTCOME

Use advanced manufacturing technology available 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: Use a non-conventional machining process for complex shapes and hard-to-machine components.
CO2: Maintain CNC machine and prepare CNC part programme for CNC Lathe and CNC Milling.
CO3: Choose a relevant machining process to produce gears.
CO4:Classify manufacturing operations and levels of automation.
CO5: Make use of Group technology, Cellular Manufacturing, Flexible Manufacturing Systems and CIM.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned toCO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		Section - 1		
	UNIT-I NON-CONVENTIONAL MACHINING PROCESSES (CL Hrs-10, Marks-10)			
1.	TLO1.1 State the working principle of the given non – non-conventional machining method with neat sketches. TLO1.2 List advantages, limitations and applications of the given non –non-conventional machining method. TLO1.3 Suggest NCMmethod for the given job withjustification. TLO1.4 List process parameters for the given job and NCM process with justification.	1.1.Fundamentals of Non – Non-conventional methods – Needs and types of non-conventional methods. Importance of methods. 1.3. Advantages, limitations and applications of – EDM, WEDM ECM, PAM, AJM, USM, EBM LBM, and WJM. 1.2Working principle, set up, process parameters of – EDM" WEDM ECM, PAM, AJM, USM, EBM and LBM. 1.3.Advantages, limitations and applications of – EDM, WEDM ECM, PAM, AJM, USM, EBM LBM and WJM.	Chalk-Board Model Demonstration Video Demonstrations	CO1
	UNIT-II FUNDAMENTALS OF COMPUTER AIDED MANUFACTURING (CAM) (CL Hrs-12, Marks-14)			
2	TLO2.1 State the function of the given element(s) of the CNC Machine. TLO2.2 Select tool(s) and tool holders(s) used on the CNC machine for the given job with justification. TLO2.3 List different elements of the CNC Machine TLO2.4Explainconstructional features of CNC turning	2.1.CAM concept, NC (Numerical Control), CNC (Computerized Numerical Control) and DNC (Direct Numerical Control) –concept, features and differences. 2.2.CNC machines: Types, classification, working and constructional constructional features Advantages, limitations and selection criteria. 2.3.Elements of CNC machines – Types, sketch, working and importance of:	Chalk-Board Model Demonstration Video Demonstrations	CO2

Sr. No	Theory Learning Outcomes (TLO's) aligned toCO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	centers TLO2.5List different work-holding devices	Slideways; Recirculating ball screw; Feedback devices (Transducer and encoder). Automatic tool changer (ATC); Automatic pallet changer (APC) 2.4.CNC tooling: Tool presettingconcept and importance; Qualified tools- definition need and advantages; Tool holders types and applications. 2.5.CNC turning centres: Types; Features; Axes nomenclature; Specification; Work holding devices -types, working and applications. 2.6.CNC machining centres: Types; Features; Axes nomenclature; Specification; Work holding devices-types, working and applications.		
	UNIT-III CNC PART PROGRAMMING(CL Hrs-10, Marks-12)			
3	TLO3.1Statevariousterminology related to CNC programming TLO3.2Interpret given CNC part programming code(s). TLO3.3Demonstrate part programme using G and M codes for the given job. TLO3.4Develop advanced CNC part programming features like canned cycle, do loop, subroutine etc. in the given situation. TLO3.4Describethe procedure for setting the given compensation(s) on the given CNC machine.	3.1.Definition and importance of various positions like machine zero, home position, workpiece zero and programme zero. 3.2. CNC part programming, Programming format, and structure of the part programme 3.3. ISO G and M code for turning and milling-meaning and application of the important code. 3.4. Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation). 3.5. Simple part programming for milling using ISO format. 3.6. Importance, types, applications and format for: Canned cycles; Macro; Do loops; Subroutine; 3.7.CNC turning and milling part programming using canned cycles Do loops and Subroutine. 3.8. Need and importance of various components:Tool lengthcompensation; Pitch error compensation; Tool radius compensation; and Tool offset. 3.9. Simple part programming using various compensations.	Chalk-Board Model Demonstration Video Demonstrations	CO2

Sr. No	Theory Learning Outcomes (TLO's) aligned toCO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		Section - 2		
	UNIT- IV GEAR MANUFACTURING METHODS (CL Hrs-8, Marks-10)			
4	TLO4.1Choose a gear manufacturing method for the given job. TLO4.2 Describe gear generatingmethod with a sketch. TLO 4.3Describethe gear finishingmethod with a sketch. TLO4.4 recommends the process parameters for the given gear manufacturing and finishing process with justification.	4.1. Function and types of gears, and gear manufacturing methods. 4.2. Gear Hobbing:- working principle, types of gear hobbing, advantages, limitations & application of gear hobbing. 4.3. Gear Shaping: - Gear shaping by pinion cutter, gear shaping by rack cutter, advantages, limitations & application of gear shaping. Comparison of Gear Hobbing& Gear Shaping. 4.4 Gear Finishing Method:- Need of gear finishing, gear finishing methods – Honning, Lapping etc.	Chalk-Board Model Demonstration Video Demonstrations	CO3
	UNIT- V MANUFACTURING OPERATIONS & AUTOMATION (CL Hrs-10, Marks-12)			
5	TLO5.1 Classify manufacturing industry and product TLO5.2Describe different types of manufacturing operation TLO5.3List different cost of manufacturing operation TLO5.4State basic element of an automated system.	5.1.Manufacturing Industries and Products 5.2.Manufacturing operations-Processing and assembling operations, other factory operations. 5.3.Costs of manufacturing operations and variable cost, direct labour, material and overhead, and cost of equipment usage. 5.4.Definition of Automation, Basic elements of Automated system to accomplish the Automated process, Program of instruction, Control system, Reason for Automating, Automation principles and strategies- USA Principle-Ten Strategies for Automation and production, Levels of Automation.	Chalk-Board Model Demonstration Video Demonstrations	CO4
	UNIT –VI MANUFACTURING SYSTEMS (CL HRS-10, MARKS-12)			
6	TLO 6.1State term Group Technology TLO 6.2 Describe cellular manufacturing TLO 6.3 List applications of FMS. TLO 6.4 Relate concept of FMS TLO 6.5 Relate Concept and element of CIM System .	6.1. Group Technology and Cellular Manufacturing: Part families, part classification & coding 6.2. Cellular manufacturing- composite part concept, Machine cell design. 6.3. Flexible Manufacturing System: FMS Concept, Component- Workstation, Material handling and storage system, computer control system and human resource 6.4. FMS Application and Benefits, FMS Planning & Implementation 6.5. CIM – Introduction to CIM, definition, Concept and elements of CIM system. Application of CIM.	Chalk-Board Model Demonstration Video Demonstrations	CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIALEXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory LearningOutcome(LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number ofhrs.	Relevant COs
1	LLO1.1Demonstrate workingof nonconventionalmachines.	*Demonstrate working of any one nonconventional method EDM /WEDM/ECM /PAM/AJM /USM/ EBM /LBM	6	1
2	LLO2.1Recognise anddemonstrate elements of the CNC machine.	Demonstrate the working & function of various elements of CNC Turning and CNC machining centers	4	2
3	LLO3.1Prepare CNC part program using G and M codes	*Prepare CNC part program using G and M codes with ISO format for Simple jobs involving basic machining operations on Turning centers	6	2
4	LLO4.1Prepare CNC part program using G and M codes	Prepare CNC part program using G and M codes with ISO format for Simple jobs involving basic machining operations in machining centers.	6	2
5	LLO5.1Prepare a part program for a simple job.	*Produce a simple job using a part program developed in Pr 3.1 and Pr 4.1	6	2
6	LLO6.1Preapre part program using canned cycles/ Do loops/ Subroutine.	Prepare a part program for a CNC turning machine/machining center for a job involving canned cycles/ Do loops/ Subroutine.	6	2
7	LLO7.1 Part program on virtual CNC simulator	Prepare part program on virtual CNC simulator using a part program developed in Pr 3.1 and Pr 4.1	4	2
8	LLO 8.1 Prepare gear using the relevant machine.	*Make a gear blank on the lathe and produce a gear on the milling /shaper machine.	6	3
9	LLO9.1Draw Gear Hobbing and Gear Shaping Mechanism	Demonstrate working of Gear Hobbing and gear shaping.	4	3
10	LLO10.1 Evaluate information for primary, secondary & tertiary types of Industry.	Collect information on any one of the primary, secondary & tertiary types of Industry.	4	4
11	LLO11.1 Demonstrate material handling system	*Demonstrate the material handling system of any industrial assembly line	4	4
12	LLO12.1 Demonstrate FMS	*Observe Flexible Machine Station in an Industry.	6	5
13	LLO13.1 Design FMS line	Demonstrate FMS line for a given problem which includes level of flexibility, type of operation, and number of machines used.	4	5
			60	

Note: Out of the abovesuggestiveLLOs-

- '*'MarkedPracticals(LLOs)Aremandatory.

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.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFICLEARNING/SKILLS DEVELOPMENT(SELF-LEARNING) --- NA

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	EquipmentNamewithBroadSpecifications	Relevant LLONumber
1	Equipment of Anyone of the following manufacturingprocess EDM/WEDM/ECM/PAM/AJM/USM/ EBM/LBM/WJM.	1.1
2	CNC Turning 250 with standard accessories and multi-controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC. (Suggested)	2.1, 3.1, 5.1, 7.1
3	CNC Milling 250 with standard accessories and multi-controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel – 225 mm, Y axis travel – 150 mm, Z axis travel – 115 mm, with ATC. (Suggested)	2.1, 4.1, 6.1, 7.1
4	Column and knee type milling machine along with dividing head (Length X width of the working table 800 mm X 300 mm)	8.1,9.1

VIII. SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS&ASSESSMENTPURPOSE (SpecificationTable)

Sr.No	Unit	UnitTitle	AlignedCOs	LearningHours	R-Level	U-Level	A-Level	TotalMarks
1	I	Non-Conventional Machining Processes	1	10	2	4	4	10
2	II	Fundamentals of Computer-Aided Manufacturing	2	12	4	4	6	14
3	III	CNC Part Programming	2	10	2	4	6	12
4	IV	Gear Manufacturing	3	08	2	2	6	10
5	V	Manufacturing Operations & Automation	4	10	2	4	6	12
6	VI	Manufacturing Systems	5	10	2	4	6	12
Grand Total				**60**	**14**	**22**	**34**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessmentfor Learning)	Summative Assessment (Assessmentof Learning)
1. Tests 2. Seminar/Presentation 3. Term Work	1. ESE Practical Examination 2. End Semester Theory Examination

X. SUGGESTED COS- POSMATRIXFORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 BasicandDiscipline-SpecificKnowledge	PO-2 Problem Analysis	PO-3 Design/ DevelopmentofSolutions	PO-4 EngineeringTools	PO-5 EngineeringPracticesforSociety,Sustainabilityand Environment	PO-6 ProjectManagement	PO-7 LifeLong Learning	PSO-1	PSO-2	PSO-3
CO1	3	--	--	2	2	--	2	-	3	-
CO2	3	2	--	3	2	2	3	3	3	-
CO3	2	2	--	2	2	2	3	--	3	-
CO4	2	2	--	2	2	--	3	--	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. SUGGESTEDLEARNINGMATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Rao, K VaraPrasada	Unconventional manufacturing processes	New Edge Publication, New Delhi,2009, ISBN: 978-81-224-2759-2
2	Singh M.K. New Edge Publication,	A textbook of Production Engineering	New Delhi, 2009, ISBN: 978-81-224-2244-3
3	Jain V. K.	Advanced Machining Processes	Allied Publishers, Mumbai, 2009, ISBN 81-7764-294-4
4	Pabla B.S.	CNC Machines	Adithan M. New Age International, New Delhi, 2014, ISBN: 9788122406696
5	Quesada Robert	Computer Numerical Control-Turning and Machining centres	Prentice Hall India, New Delhi, 2014, ISBN: 978-0130488671
6	GrooverMikell P	CAD/CAM: computer-aided design and manufacturing	Zimmered W Emory, Prentice Hall, New Delhi, 2011, ISBN: 9780131101302
7	MartandTelsang	Industrial Engineering and Production Management	S Chand,1998, ISEB:81-219-1773-5
8	Rao P N, Tiwari N K, Kundra T	Computer Aided Manufacturing	Tata McGraw Hill, New Delhi, 2017, ISBN: 978-0074631034
9	ChoudharyHajara S.K.	Workshop Technology Vol- II	Media Promoters and Publishers Limited, Mumbai, 2005, ISBN: 9788185099156

XII. LEARNINGWEBSITES& PORTALS

Sr.No	Link/Portal	Description
1.	https://nptel.ac.in/	Online Learning Initiatives by IITs and IISc
2.	http://nptel.ac.in/video.php?subjectId=112105126	NPTEL Introduction
3.	http://nptel.ac.in/courses/112104028/	Lecture-01.Advanced Machining Processes
4.	https://www.youtube.com/watch?v=tTnXn498F90&list=PLWv6RLxuaVQwMg6kFEoceMEGTWNnr7Jmr	Non-conventional machining process
5.	https://www.youtube.com/watch?v=ImtSsDLgAaI&list=PLSGws_74K01-KX9YtVZACpOoFYy6oaJIC	Computer Numeric Control Of Machine
6.	https://youtube.com/playlist?list=PLLy_2iUCG87A-kHGx4YUY97ShTTqBfA6-&si=qjbBeRcTsYzu2Coc	Production and Operation Management
7.	https://www.youtube.com/watch?v=YoslM2Sxihs&pp=ygUNZm1zIGNpbSBucHRlbA%3D%3D	Flexible Manufacturing System
8.	https://youtube.com/playlist?list=PLFW6lRTa1g808_CfYhZKdv2eXplAQiAwS&si=3-Dgj6GQ0pWU6wbV	Computer Integrated Manufacturing
9	https://www.youtube.com/watch?v=--pAaaFJAzI	Gear Shaping using Pinion Type Cutter
10	https://www.youtube.com/watch?v=J1UOjBLo-2M	Gear Shaping and Hobbing.

Name &Signature:

(Mrs. D.S.Waghmare)
Lecturer in Mechanical Engineering

(R.S.Solanke)
Lecturer in Mechanical Engineering

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GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMAINME
PROGRAMME CODE	04
COURSE TITLE	ENGINEERING THERMODYNAMICS
COURSE CODE	ME31202
PREREQUISITE COURSE CODE & TITLE	NA

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	
ME31202	ENGINEERING THERMODYNAMICS	DSC	03	-	02	01	06	03	03	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, **@S** - Internal Online Examination

Note:

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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:

Engineering Thermodynamics is a core course which deals with energy,energy conversion systems, heat transfer principles and the applications based on these principles.Diploma holders in Mechanical Engineering are expected to take responsibility for maintaining IC engines, steam boilers, steam turbines, steam condensers, cooling towers etc. Understanding the fundamentals of thermodynamics is crucial to comprehend the operation and maintenance of these applications. This course emphasizes building the foundation of mechanical engineering.

III. INDUSTRY EXPECTED OUTCOME

Apply engineering thermodynamics principles to different thermodynamic systems and equipment.

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 thermodynamic principles to a different thermodynamic system
CO2: Determine different properties of steam using the steam table and mollier's chart
CO3: Maintain different components of the steam power plant
CO4: Select heat exchanger with justification
CO5: Identify different components and systems of the I.C.engine

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Out comes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I FUNDAMENTALS OF THERMODYNAMICS (CL HRS-10, MARKS-14)				
1.	TLO 1.1Classify thermodynamic systems TLO 1.2 Correlate different units ofproperties of systems TLO 1.3Interpret various laws of thermodynamics. TLO 1.4Apply steady flow equation to different application	1.1 Thermodynamic system, Types of systems- Open, closed & isolated system, Extensive and Intensive properties, Process and Cycle. Properties of Thermodynamic system- Pressure,Temperature,Volume, Density and their units. Thermodynamic definition of work, heat, difference between heat and work, flow work, concepts of enthalpy and entropy. 1.2 Laws of Thermodynamics - Zeroth law, first law and second law of thermodynamics. Kelvin Planks, Clausius statements. Concept of Heat engine, Heat pump and Refrigerator. 1.3 Application of Laws of Thermodynamics - Steady flow energy equation and its application toboiler, Nozzle, turbine, and condenser.	Lecture using Chalk and Board	CO1
UNIT-II SINGLE PHASE AND TWO-PHASE SYSTEM (CL HRS-10, MARKS-14)				
2	TLO2.1 Represent Ideal gas processes on the P-V & T-S diagram. TLO2.2 Determine work done, heat transfer, internal energy, the enthalpy change for various ideal gas processes. TLO2.3 Define Wet, Dry and saturated and Superheated Steam TLO2.3 Calculate different properties of steam using steam table. TLO2.4 Determine different properties of Steam using Mollier's Chart	2.1 Characteristics gas constant and universal gas constant. 2.2 Ideal gas processes –Isobaric, Isochoric, Isothermal, Isentropic, Polytropicand their representation on P-V and T-S diagrams. Determination of work, heat, internal energy, enthalpy change. (only simple numerical based on above). 2.3 Steam fundamentals - Applications of steam, generation of steam at constant pressure with representation on T-H &T-S chart. Types of steam: Wet, dry, superheated steam. 2.4 Use of Steam Table and Mollier's chart, Properties of steam: Sensible,	Lecture using Chalk and Board	CO1,CO2

Sr. No	Theory Learning Out comes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		latent, total heat, specific Volume, dryness fraction. Use of the steam table. (Only simple numerical based on above).		
UNIT-III STEAM POWER PLANT (CL HRS-10, MARKS-14)				
3	TLO3.1 Draw a layout of steam power plant. TLO3.2Explain construction and working of the steam Boiler, Steam turbine. Steam condenser TLO3.3 Calculate Condenser, volumetric efficiency and mass of air present in the steam condenser TLO3.4 Explain the construction of cooling tower TLO 3.5 Explain the necessity of compounding of Steam turbine .	3.1 Rankine Cycle, Layout of Steam power Plant, Steam power plants in India and its generation capacity. 3.2 Indian Boiler Regulatory Act (IBR), Classification of boilers,Introduction to high pressure boiler, Construction and working withLamontBoiler and Benson Boiler. 3.3 Steam nozzle & Steam Turbines, Function,types,and applications of steamnozzles. Construction and working of Impulse and Reaction turbine. Need of compounding. Regenerative feed heating & bleeding of steam. 3.4 Steam condensers - Dalton's law of partial pressure, function, classification of condensers, construction and working of surface Condenser. Sources of air leakage and its effect. Condenser and volumetricefficiency. (Simple numerical based on the above) 3.5 Classification of cooling towers, Construction and working of natural, forced and induced draught cooling tower.	1. Lecture using Chalk and Board 2. Charts and Models 3. Video presentation	CO3
UNIT- IVHEAT TRANSFER AND HEAT EXCHANGER (CL HRS-08, MARKS-14)				
4	TLO4.1 namedifferent modes of heat transfer. TLO4.2 Calculate heat transfer by conduction through slab & composite walls. TLO4.3 State different laws of heat transfer related to conduction, Convection and radiation. TLO4.4 Define absorptivity,	4.1 Modes of heat transfer - Conduction, convection and radiation. 4.2 Conduction - Fourier's law, conduction through slab & composite wall (simple Numerical based on Composite wall and Slab) 4.2 Convection - Newton's law of cooling, natural and forced convection. 4.3Radiation - absorptivity, transmissivity, reflectivity, emissivity, black body,	1.Lecture using Chalk and Board 2.Charts and Models 3.Video presentation	CO4

Sr. No	Theory Learning Out comes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	transmissivity, reflectivity, emissivity, black body, grey body TLO4.5 Classify heat exchangers. TLO4.5 Explain constriction and working of different heat exchangers TLO4.6 Calculate the LMTD of given parallel or counter flow heat exchanger	gray body, Stefan Boltzmann law. 4.4 Heat Exchangers - Classification, construction and working of shell and tube, plate-type heat exchanger and its applications. Calculation of heart transferbetween cold and hot fluid, Logarithmicmean temperature difference(LMTD) (Simple numerical on Parallel and counterflow heat exchanger only)		
UNIT –V POWER CYCLES AND INTRODUCTION TO I.C.ENGINE (CL HRS- 10, MARKS-14)				
5	TLO5.1 Represent various power cycles on the P-V & T-S diagram. TLO5.2 Classify I. C. Engines. TLO5.3Explain construction and working of two strokes & four-stroke I.C. engine TLO5.4 Explain different systems used in I.C.engine with neat sketch TLO5.5 State functions of different components used in I.C.Engine	5.1 Power Cycles – Carnot Cycle, Otto cycle, Diesel cycle, Dual Cycle and its representation on the P-V and T-S diagram. (No numerical on above) 5.2 Introduction to I.C. Engine – Classification and application of IC engines, Engine Terminology Construction & working of two strokes and four strokes I.C. engines (S.I. and C.I. engine) 5.3 Systems of I.C.Engine- types and construction of an Ignition system, fuel injection system, Cooling system, Fuel feed system, Lubrication system 5.4 Constructionand Functions of- Piston, suction and delivery valve, Combustion chamber, camshaft, Connecting rod, crankshaft,Fuel pump (To be covered in Practical only)	1.Lecture using Chalk and Board 2.Charts and Models 3.Video presentation	CO1,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	LLO1.1 Use different measuring instruments for measuring thermodynamic parameters of the system.	*Measurement of Temperature, Pressure, Volume, and discharge using different instruments	2	CO1
2	LLO2.1 Measure the Power consumption of given system using an energy meter	Measurement of power using energy meter	2	CO1
3	LLO3.1 Determine steam properties using steam table and mollier's chart	*Use of steam table and Mollier's Chart	2	CO2
4	LLO4.1 Identify different components of Steam boiler. LLO4.2 Draw constructional details of the given steam boiler.	* Demonstration of Lancashire/Babcock & Wilcox /Benson/Willox Boiler	2	CO3
5	LLO5.1 Identify different components of boiler mountings and accessories.	Demonstration of boiler Mountings and Accessories	2	CO3

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
	LLO5.2 Draw constructional details of any two boiler mountings and accessories.			
6	LLO6.1 Identify different components of steam turbine. LL O6.2 Draw constructional details of the given steam turbine.	Demonstration of Steam Turbine using models.	2	CO3
7	LLO7.1 Identify different components of steam condenser. LLO7.2 Draw constructional details of the given steam condenser.	Demonstration of Steam Condenser.	2	CO3
8	LLO8.1 Measure heat transfer of cold fluid flowing through the heat exchanger.	Measurement of heat transfer using shell andtubetype heat exchanger.	2	CO4
9	LLO9.1 Identifythe given heat exchanger. LLO9.2 Measure LMTD of given heat Exchanger.	*Measurement of LMTD using parallel andCounterflow heat exchanger.	2	CO4
10	LLO10.1 Identify different components of heat exchanger. LLO10.2 Draw constructional details ofgiven heat exchanger.	Demonstration of different heat exchanger available in the Laboratories.	2	CO4
11	LLO11.1 Measure the thermal conductivity of givenmetal.	Measurement of thermal conductivity of givenmetal.	2	CO4
12	LLO12.1 Measure the heat transfer coefficient of agiven fluid.	Measurement of heat transfer coefficient of a given fluid.	2	CO4
13	LLO13.1 Identify different circuits of Solex Carburetor. LLO13.2 Maintainsolex carburetor.	*Dismantling and Assembly of Solex Carburetor.	2	CO5
14	LLO14.1 Identify different circuits of the inline fuel injection pump. LLO14.2 Maintain inline fuel pump.	Dismantling and Assembly of injection pump.	2	CO5
15	LLO15.1 Identify different components of givenI.C.Engine. LLO15.2 Dismantle given I.C.Engine. LLO15.3 Assemble given I.C.engine	*Dismantling and Assembly of multi cylinderI.C.Engine.	4	CO5
16	LLO16.1 Compare thermodynamic measuring instruments for thermodynamic parameters of modern and ancient India	(*IKS) Collect information of measuring instruments for thermodynamic parameters used in ancient India.	2	CO1
			34	

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.

VII. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIESF OR SPECIFIC LEARNING/SKILLS DEVELOPMENT(SELF-LEARNING)

Microproject: NA

Assignment: NA

VIII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLONumber
1	Thermometer- Mercury (Range up to 100 °C) - Qty 01 Thermometer- Alchohol (Range up to 150 °C) - Qty 01 Non-Contact Type Thermometer (Range- -30 °C - 250 °C) - Qty 01	01,08,09
2	Bourdons Pressure Gauge (Rangeuotp 12 bar) - Qty 1 U Tube Manometer - Qty1	01
3	Analogue Digital Energymeter- Qty.01 Digital Enrgymeter - Qty. 01	02
4	Model and charts of Lancashire Boiler, Cochran Boiler, Babcockwilcox Boiler – Qty (one each)	04
5	Charts of Loeffler,Wilox, and Lamont Boiler (one each)	04
6	Model and charts of Dead weight safety valve,Spring loaded safety valve, Ramsbottom lever safety valve, Water level indicator, Fusible plug, High steam low water safety valve,Economiser,Superhetaer,feed check valve- (one each)	05
7	Model and chart of Impulse turbine, Reaction turbine,Pressurecompounding,Velocity compounding – (one each)	06
8	Model and chart of Steam Condenser	07
9	Working Model of shell and Tube-type condenser	08
10	Parallel and counter flow heat exchanger kit	09
11	Charts and Models of the Surface heat exchanger,Plate type heat exchanger, Forced and natural air cooled Heat Excnager, Water cooled heat exchanger (one each)	09,10
12	Thermal conductivity apparatus- Test piece copper/brass of Min. 50 diameter and 300 mm length, Heating coil connected at one end and other end water jacket, Insulation of PUF, Thermostats placed at 50 mm on the test piece, 4 thermostats placed at different locations of insulation, water In and Out temperature measurement by a thermostat. Temperature selector with RTD temp digital display, digital Energy meter, Voltmeter,Ammeter. Measuring flask, The Unit should be mounted on apowder-coated stand.	11
13	Convective heat transfer apparatus- 1 Phase,220 V AC,2 amp., min. Test piece diam .24 mm and length 300mm, Nicrome wire heater,Blower, RTD digital temp. indicator, voltmeter,ammeter. The unit should be mounted on powder coated stand.	12
14	Solexcarburettor	13
15	Inline fuel injection pump	14
16	4 stroke-4 cylinder petrol or diesel engine	15
15	Toolbox with trolley- ring spanners set, box spanners set, Plier, hammer, Mallet, hacksaw screwdriver set,mallet,bearing puller, Torque wrench	13,14,15

IX. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(SpecificationTable)

Sr.No	Unit	UnitTitle	AlignedCOs	LearningHours	R-Level	U-Level	A-Level	TotalMarks
1	I	Fundamentals of Thermodynamics	CO1	10	4	4	6	14
2	II	Single-Phase and Two-Phase System	CO1,2	10	2	4	8	14
3	III	Steam Power Plant	CO3	10	4	4	6	14
4	IV	Heat Transfer and Heat Exchanger	CO4	08	2	4	8	14
5	V	Power Cycles and Introduction to I.C.Engine	CO5	10	4	4	6	14
Grand Total				**48**	**16**	**20**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessmentfor Learning)	Summative Assessment (Assessmentof Learning)
1. Term work	1. End semester practical examination

XI. SUGGESTED COs- POsMATRIXFORM

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

Legends: -High:03,**Medium:**02,**Low:**01,**No Mapping:-**
*PSOsaretobeformulatedattheinstitutelevel

XII. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R.K.Rajput	Engineering Thermodynamics	Laxmi Publication, New Delhi ISBN-8131808041
2	M.M.Rathore	Thermal Engineering	McGraw Hill Education ISBN-0070681139
3	P.K.Nag	Applied Thermodynamics	McGraw Hill Education ISBN-9789352606429
4	S.Domkunwar and A.Domkunwar	A course of Thermal Engineering	Dhanpat Rai and Sons. ASIN-B01MZAPV8F
5	R.S.Khurmi	A textbook of Thermal Engineering	S.Chand Publication. ISBN- 9788121925730

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://onlinecourses.nptel.ac.in/noc24_me63/pr view	Fundamentals of thermodynamics
2.	https://www.youtube.com/watch?v=-cr5vfV4YAI	https://www.youtube.com/watch?v=-cr5vfV4YAI
3.	https://www.youtube.com/watch?v=Kj_NEUu2xvw	https://www.youtube.com/watch?v=Kj_NEUu2xvw
4.	https://www.youtube.com/watch?v=qO9BrKLKiLE	https://www.youtube.com/watch?v=qO9BrKLKiLE
5.	https://www.youtube.com/watch?v=H_RgFXjg-5s	https://www.youtube.com/watch?v=H_RgFXjg-5s

Name &Signature:

(Mr. Pushpak U. Garge)
Lecturer in Mechanical Engineering

(Mrs. Sonali S.Nagawade)
Lecturer in Mechanical Engineering

(Course Experts)

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

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMAINME
PROGRAMME CODE	04
COURSE TITLE	FLUID MECHANICS AND MACHINERY
COURSE CODE	ME31202
PREREQUISITE COURSE CODE & TITLE	NA

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	
ME31207	FLUID MECHANICS AND MACHINERY	DSC	4	--	2	--	6	3	3	30	70	100	40	25	10	25@	10	--	---	150

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. RATIONALE:

The knowledge of fluid mechanics & fluid machinery is essential in many fields of engineering like power generation, irrigation, water supply, etc. This course aims to develop the skills that will enable the students to select appropriate hydraulic devices and machines like pressure gauges, flow measuring devices, pipes, pumps, turbines, etc. for a particular application. The fundamentals of this subject are essential for the subject of Industrial Hydraulics to be taught in higher semesters.

III. INDUSTRY EXPECTED OUTCOME

- Maintain fluid machinery available in the industry

IV. COURSE-LEVEL LEARNING OUT COMES(CO's)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning.

CO1: Measure pressure using various pressure measurement devices.

CO2: Apply Bernoulli's theorem to various flow measuring devices to measure flow rate and velocity of flow.

CO3: Calculate the various losses in flow through pipes

CO4: Select a suitable hydraulic turbine and pump for the given application

CO5: Evaluate the performance of hydraulic turbines and pumps

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes(TLO) alignedtoCO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I PROPERTIES OF FLUID AND PRESSURE MEASUREMENT (CL Hrs-10, Marks-12)				
1.	**TLO 1.1** Explain various properties of fluids **TLO 1.2** Explain different types of fluids **TLO 1.3** Compare given fluids based on the required physical properties **TLO 1.4** Select a suitable pressure measuring device for the given application with justification **TLO 1.5** Calculate fluid pressure, total pressure and center of pressure on a given immersed body for a given position in a specified liquid	**1.1 Properties of Fluid:** Density, Specific gravity, Specific volume, Specific Weight, Dynamicviscosity, Kinematic viscosity, Surface tension, Capillarity, VapourPressure, Compressibility.Types of fluids, Simple numerical on properties of fluids. **1.2 Fluid Pressure:** Fluid pressure, the relation between Pressure head and Pressure intensity, Pascal's law, Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure, Different units of pressure and their inter-relation. **1.3 Fluid Pressure Measurement Devices:** Construction and working principle of piezometer, simple and differential manometers, Micromanometers, Numerical on above manometers,Construction and working principle of Bourdon tube pressure gauge **1.4 Hydrostatics:** The total pressure, center of pressure on the immersedsurface of the plane in horizontal and vertical position only, Simple Numericals	1. Lecture Using Chalk-Board 2. Presentations 3. Video Demonstration 4. Model Demonstration	CO1
UNIT-II FUNDAMENTALS OF FLUID FLOW AND FLOW MEASUREMENT(CL Hrs-10, Marks-12)				
2	TLO 2.1 Classify different types of fluid flows TLO 2.2Apply Continuity equation and Bernoulli's equation to the various flow measuring devices TLO 2.3 Describe the procedure to calculate discharge using the given flow-measuring device TLO 2.4 Calculate the flow rate using the given flow-measuring device	**2.1 Types of Fluid Flows:** Laminar, turbulent, steady, unsteady, uniform, non-uniform, rotational, irrotational, 1-D, 2-D and 3-D flows Continuity equation, Bernoulli's theorem Construction, working principle of Venturimeter, coefficient of discharge, Derivation for discharge through venturimeter and numerical on it Construction, Working principle of Orifice meter, Hydraulic coefficients (Cd, Cc, Cv), Derivation for discharge through Orifice meter and numerical on it Construction, Working principle of Pitot Tube and numerical on it	1. Lecture Using Chalk-Board 2. Presentations 3. Video Demonstration 4. Model Demonstration Hands-on	CO2

UNIT-III FLOW THROUGH PIPES(CL Hrs-06, Marks- 08)				
3	TLO 3.1 State laws of fluid friction for laminar and turbulent flow TLO 3.2 Calculate frictional losses using Darcy's equation and Chezy's equation TLO 3.3 Describe various minor losses in fluid flow TLO 3.4 Calculate hydraulic power transmission efficiency through pipes TLO 3.5 Describe the water hammer phenomenon with remedial measures	3.1 Laws of fluid friction for laminar and turbulent flow 3.2 Darcy's and Chezy's equation to calculate the loss of head due to friction. Numerical on above equations 3.3 Minor losses in pipe fittings 3.4 Hydraulic gradient line and total energy line 3.5 Hydraulic power transmission through pipes, Simple numerical 3.6 Water hammer phenomenon in pipes, causes and remedial measures	1. Lecture Using Chalk-Board 2. Presentations 3. Video Demonstration 4. Hands-on Roleplay	CO 3
UNIT- IVIMPACT OF JET AND HYDRAULIC TURBINES(CL Hrs-20, Marks-22)				
4	TLO 4.1 Calculate the force exerted by a jet, work done and efficiency for the given vane condition TLO 4.2 Explain the working of a hydroelectric power plant TLO 4.3 Explain the construction and working of a given hydraulic turbine along with velocity diagrams TLO 4.4 Select the suitable hydraulic turbine for a given application with justification TLO 4.5 Evaluate the performance of a given hydraulic turbine	4.1 Impact of jet on fixed & moving vertical flat plate, fixed & moving inclined plate, fixed & moving curved vanes with special reference to turbines and pumps, Numerical on above conditions 4.2 Layout of the hydroelectric power plant and function of each component, Water Storage systems used in Ancient India (IKS) 4.3 Classification of hydraulic Turbines 4.4 Construction, working principle, velocity diagram and applications of Pelton wheel, Kaplan turbine and Francis turbine 4.5 Draft tubes: Types and constructional details, Concept of cavitation in turbines 4.6 Calculation of Work done, Power output, and efficiency of Pelton turbine only 4.7 Criteria for selection of hydraulic turbines and performance characteristics	1. Lecture Using Chalk-Board 2. Presentations 3. Video Demonstration 4. Model Demonstration 5. Case study Hands-on	CO 4, CO 5
UNIT –V CENTRIFUGAL AND RECIPROCATING PUMPS (CL Hrs-14, Marks-16)				
5	TLO 5.1 Describe the construction and working of different types of hydraulic pumps TLO 5.2 Select the suitable hydraulic pump for a given application with justification TLO 5.3 Evaluate the performance of the given hydraulic pump TLO 5.4 Apply the troubleshooting procedure to rectify the identified fault in centrifugal pump TLO 5.5Distinguish between centrifugal and reciprocating pump	**5.1 Centrifugal Pumps:** Water lifting devices used in Ancient India (IKS),Classification, Construction and working principle of Centrifugal pump, Types of casings and impellers, Priming methods, Static head, Manometric head, NPSH, Work done, Manometric efficiency, Overall efficiency, Numerical on above parameters, Performance Characteristics of Centrifugal pumps, Troubleshooting, Construction, working and applications of multistage pump **5.2 Reciprocating Pump:** Construction, working principle and applications of single and double-acting reciprocating	1. Lecture Using Chalk-Board 2. Presentations 3. Video Demonstration 4. Model Demonstration 5. Case study Hands-on	CO 5

		pumps, Slip, Negative slip, Cavitation and separation, Use of air vessels, Indicator diagram with effect of acceleration head & frictional head, Pump selection criteria based on head and discharge (Simple numerical on reciprocating pumps)		

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIALEXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Use Bourdon tube pressure gauge for pressure measurement LLO 1.2 Use a U-tube Manometer for pressure measurement	Measurement of water pressure by using Bourdon tube pressure gauge and U-tube Manometer	02	CO1
2	LLO 2.1 Calculate the discharge of water using a measuring tank and stopwatch (or rotameter/ flow meter)	Measurement of discharge of water by using a measuring tank and stopwatch (or rotameter/ flow meter)	02	CO2
3	LLO 3.1 Calculate the total energy available at different sections of a pipe layout LLO3.2 Verify Bernoulli's theorem	*Measurement of total energy available at different sections of a pipe layout to verify Bernoulli's theorem	02	CO2
4	LLO 4.1 Apply Bernoulli's theorem to Venturimeter/ Orifice meter LLO 4.2 Measure discharge through the pipe using a Venturimeter/ Orificemeter	*Measurement of discharge through the pipe using a Venturimeter/ Orifice meter	02	CO2
5	LLO 5.1 Measure discharge using a sharp-edged circular orifice	Determine Cd, Cc, and Cv of flow for sharp-edged circular orifice	02	CO2
6	LLO 6.1 Measure the discharge of water in the open channel using a Triangular/ Rectangular notch	*Measurement of the discharge of water in the open channel using Triangular/ Rectangular notch	02	CO2
7	LLO 7.1 Calculate Darcy's friction factor 'f' in pipes of different diameters LLO7.2 Interpret the effect of material and diameter of the pipe, flow rate of water on Darcy's friction factor 'f'	*Calculation of Darcy's friction factor 'f' in pipes of different diameters for different discharges	02	CO3
8	LLO 8.1 Calculate minor frictional losses due to sudden expansion in a pipe LLO 8.2 Calculate minor frictional losses due to sudden contraction in a pipe	*Determination of head loss due to sudden expansion, sudden contraction, elbow and bend in a pipe	02	CO3
9	LLO 9.1 Measure the power output of the Pelton wheel at different flow rates LLO 9.2 Calculate the overall efficiency of the Pelton wheel LLO 9.3 Plot performance characteristics of Pelton wheelbased on results	*Determination of overall efficiency of Pelton using Pelton wheel test rig	02	CO4CO5

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
10	LLO 10.1 Measure the power output of the Francis turbine at different flow rates LLO 10.2 Calculate the overall efficiency of the Francis turbine LLO10.3 Plot performance characteristics Francis turbine based on results	*Determination of overall efficiency of Francis turbine using Francis turbine test rig	02	CO4CO5
11	LLO 11.1 Measure the power output of the Kaplan wheel at different flow rates LLO11.2 Calculate the overall efficiency of the Kaplan wheel LLO11.3 Plot performance characteristics of Kaplan wheelbased on results	*Determination of overall efficiency of Kaplan turbine using Kaplan turbine test rig.	02	CO4 CO5
12	LLO 12.1 Identify various components of the centrifugal pump LLO 12.2 Assess the condition of various components of the centrifugal pump LLO 12.3 Suggest remedial action to be taken	Dismantling and Assembly of a Centrifugal pump	02	CO4
13	LLO 13.1 Measure the manometric head (Hm) at different flow rates LLO 13.2 Calculate the overall efficiency of the centrifugal pump LLO 13.3 Plot performance characteristics based on the results	*Determination of overall efficiency of Centrifugal pump using Centrifugal pump test rig	02	CO4, CO5
14	LLO 14.1 Identify various components of available reciprocating pump LLO 14.2 Assess the condition of various components of the reciprocating pump LLO14.3 Suggest remedial action to be taken	Dismantling and Assembly of a Reciprocating pump	02	CO4
15	LLO15.1 Calculate the overall efficiency of the reciprocating pump LLO15.2 Calculate the percentage slip of the reciprocating pump	*Determination of overall efficiency and percentage slip of the Reciprocating pump using the Reciprocating pump test rig	02	CO4, CO5
16	LLO16.1 Compare water lifting systems in Ancient India and Modern India	* Collect information on water-lifting arrangements in ancient India	02	IKS
		Total	**30**	

Note :

- **Out of the above suggestive LLOs- '*' Marked Practicals (LLOs) are mandatory.**
- **A minimum of 12 practicals from the above list of 15 practicals are to be performed. Judicial mix of LLOs is to be performed to achieve desired outcomes.**

VII. SUGGESTEDMICROPROJECT/ASSIGNMENT/ACTIVITIESFORSPECIFICLEARNING/SKILLS DEVELOPMENT(SELF-LEARNING)

Microproject:

Following are the suggestive Micro projects / Assignment/ Activities for specific learning / Skills Development of the students:

1. Prepare a chart showing the various units of pressure and interrelation among them.
2. Prepare a detailed report based on locations and specifications of Pelton wheel/ Kaplan/ Francis/ any other turbine used in hydroelectric power plants in India or Abroad from the internet.
3. Prepare a detailed report based on the range of products, manufacturer and technical specifications of Centrifugal/ reciprocating/ multistage pumps/ submersible pumps/any other pump from the local market or internet.
4. Visit a hydroelectric power plant and prepare a report on the layout of the plant, components of the plant and specifications of turbines used in the plant.

VIII. LABORATORYEQUIPMENT/INSTRUMENTS/TOOLS/SOFTWAREREQUIRED

Sr. No	Equipment Name with Broad Specifications	LLO Sr. No.
1	Centrifugal pump test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Bourdon tube pressure gauge: Range-0-12 bar Venturimeter: 13 mm (Mild steel) U-tube manometer: Wall/ Stand mounted thick walled Borosilicate glass tube Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm Any other measuring device like a rotameter/ flow meter of suitable specifications	1,2,13
2	Bernoulli's theorem Test rig along with necessary pipe fittings and accessories comprising of: Pump with Motor: Mono-block pump- Single phase, 0.5 HP Differential Venturi of 300 mm length made out of Acrylic square bar Supply tank: 80 Ltrs. made of Mild steel with FRP lining Piezometer tubes: Range- 0 to 12 bar Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm	3
3	Venturimeter Test Rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Venturimeter: 13 mm (Mild steel) (or Orifice meter of suitable specifications) U-tube manometer: Connected to pipe and throat of Venturimeter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale	4

	Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm	
4	Sharp-edged circular orifice test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with a motor of suitable specifications Supply tank: 80 Ltrs. made of Mild steel with FRP lining Sharp-edged circular orifice of suitable specifications U-tube manometer: Connected to pipe and Orifice meter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm	5
5	Open channel flow measuring Test rig with necessary pipe fittings and accessories comprising of: Triangular/ Rectangular notch of suitable specifications Measuring tank: 200 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and measuring scale	6
6	Flow through pipe Test rig with necessary pipe fittings and accessories comprising of: Pipes: 03 nos. Made of GI ½'', 1'', 1.5'' diameter or equivalent diameters and length 1m, 1.5m, 2m or equivalent length Large bend: Made of GI Sudden enlargement fitting of suitable size Sudden contraction fitting of suitable size Pump: 1HP Centrifugal pump Motor: 1HP Supply tank: 80 Ltrs. made of Mild steel with FRP lining U-tube manometer: Connected to pipe at required locations using plastic tubing Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale Gate valves to regulate the flow of water Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm	7,8
7	Pelton wheel test rig with necessary pipe fittings and accessories comprising of: Pelton wheel: Speed- 750-900 rpm, Output power- 3.7 kW (5 HP), Head- 45-50 m, Discharge- 700-900 LPM Centrifugal pump, Venturimeter, U-tube differential manometer, Water storage and supply arrangement as per requirement	09
8	Francis turbine test rig	10
9	Kaplan turbine test rig	11
10	Working model of centrifugal pump having technical Specifications: Power: 1HP (0.75 kW) Max. head: Up to 34 meters Max. discharge: Up to 2700 LPH OR Any other suitable centrifugal pump which can be dismantled and assembled	12

	using a spanner set and tool kit	
11	Working model of reciprocating pump having technical Specifications: Reciprocating Pump: 1.02HP/0.8KW, 2900 RPM, Single phase OR Any other suitable centrifugal pump which can be dismantled and assembled using a spanner set and tool kit	14
12	Reciprocating pump test rig with necessary pipe fittings and accessories comprising of: Reciprocating Pump: 1 HP, 700 RPM Motor: 1 HP, 1500 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with a piezometer tube and scale Tachometer: 10-10,000 RPM. Accuracy- 0.5% Full scale Energy meter for motor input measurement Pressure & Vacuum gauge for measurement of head Dimmer to vary the speed Stopwatch: Electronic with the least count of 0.01 sec Measuring scale: Range up to 60 cm.	15

IX. SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS&ASSESSMENTPURPOSE

Sr. No.	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Properties of Fluid and Fluid Pressure Measurement	CO1	10	02	04	06	12
2	II	Fundamentals of Fluid Flow and Flow Measurement	CO2	10	04	04	04	12
3	III	Flow through Pipes	CO3	06	02	02	04	08
4	IV	Hydraulic Turbines	CO4, CO5	20	02	08	12	22
5	V	Centrifugal and Reciprocating Pumps	CO4 ,CO5	14	04	04	08	16
Grand Total				**60**	**14**	**22**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessmentfor Learning)	Summative Assessment (Assessmentof Learning)
• Continuous assessment based on process and product-related performance indicators. Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product	• End Semester Examination • End Semester Practical Examination

XI. SUGGESTED COs- POsMATRIXFORM

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	1	1	1	-	-	1	--	2
CO2	3	1	1	1	-	-	1	--	2
CO3	3	2	1	1	-	-	1	--	2
CO4	3	2	2	2	1	-	2	--	3
CO5	3	3	2	2	-	-	2	--	3

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

XII. SUGGESTEDLEARNINGMATERIALS/BOOKS

Sr. No	Author	Title	Publisher with ISBN Number
1	Rajput R.K.	A Textbook of Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi 2016 or the Latest Edition ISBN: 9789385401374
2	Bansal R.K.	Fluid Mechanics and Hydraulic Machines	Laxmi Publications Pvt. Ltd., New Delhi 2019 or the Latest Edition ISBN: 9788131808153
3	Modi P.N. Seth S.M.	Hydraulics and Fluid Mechanics including Hydraulic Machines	Standard Book House, New Delhi 2019 or the Latest Edition ISBN: 13: 9788189401269
4	S. Ramamrutham	Hydraulic, Fluid Mechanics and Fluid Machines	Dhanpat Rai Publishing Company (P) Ltd. 2014 or Latest Edition ISBN: 9789384378271

5	Victor Streeter, K.W. Bedford, E. Benjamin Wylie	Fluid Mechanics	McGraw-Hill Education,New Delhi 2017 or Latest Edition ISBN: 9780070701403
6	K. Subramanya	Fluid Mechanics and hydraulic Machines: Problems and Solutions	Tata McGraw-Hill Co. Ltd., New Delhi 2018 or the Latest Edition ISBN: 9789353163426
7	R.S. Khurmi, N. Khurmi	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi 2015 or the Latest Edition ISBN: 9788121901628
8	Som S.K., Biswas G.	Introduction to Fluid Mechanics and Fluid Machines	Tata McGraw-Hill Co. Ltd., New Delhi 2017 or Latest Edition ISBN: 9780071329194
9	Dr. Jagdish Lal	Fluid Mechanics and Hydraulic Machines	Metropolitan: 2008 or Latest Edition ISBN: 9788120004221
10	C.S.P. Ojha, P.N. Chandramouli, and R. Berndtsson	Fluid Mechanics and Machinery	Oxford University Press, New Delhi 2010 or Latest Edition ISBN: 9780195699630
11	Raikar R.V.	Laboratory Manual Hydraulics and Hydraulic Machines	PHI Learning Pvt. Ltd., New Delhi Edition: Fourth Edition or Latest Edition ISBN: 9788120346642

XII. LEARNINGWEBSITES& PORTALS

Sr. No.	Link / Software	Description
1	http://ecoursesonline.iasri.res.in/course/view.php?id=27	Fluid Mechanics Course
2	https://www.realpars.com/blog/manometer#:~:text=Measuring%20pressure,-The%20tube%20is&text=When%20the%20pressures%20are%20equal,side%20because%20P1%20equals%20P2.	Manometer working principle
3	https://tameson.com/pages/bourdon-tube-pressure-gauge	Bourdon Tube Pressure Gauge
4	http://www.aboutmech.com/2016/08/total-pressure-and-centre-of-pressure.html	Total Pressure and Centre of Pressure
5	https://theconstructor.org/fluid-mechanics/types-fluid-flow-pipe/38078/	Types of Fluid Flows
6	https://www.youtube.com/watch?v=UJ3-Zm1wbIQ	Bernoulli's Principle
7	https://www.youtube.com/watch?v=_bfcdRhY7Rw	Working Principle of Venturimeter
8	https://www.youtube.com/watch?v=iRdJHPFVHwM	Orifice Meter Working Principle
9	https://www.youtube.com/watch?v=3zEdtkuNYLU	Pitot Tube Working Animation
10	https://www.youtube.com/watch?v=Rwl1mu0TJmE	Types of Notches
11	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1086	Major and Minor Hydraulic Losses Through Pipes And Fitting
12	https://www.youtube.com/watch?v=FHTVmKdS_Lk&list=PLd	Impact of Jet on Fixed Vertical Plate

	olhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=2	
13	https://www.youtube.com/watch?v=tOoBx4-ieyU&list=PLdolhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=3	Impact of Jet on Moving Vertical Flat Plate
14	https://www.youtube.com/watch?v=cpM6hF23eeQ&list=PLdolhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=11	Impact Of Liquid Jet On Series Of Flat Plate Mounted On A Wheel
15	https://www.energy.gov/eere/water/types-hydropower-turbines	Types of Hydropower Turbines
16	https://www.youtube.com/watch?v=Jd5BN7SPkqI	Pelton Wheel
17	https://www.youtube.com/watch?v=0p03UTgpnDU	Kaplan Turbine Working and Design
18	https://www.youtube.com/watch?v=3BCiFcykRzo	Working of Francis Turbine
19	https://www.youtube.com/watch?v=IiE8skW8btE	Centrifugal Pump
20	https://www.youtube.com/watch?v=xqGyPdxLlRg	Jet Pump Working Animation
21	https://www.youtube.com/watch?v=41vb6T42_Tk	Reciprocating Pump animation
22	https://www.chaitanyaproducts.com/blog/ancient-indian-water-conservation-techniques-part-1/	Ancient Water Storage Systems (IKS)
23	https://www.youtube.com/watch?v=hQr5Op4S5q4&t=83s	Ancient Water Lifting Devices-Araghatta (IKS)
24	https://www.youtube.com/watch?v=uTrajIJ79ME&t=49s	Ancient Water Lifting Devices- Chadas (IKS)

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

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN EE/ME**
PROGRAMME CODE	**02/04**
COURSE TITLE	**FUNDAMENTALS OF PYTHON PROGRAMMING**
COURSE CODE	**ME41202**
PREREQUISITE COURSE CODE & TITLE	**NA**

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	
ME41202	FUNDAMENTALS OF PYTHON PROGRAMMING	SEC	1	-	2	1	4	2	--	--	--	--	--	25	10	25@	10	25	10	75

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,**@S** - 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.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.

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

II. RATIONALE:

Python's reputation as a powerful programming language is well-deserved. Its high-level data structures and object-oriented approach streamline complex software development, making it accessible for beginners and efficient for seasoned programmers. The simplicity and readability of Python code, alongside its intuitive nature, contribute to its widespread use in teaching computing and problem-solving concepts. Moreover, Python's elegant syntax and dynamic typing, combined with its interpreted nature, facilitate scripting and rapid application development across diverse fields and platforms, solidifying its position as a versatile tool in the developer's toolkit.

III.INDUSTRY EXPECTED OUTCOME

- Use python programming for identifying automation system problems.

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: Acquire fundamental Python programming skills, empowering them for creating simple scripts and for grasping essential concepts including variables and data types.
CO2: Develop python programs using control flow statements.
CO3: Perform operations on various data structures in Python.
CO4: Develop functions, modules to solve given problem using python.
CO5: Write Python code for File and Exception Handling.

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 PYTHON			
1.	**TLO1.1** Explain the given features of python. **TLO1.2** Write python program to perform basic input output operations. **TLO1.3** Write python program to solve given expression. **TLO1.4** Implement the given decision making statements and looping statements in python program.	**1.1 Introduction:** Features, History and Applications of Python, Python IDE's **1.2 Python Environment Setup:** Installation and working of IDE **1.3 Python building blocks:** Indentation, Identifiers, Variable, Comments, Keywords. **1.4 Python Data Types:** Numbers, String, Tuples, Lists, Dictionary. Declaration and use of data types. **1.5 Basic input output operations:** input(), print(). **1.6** Running Simple Python scripts to display the given text messages.	Chalk-Board Demonstration Presentations , Hands-on	**CO1**
	UNIT-II PYTHON OPERATORS AND CONTROL FLOW STATEMENTS			
2	**TLO2.1** Write simple Python program for the given arithmetic expressions. **TLO2.2** Write python program to manipulate tuples. **TLO2.3** Write python program for	**2.1 Operators:** Arithmetic, Relational, Assignment, Logical, Bitwise, Membership and Identity operator. **2.2 Control flow statements:** **2.2.1** Conditional Statements (if, if ... else, nested if) **2.2.2** Looping in python (while loop, for loop, nested loops) **2.2.3** loop manipulation using	Chalk-Board Demonstration Presentations , Hands-on	**CO2**

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	manipulate sets. **TLO2.4** Write python program for manipulate dictionaries.	continue, pass, break, else.		
	UNIT- III DATA STRUCTURES IN PYTHON			
	TLO3.1 Write python program to use and manipulate lists for the given problem **TLO3.2** Write python program to use and manipulate Tuples for the given problem **TLO3.3** Write python program to use and manipulate Sets for the given problem **TLO3.4** Write python program to use and manipulate Dictionaries for the given Problem	**3.1 Lists:** Defining Lists, Accessing values in list, deleting values from list, updating lists. Basic List Operations, Built-in List Functions. **3.2 Tuples:** Accessing values in Tuples, deleting values from Tuples and updating Tuples. Basic Tuple operations, Built-in Tuple Functions. **3.3 Sets:** Accessing values in Set, deleting values from Set and updating Sets. Basic Set operations, Built-in Set Functions. **3.4 Dictionaries:** Accessing values in Dictionary, deleting values from Dictionary and updating Dictionary. Basic Dictionary operations, Built-in Dictionary Functions.	Chalk-Board Demonstration Presentations , Hands-on	**CO3**
	UNIT-IV PYTHON FUNCTIONS, MODULES			
3	**TLO4.1** Write relevant user defined functions for the given problem. **TLO4.2** Write relevant user defined module for the given problem. **TLO4.3** Write packages for the given problem	**4.1 Use of Python built-in functions** (e.g. type/data conversion functions, math functions etc.). **4.2 User defined functions:** Function definition, Function calling, function arguments and parameter passing, return statement, scope of variable: Global variable and Local variable. **4.3 Modules:** Writing modules, importing modules, importing objects from modules, python built-in modules, (e.g. Numeric and mathematical	Chalk-Board Demonstration Presentations , Hands-on	**CO4**

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		module, Functional programming module), Namespace and Scoping.		
	UNIT –V FILE HANDLING AND EXCEPTION HANDLING			
5	**TLO 5.1** Write Python code for the given reading values from keyboard. **TLO5.2** Read data from the given file. **TLO5.3** Write the given data to a file. **TLO5.4** Handle the given exceptions through python program.	**5.1 I/O operations:** Reading keyboard input, printing to screen. **5.2 File Handling:** Opening file in different modes, accessing file contents using standard library functions, reading and writing files, closing files renaming and deleting files. **5.3 Exception Handling:** Introduction, 'try: except:' statement, 'raise' statement, user defined exceptions.	Chalk-Board Demonstration Presentations , Hands-on	**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	LLO 1.1 Install the given Python IDE.	Install given Python IDE.	2	CO1
2	LLO 2.1 Write python program for performing basic input and output operation in given problem.	*1.Write python program display welcome message on screen. 2. Implement the python program to read data from user and display data on screen.	2	CO1
3	LLO 3.1 Write python program to solve given expression.	Implement a python programs using following operators: 1. Arithmetic 2. Relational & logical 3. Assignment 4. Bitwise 5. Membership 6. Identity	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
4	LLO 4.1 Write python program for solving given problem using various If statements. Implement a python program to demonstrate the use of following conditional statements: 1. if statement 2. if..else statement 3. if..elif..else statement 4. nested if statement	*Implement a python program to demonstrate the use of following conditional statements: 1. if statement 2. if..else statement 3. if..elif..else statement 4. nested if statement	2	CO2
5	LLO 5.1 Write python program for solving given problems using a while loop. LLO 5.2 Write python program for solving given problem using for loop.	Implement a python program to demonstrate the use of following looping statements: 1. while loop 2. for loop 3. nested loop	2	CO2
6	LLO 6.1 Use loop control statements in python for solving given problem.	Implement python program to demonstrate the use of loop control statements. [continue, pass, break, else]	2	CO2
7	LLO 7.1 Write python program to perform operations on list.	*Implement a python program to demonstrates various operations on a list, such as appending elements, inserting elements at specific positions, removing elements, reversing the list, sorting the list, finding the index and count of elements, and clearing the list	2	CO3
8	LLO 8.1 Write python program to perform operations on tuple.	Implement python program to demonstrates various operations on a tuple, such as accessing elements, slicing, concatenating, repeating, finding length, checking element existence, finding index, counting occurrences, and converting between tuple and list.	2	CO3
9	LLO 9.1 Write python program to manipulate the set.	Implement a python program to demonstrates various operations on sets, such as union, intersection, difference, symmetric difference, checking subset and superset, adding and removing elements, discarding elements, and clearing the set.	2	CO3

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
10	LLO 10.1 Write python program to perform operations on dictionary.	Implement a python program to demonstrates various operations on dictionaries, such as accessing values, adding and modifying key-value pairs, removing key-value pairs, checking for key existence, getting keys and values, and clearing the dictionary.	2	CO3
11	LLO 11.1 Write python program to use built-in functions on list.	*Implement Python program to demonstrates the use of various built-in functions on a list, including len() to get the length of the list, sum() to calculate the sum of elements,•min() and •max() to find the minimum and maximum elements, •sorted() to sort the list, and •reversed() to reverse the list.	2	CO4
12	LLO12.1 Write functions to solve given problem.	Write a user define function to implement following features: 1. Function without argument 2.Function with argument 3. Function returning value	2	CO4
13	LLO 13.1 Write user defined module to solve given problem.	Write a python program to create and use a user defined module for a given problem.	2	CO4
14	LLO14.1 Select appropriate module to solve given problem. LLO 15.2 Use given module to solve problem.	Write a python program to demonstrate the use of following module: 1. math module 2. random module 3. O.S. module	2	CO4
15	LLO15.1 Write python program using file handling to solve given problem.	*Write Python Program to demonstrate File Handling through: 1.Opening file in different modes 2.Accessing file Reading and Writing file 3.Closing file 4.Renaming and Deleting file	2	CO5
16	LLO16.1 Write python program to implement exception.	Implement python program to demonstrate 1.user defined exception	2	CO5
		Total	30	

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

SELF-LEARNING - MICRO PROJECT/ASSIGNMENT/ACTIVITIES

1. **Arithmetic Calculator:** Create a calculator program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.

2. Write a script that uses a dictionary to store information about books, including titles and authors. Allow the user to search for books by title or author.

3. Implement a module that contains functions for sorting a list of numbers using different algorithms (e.g., bubble sort, **insertion** sort, selection sort).

4. **Student Grade Calculator:**
   - Create a program that takes input marks for different subjects from the user and calculates the total score, average score, and grade based on predefined criteria(e.g., A, B, C, D)
   - Utilize functions to modularize the code for calculating total score, average score, and determining the grade.
   - Implement error handling to validate input marks and provide appropriate feedback to the user.

5. **Contact Management System:**

   • Develop a simple contact management system that allows users to add, delete, search, and display contacts.
   • Use dictionaries to store contact information (e.g., name, phone number, email).
   • Organize the functionality into functions/modules for adding, deleting, searching, and displaying contacts.

6. **Word Count Tool:** Develop a script that analyzes a text file and counts the occurrences of each word, providing statistics such as the total number of words and the most frequent words.

7. 5. **Quiz or Trivia Game:** Build a quiz or trivia game where players answer multiple-choice questions on various topics. The program can keep track of the player's score and provide feedback at the end.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	a) Computer System with all necessary Peripherals and Internet connectivity. b) Any Open Office Software c) Any Browser (Any General Purpose Computer available in the Institute)	ALL

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

NA

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning and Seminar/Presentation	Lab. Performance, viva voce

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	3	2	--	--	--	--	--	--
CO2	2	3	3	--	--	--	--	--	--
CO3	3	3	2	--	--	--	3	--	--
CO4	2	2	2	--	--	--	3	3	--
CO5	3	--	3	--	--	--	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	Kenneth A. Lambert	Fundamentals of Python : First Programs 2E	Cengage Learning India Private Limited, ISBN:9789353502898
2	Yashavant Kanetkar, Aditya Kanetkar	Let Us Python - 6th Edition	BPB Publications, ISBN: 9789355515414
3	K. Nageswara Rao, Shaikh Akbar	Python Programming	Scitech Publications (India) Pvt. Ltd. ISBN:9789385983450
4	Mark Lutz	Learning Python	O'Reilly Publication, 5th Edition ISBN13:9781449355739
5	David Beazley	Python Essential Reference	Addison-Wesley Professional 4th Edition ISBN:9780672329784

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.w3schools.com/python	Python programming
2	https://www.tutorialspoint.com/index.htm	Python programming
3	https://www.python.org/	Python programming
4	https://realpython.com	Python programming

Name & Signature: **(Mr.S.B.Kulkarni)** Lecturer in Mechanical Engineering	**(Mr. A.M.Joshi)** Lecturer in Mechanical Engineering
(Course Experts)	
Name & Signature: **(Dr.N.G.Kulkarni)** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC PUNE
AUTONOMOUS INSTITUTE
TECHNICAL EDUCATION FOR SELF RELIANCE

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	**SOCIAL AND LIFE SKILLS**
COURSE CODE	**HU21204**
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	
HU21204	SOCIAL AND LIFE SKILLS	VEC	1	--	2	1	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 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.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.
6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The introduction of a social and life skills course for diploma engineers is indeed a significant step forward in shaping well-rounded professionals. By integrating soft skills training with technical education, this curriculum addresses the growing need for engineers who are not only experts in their field but also adept in interpersonal communication, collaboration, and leadership. Such skills are crucial for success in the modern workforce, where the ability to navigate complex social dynamics can be just as important as technical know-how. Moreover, the emphasis on ethical decision-making prepares engineers to approach their work with integrity and responsibility. As these professionals progress in their careers, the benefits of this comprehensive education will manifest in their ability to innovate, lead, and contribute positively to their communities and the broader society. This forward-thinking approach ensures that the engineers of tomorrow are equipped not just with the tools to excel in their careers, but also with the vision to drive societal progress.

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: Achieve shared goals through effective teamwork in executing sustainable community development projects.

CO2: Improve cooperation and understanding through refined communication skills.

CO3: Encourage ethical choices and compassionate behaviour by nurturing moral values.

CO4: Foster ethical judgment, honesty, and societal accountability to shape principled and conscientious professionals.

CO5: Equip students with practical financial literacy skills for efficient financial management.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No	TheoryLearning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I ENGAGEMENTS WITHIN UNNAT MAHARASHTRA ABHIYAN (UMA) (CL Hrs-03, Marks-NIL)			
1.	**TLO1.1:** Recognize the importance of addressing societal needs and involving relevant stakeholders in problem-solving efforts. **TLO1.2:** Integrate academia, society, and technology to devise comprehensive solutions for complex societal issues. **TLO1.3:**Enhance communication and negotiation skills to effectively engage stakeholders, ensuring diverse perspectives and productive collaboration in problem-solving. **TLO1.4:** Utilize critical data sources such as economic surveys, and environmental data to guide decision-making and solution development in problem-solving endeavours. **TLO1.5:** Identify key stakeholders and delineate their roles and interests in addressing societal challenges. **TLO1.6:** Identify essential attributes for measurement in the problem-solving process. **TLO1.7:** Explore diverse	**1.1 Identifying Regional Societal Challenges:** Recognizing Community Needs Requiring Engineering Solutions. **1.2Integrating Multidisciplinary Approaches:** Linking Academia, Society, and Technology **1.3 Involving Diverse Stakeholders:** Engaging Various Actors in the Problem-Solving Process **1.4Accessing Secondary Data Sources:** Utilizing Resources like Census and Economic Surveys **1.5Mapping Problems and Stakeholders:** Understanding Activities' Relevance to System Components and Key Stakeholders **1.6Defining Measurement Metrics:** Identifying Essential Attributes for Evaluation **1.7 Employing Data Collection Tools:** Exploring Surveys and Measurement Equipment **1.8Establishing Measurement Standards:** Developing Survey Forms and Piloting Processes **1.9Conducting Field Surveys:** Quantifying Local Systems such as Agriculture and Transportation **1.10Analyzing Data and Creating Reports:** Summarizing Data and	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the course. iii) A team of course faculty will visit local governing bodies like Municipal Corporations, Villages, Panchayats, Zilla Parishads, and Panchayat Samitis to assess small-scale technological or engineering needs within their jurisdiction. iv) The team of course instructors will conduct initial field visits to explore various scenarios and options	**CO1**

	tools and templates for data collection, including surveys and measurement equipment. **TLO1.8:** Establish a structured framework for measuring identified attributes, including the development of survey forms and piloting the measurement process. **TLO1.9:** Gain practical experience in conducting fieldwork to gather primary data, such as agricultural output, rainfall, and transportation networks. **TLO1.10:** Develop proficiency in data analysis to draw meaningful conclusions, informing decision-making and solution development processes.	Reflections in Reports, Utilizing Various Formats like Tables and Graphs	for student-led fieldwork to assess and quantify different parameters and characteristics. **a) Session I** will introduce the development approach, fieldwork methodology, and the utilization of case studies as instructional tools. **b) Sessions II** - VII will cover topics such as societal dynamics, stakeholder engagement, value creation, establishing metrics, basic analysis, and preliminary reporting. **c) Session VIII** will wrap up the program with feedback collection and assessment. **d) Field Work:** **1. Pilot Visit** - Testing the survey instrument **2. Survey Visit 1** - Gathering data/information Survey. **3. Visit 2-** Further data collection. **4.SummaryVisit-** Concluding activities post-analysis.	
UNIT - II NATIONAL SERVICE SCHEME (NSS) (CL Hrs-03, Marks- NIL)				
2	**TLO2.1:** Enhance communication and leadership abilities to effectively interact with local leaders. **TLO2.2:** Develop proficiency in conducting socio-economic surveys using appropriate data collection techniques and analysis methods to understand community needs. **TLO2.3:** Identify suitable villages and devise activity plans based on community	2.1 Engaging with Village/Area 2.2 Conducting initial socio-economic surveys in nearby villages. 2.3 Selecting villages for adoption and initiating project activities. 2.4 Conducting thorough socio-economic surveys in the adopted village or area. 2.5 Identifying key issues and challenges within the community. 2.6 Raising awareness about advancements in agriculture, watershed management, wasteland reclamation, renewable energy, affordable housing, sanitation,	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the course.	**CO2**

	needs and available resources. **TLO2.4:** Analyze survey findings to discern socio-economic patterns, obstacles, and potential avenues for progress. **TLO2.5:**Prioritize community issues according to their significance and impact on community welfare. **TLO2.6:** Communicate information on agriculture, watershed management, renewable energy, housing, sanitation, nutrition, and hygiene effectively. **TLO2.7:** Cultivate networking and advocacy skills to foster collaboration among government agencies, development organizations, and the community.	nutrition, and personal hygiene. Also, informing about skill enhancement programs, income generation opportunities, government initiatives, legal aid, consumer rights, and related topics. 2.7 Facilitating collaboration between the government and development agencies to implement various schemes in the adopted village or slum.	iii) Before selecting a village or slum for NSS activities, it's advisable for teachers to conduct an initial visit. iv)The selected area should have a dense population. iv)Community members should exhibit a willingness to improve their living conditions and actively engage in projects initiated by the NSS for their benefit. vi) NSS units should avoid areas with a history of political conflicts. vii) The chosen area should be conveniently accessible for NSS volunteers to conduct regular visits to the slums.	
UNIT - III UNIVERSAL HUMAN VALUES (CL Hrs-03, Marks- NIL)				
3	**TL03.1:** Apply love and compassion to promote harmony and well-being. **TL03.2:** Demonstrate honesty and transparency to build trust and authenticity. **TL03.3:** Utilize non-violent approaches to resolve conflicts and enhance empathy. **TL03.4:** Align actions with moral principles to promote justice and fairness. **TL03.5:** Employ peace-building strategies for harmony and reconciliation. **TL03.6:** Engage in acts of service to cultivate empathy and social responsibility. **TL03.7:** Prioritize others' needs to foster altruism and generosity.	**4.1 Exploring Love and Compassion (Prem and Karuna):** Learning about and embodying the principles of love and compassion in daily life. **4.2 Embracing Truth (Satya):** Understanding the significance of truthfulness and integrating it into one's actions and interactions. **4.3 Embracing Non-Violence (Ahimsa):** Understanding the importance of non-violence and applying it in personal and societal contexts. **4.4 Upholding Righteousness (Dharma):** Exploring the concept of righteousness and practising it through ethical conduct and moral values. **4.5 Cultivating Peace (Shanti):** Reflecting on the essence of peace and cultivating	Proposed Learning Approaches for: i) Lecture Delivery ii) Demonstrations iii) Case Studies iv)Role-playing exercises v)Observational Learning vi)Portfolio Development vii) Simulations viii) Inspirational Talks from Industry Professionals ix) On-site Visits to sites or Industries	**CO3**

	TL03.8: Exhibit behaviours that uphold gender equality and respect for diversity to create an inclusive	inner tranquillity while promoting harmony in relationships and communities. **4.6 Embracing Service (Seva):** Understanding the value of selfless service and actively engaging in acts of kindness and support for others. **4.7 Embracing Renunciation (Sacrifice) Tyaga**: Understanding the concept of renunciation and willingly **letting go of self-interest for the greater good. and attitudes.** **4.8 Promoting Gender Equality and Sensitivity:** Recognizing the importance of gender equality and fostering an environment of inclusivity and respect for all genders through actions and attitudes.		
UNIT - IV VALUE EDUCATION (UNNATI FOUNDATION) (CL Hrs-03, Marks- NIL)				
4	**TLO4.1:** Display comprehension of one's own identity, values, and beliefs. **TLO4.2**: Recognize and express personal strengths and weaknesses effectively. **TLO4.3:**Demonstrate adeptness in active listening by providing feedback and demonstrating empathy. **TLO4.4:**Acquire strategies for handling conflicts constructively and respectfully. **TLO4.5:** Assess and reflect on moral values and principles that influence personal actions and choices. **TLO4.6:** Analyze and assess the moral values and principles guiding individual actions and decisions.	**4.1. Self-awareness and Personal Development** Self-understanding, Identification of strengths and weaknesses, Setting goals and devising plans, Building self-esteem and confidence **4.2.Interpersonal Skills and Effective Communication** Engaging in active listening, Resolving conflicts, Cultivating healthy relationships **4.3. Ethics and Morality** Grasping ethical concepts, Upholding moral values and principles, Making ethical decisions, Demonstrating integrity and honesty **4.4. Social Values and Responsibility** Being punctual and initiating conversation, Managing emotions effectively, Introducing oneself and others, Maintaining a positive attitude Valuing family bonds, Creating favourable impressions,	i)Video Demonstrations ii)Flipped Learning Environment iii) Case Studies iv)Role-playing Activities v)Group-based Learning vi)Team-based Learning vii)Utilization of Chalkboard	**CO4**

		Communicating effectively, Emphasizing cleanliness, hygiene, and organization, Expressing preferences, Fostering confidence Enhancing listening skills, Demonstrating appropriate greetings, Promoting gender equality and sensitivity, Exercising responsibility, Integrating visual and verbal learning, Establishing and pursuing goals, Observing social media etiquette, Efficiently managing time and daily routines		
UNIT - V FINANCIAL LITERACY(CL Hrs-03, Marks- NIL)				
5	**TLO5.1:**Comprehending Savings and Investment Practices. **TLO5.2:**Cultivating Proficiency in Financial Planning. **TLO 5.3:**Developing Competence in Transaction Handling. **TLO5.4:**Achieving Proficiency in Income, Spending, and Budget Management. **TLO 5.5:**Attaining Understanding of Inflation Concepts. **TLO 5.6:** Fostering Competence in Loan Administration. **TLO5.7:** Acknowledging the Significance of Insurance.	**5.1. Fundamentals of Finances:** Grasping concepts of income, expenses, and savings, Employing budgeting techniques, Understanding assets and liabilities, and Recognizing the significance of emergency funds. **5.2. Banking Essentials** Initiating and managing bank accounts, Familiarizing oneself with various account types (savings, checking, etc.), Comprehending interest rates, and Safely utilizing ATMs. **5.3. Management of Credit and Debt** Interpreting credit scores and reports. Identifying different credit types (credit cards, loans, etc.), Responsible debt management, and Preventing involvement in predatory lending. **5.4. Foundations of Investment** Understanding investment types (stocks, bonds, mutual funds, etc.), Assessing risk and return, Implementing diversification strategies, and Formulating investment approaches. **5.5. Financial Planning and Goal Establishment** Establishing financial objectives, Crafting a personalized financial blueprint, Continuously monitoring and adjusting financial goals, and Engaging in long-term financial	i) Video Demonstrations ii) Presentations iii) Case Studies iv) Chalkboard Utilization v) Collaborative Learning	**CO5**

		strategizing. **5.6. Consumer Rights and Duties** Familiarizing oneself with consumer entitlements, Safeguarding against financial scams and fraudulent activities Exercising responsible borrowing and spending practices, Upholding financial privacy and security measures. **5.7. Essentials of Insurance** Exploring different insurance categories (health, life, auto, home, etc.), Understanding insurance policy specifics, Recognizing the importance of insurance coverage, and Navigating the insurance claims process. **5.8. Economic Literacy** Grasping fundamental economic principles, Understanding the concepts of inflation and deflation, Analyzing market trends, and Interpreting economic indicators.		

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	**LLOI.I.1:** Communicating and interacting with residents or children with compassion and empathy, demonstrating an understanding of their needs and emotions.	1.1 Encouraging empathy and kindness through volunteer work at: i) a nearby nursing home ii)a care centre for children from disadvantaged families or similar types of facilities.	2	CO3
2	**LLO 2.1** Enhance goal-setting abilities by engaging in collaborative planning, analyzing obstacles, and reflecting on personal aspirations to align them with broader academic or career goals.	2.1 Pathway to Success: Goal-Setting Exercise	2	CO4
3	**LLO3.1:** Develop effective communication skills by demonstrating compassion, empathy, and understanding towards residents or children, while acknowledging and addressing their needs and emotions.	3.1 Exploring Your Inner World: Self-Reflection Activity	2	CO4
4	**LLO4.1:** Laboratory Learning Outcome: Cultivate structured self-reflection skills to assess personal	4.1 Strengths and Weaknesses Identification and Analysis Exercise	2	CO4

	strengths and weaknesses.			
5	**LLO 5.1:** Display proficiency in time management through the creation and adherence to structured timelines for task coordination.	5.1 Time Management Simulation for Coordinating Industrial Visits	2	CO4
6	**LLO 6.1**: Demonstrate competency in social media etiquette through engaging in activities and adhering to established norms and guidelines.	6.1 Activity on Social Media Etiquette	2	CO4
7	**LLO 7.1:** Develop skills in mapping and analyzing family income and expenses through structured exercises.	7.1. Exercise on Mapping and Analyzing Family Income and Expenses	2	CO5
8	**LLO 8.1**: Apply their knowledge of interest rate calculation to real-world financial situations, improving decision-making skills.	8.1 Exploring Simple and Compound Interest: A Hands-On Exercise on Interest Rate Calculation and Its Impact on Savings and Loans.	2	CO5
9	**LLO9.1:** Enhance comprehension of interest rates and their impact on financial dealings, encompassing savings accounts, Fixed Deposits (FDs), and loans.	9.1 Interest Rate Comparison Exercise: Analyzing Rates for Savings, Fixed Deposits, and Loans.	2	CO5
10	**LLO10.1:** Mastering and implementing safety protocols for ensuring secure ATM transactions.	10.1 Safety Precautions for ATM Usage: Exploring Tips for Secure Transactions	2	CO5

Note: Out of the above suggestive LLOs –

1. A judicial mix of LLOs is to be performed to achieve the desired outcomes

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

SELF-LEARNING - MICRO PROJECT/ASSIGNMENT/ACTIVITIES (ANY ONE)

The following list provides examples of activities that can be pursued under the program. Each group has the flexibility to choose from these options or undertake any other activity deemed suitable based on local requirements. The group focuses on the holistic development of the selected area, whether it is a village or a slum.

a) Community clean-up drives

Group tasks for community clean-up drives are,

1. Site Survey and Planning: Identify areas needing attention and plan tasks.
2. Logistics Management: Coordinate supply distribution to volunteers.
3. Volunteer Coordination: Welcome, register, and assign tasks to volunteers.
4. Trash Collection and Segregation: Collect and sort waste into categories.
5. Street Sweeping and Cleaning: Sweep and clean streets, sidewalks, and public areas.
6. Beautification and Landscaping: Enhance aesthetics by planting and trimming.

7. Safety and First Aid: Ensure volunteer safety and manage emergencies.
8. Documentation and Reporting: Capture progress through photos and reports.
9. Community Engagement: Educate and raise awareness among residents.
10. Post-Clean-up Evaluation: Review success and plan future initiatives.

b) Tree plantation initiatives

Group tasks for Tree plantation initiatives,

1. Community Awareness: Workshops to educate on tree benefits.
2. Community Participation: Engage locals in all planting
3. Team Building: Group activities to strengthen community bonds.
4. Leadership Development: Empower individuals to lead initiatives.
5. Communication Workshops: Enhance effective messaging.
6. Problem-solving Discussions: Address planting challenges.
7. Environmental Responsibility: Foster care for green spaces.
8. Cultural Integration: Incorporate local traditions into initiatives.
9. Sustainability Education: Teach sustainable planting practices.
10. Monitoring and Evaluation: Assess impact and plan improvements.

c) Environmental conservation awareness

Group tasks for Environmental conservation awareness

1. Educational Workshops: Teach about conservation methods.
2. Art Competitions: Promote environmental themes through art.
3. Street Plays: Perform interactive skits in public spaces.
4. Awareness Walks: Organize marches with environmental messages.
5. Tree Plantation: Plant trees to enhance green spaces.
6. Clean-up Campaigns: Remove litter from local areas.
7. Guest Lectures: Invite experts to discuss environmental issues.
8. Film Screenings: Show documentaries on conservation topics.
9. Social Media Campaigns: Spread awareness through online platforms.
10. Community Workshops: Educate on waste management and sustainability.

d) Health and sanitation programs

1. Health Education Sessions: Conduct informative sessions on hygiene, disease prevention, and nutrition.
2. Sanitation Infrastructure Evaluation: Assess the effectiveness of existing sanitation facilities and propose improvements.
3. Community Clean-up Events: Organize collective efforts to clean and maintain public spaces for better health outcomes.
4. Distribution of Hygiene Kits: Provide essential hygiene items such as soap, toothpaste, and sanitary products to community members.
5. Vaccination Drives: Coordinate vaccination campaigns to protect against prevalent diseases and promote community health.
6. Water Quality Testing: Conduct regular testing of water sources to ensure safe drinking water for residents.
8. Personal Hygiene Workshops: Offer workshops focusing on personal grooming, handwashing techniques, and menstrual hygiene.
9. First Aid Training: Provide basic first aid training to community members to equip them with life-saving

skills.

10. Community Health Surveys: Conduct surveys to assess health needs and gather feedback for future program planning.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic engineering measurement instruments, GPS data collection devices, and open-sour GIS software like Google Earth and QGIS, along with the Microsoft Office suite.	ALL

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)
Formative assessment (Assessment for Learning) Report and presentation of fieldwork activities, Self- Learning (Assignment)	--

X. SUGGESTED COS- POS MATRIX FORM

NOT APPLICABLE

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Mark Stafford Smith and Pamela Matson	Sustainable Development: Principles, Frameworks, and Case Studies	Oxford University Press, ISBN: 9780199588952
2	Katar Singh	Rural Development: Principles, Policies and Management	SAGE Publications Pvt. Ltd, ISBN:978-9351502867.
3	Anand Kumar, Asim Kumar Mandal, and R. Venkata Rao	Maharashtra: Governance and Development"	Routledge India, ISBN: 978-0367709133
4	Dalai Lama and Howard C. Cutler	The Art of Happiness	Riverhead Books, and the ISBN: 978-1594488894.
5	Stephen R. Covey	The 7 Habits of Highly Effective People	Simon & Schuster, ISBN : 978-1982137274.
6	Local college students, UMA staff	Sample Case Studies on the UMA website	IITB-UMA team

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.ugc.gov.in/pdfnews/4371304_LifeSKill_JeevanKaush al_2023.pdf	UHV: UGC Course on life skills. Unit 4 i.e. Course 4 is to be referred
2	https://nss.gov.in/	The National Service Scheme (NSS) website provides information about the NSS program in India. It includes details about the objectives, history, and structure of NSS. Additionally, the website offers resources for NSS volunteers and coordinators, such as program guidelines, training materials, and reports.
3	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/20160113150152380 8.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan
4	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/20160615145407370 8.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan Guidelines
5	https://www.humanvaluesfoundation.com/.	The Human Values Foundation website offers educators resources for teaching human values and social-emotional learning to children and youth. It provides curriculum-based programs, lesson plans, and activities to foster character development, resilience, and positive behaviour. Additionally, the website shares insights into the foundation's mission, values, and the global impact of its programs in schools.

Name & Signature: **Mr. S.B.Kulkarni** Lecturer in Mechanical Engineering **(Course Experts)**	
Name & Signature: **Mr. Nitin G. Kulkarni** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMAINME**
PROGRAMME CODE	**04**
COURSE TITLE	**INDUSTRIAL QULAITY MANAGMENT TECHNIQUES**
COURSE CODE	**ME41201**
PREREQUISITE COURSE CODE & TITLE	**NA**

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	
ME41201	INDUSTRIAL QULAITY MANAGMENT TECHNIQUES	DSC	02	00	00	02	04	02	03 Hrs	30	70	100	40	--	--	--	--	25	10	125

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 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:

Meeting quality standards not only improves customer satisfaction but also protects brand reputation& it is another name for universal acceptance of products.Quality assurance is an integral part of quality management that helps manufacturers adhere to production standards through systemic activities.Hence, Mechanical engineers must be conscious of various quality aspects required for the manufacturing /service sector. This subject is about various factors and philosophies in quality development. So, the students will have most of the essential inputs before entering their profession.

III. INDUSTRY EXPECTED OUTCOME

- Use the Quality technique principle to improvethe productivity of an industry.

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

Studentswillbeabletoachieve&demonstratethefollowingCOsoncompletionofcourse-basedlearning.

CO1: Apply Quality Standards for products as per consumer needs.

CO2: Interpret data from different processes and quality charts for variables and attributes.

CO3: Apply principles of Quality Circle and Kaizen for continuous improvement in the work.

CO4:Apply various statistical tools for data interpretation in graphical format.

CO5: Use different ISO standards in practice

V. THEORYLEARNINGOUTCOMESANDALIGNEDCOURSECONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I:QUALITY(CL Hrs- 04, Marks-08)				
1.	TLO1.1Prepare a quality characteristics chart for deciding the fitness of a product. TLO1.2List parameters for the service quality of a product. TLO1.3Differentiate cost and value of Quality. TLO1.4 . Select the type and stages of inspection for a process for quality control.	1.1 Meaning of Quality of Product, Quality of design,Quality of conformance andQuality of performance, cost of Quality and value of Quality. 1.2Quality policy: definition & objectives 1.3 Quality assurance: definition & itsvarious forms 1.4Quality audit, Inspection and qualitycontrol.	Chalk & Board, Video Demonstration	CO1
UNIT-II: Statistical Process Control(CL Hrs-10, Marks-20)				
2	TLO2.1 Prepare a list of parametersfor reducing variation in Quality. TLO2.2. Calculate mean, mode, median, range, and standard deviation from given data. TLO2.3. Draw X, R and P, C charts from the given data. TLO2.4.Determine the Process capability of a given process TLO 2.5.Represent the given data ona normal distribution curve.	2.1 Meaning and importance of SQC, Variable and attribute Measurement. 2.2 Variation in Quality, Reasons of variation, inherent and assignable sources of variation, central tendency, Dispersion, universe, and Normal distribution curve. 2.3 Control charts – control charts for variables –X &R charts, defect and defective, control charts for attributes - P & C charts, Trend of control charts, Process capability. 2.4 Acceptance sampling- Need of sampling, types of sampling plans, operating characteristics (OC) curve.	Chalk & Board, Video Demonstration	CO2
UNIT-III: Total Quality Management(CL Hrs- 06, Marks-12)				
3	TLO3.1Explain an eight-dimensional model of Total Quality for the task. TLO3.2. Identify key Six Sigma roles for the given industrial situation. TLO3.3. Prepare an elementary list of parameters of	3.1 Total Quality: - Concept, definition, objectives, eight-dimensional model of Total Quality. 3.2Principles of total quantity management. TQM implementation – PDCA cycle. 3.3Six sigma: Definition and Statistical meaning, advantages, implementation, methodology of system Improvement-	Chalk & Board, Video Demonstration, Assignment	CO2, CO3

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	the PDCA cycle for a product to be manufactured. .	DMAIC and DMADV.		
UNIT- IV: Quality Management Processes & Improvement Tools (CL Hrs- 08, Marks-20)				
4	TLO4.1. Prepare a list of steps for solving the given problem in the industry using the quality circle conceptwith justification. TLO4.2. Identify wastes in the organization TLO4.3. Write steps to implement 5S in the organization. TLO4.4. Prepare a cause and effect diagram/Pareto chart for solving the given problem for root cause analysis. TLO 4.5. Apply the '5 Whys' technique to solve a problem.	4.1 Quality Circle (QC): - concept, objective, structure, steps in the formation of quality Circle, advantages of quality Circle. 4.2 Kaizen - concept, meaning and definition, areas for Kaizen, 10 ground rules for change, Traditional methods vs. kaizen, Kaizen Vs innovation. 4.3 5S in housekeeping and their meaning. 4.4Cause and effect diagram (Fishbone or Ishikawa diagram), Pareto chart. 4.5 5W & 1H, 5 Whys technique for problem solving.	Chalk & Board, Video Demonstration, Assignment	CO3, CO4
UNIT –V: Quality Management Standards (CL Hrs-04, Marks-10)				
5	TLO5.1 Identify suitable ISO standards to be implemented in the industry. TLO5.2 Prepare a list of steps in implementing suitable ISO standards in the organization. TLO5.3 Prepare documentation for implementation of ISO.	5.1 Need for quality system standards International Organization for Standardization (ISO) adopted by Bureau of Indian Standards (BIS) 5.2 ISO 14000: Significance 5.3 Introduction to Toyota Way: Toyota production system (TPS), '4' P model of Toyota Way. 5.4Toyota way: principles and their meaning.	Chalk & Board, Video Demonstration, Assignment	CO5

VI. SUGGESTEDMICROPROJECT/ASSIGNMENT/ACTIVITIESFORSPECIFICLEARNING/SKILLS DEVELOPMENT(SELF-LEARNING)

Microproject: Not Applicable

Assignment: - Students should conduct the following activities in a group.

a. Prepare wall charts of 3 sigma and six sigma curves.

b. Prepare wall charts of quality techniques and tools.

c. Prepare a report on quality technique followed by the company.

d. Searchfor information about various ISO standards of quality control.

e. Prepare a list of national and international industries working on the principle of the Six Sigma technique, and Kaizen technique.

SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS&ASSESSMENTPURPOSE (SpecificationTable)

Sr.No	Unit	UnitTitle	AlignedCOs	LearningHours	R-Level	U-Level	A-Level	TotalMarks
1	I	Quality	CO1	04	08	--	--	08
2	II	Statistical Process Control	CO2	10	08	08	04	20
3	III	Total Quality Management	CO2,CO3	06	06	06	--	12
4	IV	Quality Management Processes & Improvement Tools	CO3,CO4	08	06	08	06	20
5	V	Quality Management Standards	CO5	04	06	04	--	10
Grand Total				**32**	**34**	**26**	**10**	**70**

VII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessmentfor Learning)	Summative Assessment (Assessmentof Learning)
1. Test 2. Assignment	1. End Theory Examination

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	3	-	-	-	-	-	-	-	2
CO2	3	2	2	2	-	-	-	2	-
CO3	2	2	1	3	-	-	-	-	2
CO4	3	3	2	2	2	2	2	2	-
CO5	2	-	1	-	-	-	-	-	3

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

IX.SUGGESTED LEARNING MATERIALS/BOOKS

Sr .No	Author	Title	Publisher with ISBN Number
1	Total Quality Management	Dr K. C. Arora	S.K. Kataria and sons ISBN 13: 978-8185749990
2	Quality Management	R. Panneerselvam, P. Silvankaran	PHI Learning, ISBN: 9788120349438, 9788120349438
3	Total Quality Management	N Srinivas Gupta and B Valarmathi	Tata Mc - Graw Hill Co., New Delhi. ISBN 13: 978-0070153646
4	Total Quality Management Text and cases	B. Janakiraman and R.K.Gopal	Prentice-Hall of India Pvt. Ltd. New Delhi. ISBN 13: 978-8120329959
5	Total Quality Management	SubburajRamasamy	Tata Mc - Graw Hill Co., New Delhi. ISBN 13: 978-1259001413
6	Total Quality Management	B. SenthilArasu and J. Praveen Paul	Prentice-Hall of India Pvt. Ltd. New Delhi. ISBN 13: 978-8183715782

XII. LEARNINGWEBSITES& PORTALS

Sr.No	Link/Portal	Description
1.	https://youtu.be/ZpFqnefTGA8	Meaning of Quality
2.	https://youtu.be/zSyICkGZ6iM	Quality control vs quality assurance
3.	https://youtu.be/fKvEkOFzhjQ	Total Quality Management
4.	https://youtu.be/wEBPVQ7W2wg	Six Sigma
5.	https://youtu.be/7Kc1reo8NU0	Quality improvement tools
6.	https://youtu.be/DFsFODnb-Iw	kaizen and 5S
7.	https://youtu.be/xJ3czkvNxpk	Acceptance sampling
8.	https://youtu.be/ccReTaolqHo	Variable charts
9.	https://www.youtube.com/watch?v=uj3AUwOuULU	Toyota Way by Jeffrey K. Liker
10.	https://youtu.be/66rtASiAnbA	Attribute charts

Name &Signature:

(Mrs. V.G. Talkit)
Lecturer in Mechanical Engineering

(Mr.M.S.Pol)
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

Dr.N.G.Kulkarni
(Programme Head)

Name & Signature:

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

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMAIN ME
PROGRAMME CODE	04
COURSE TITLE	PRODUCTION ENGINEERING
COURSE CODE	ME31207
PREREQUISITE COURSE CODE & TITLE	

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	
ME31207	PRODUCTION ENGINEERING	DSC	2	--	2	--	4	2	3	30	70	100	40	25	10	25@	10	--	---	150

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. RATIONALE: Students should be trained about the wide range of production engineering concepts involved in the mass production of engineering components that need to be employed with due consideration of functional and economic aspects.

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

Students will be able to achieve & demonstrate the following COs on completion of course-based learning.

CO1: Apply work study techniques to optimize manufacturing processes.

CO2: Prepare the detailed sequence of operations for manufacturing of components.

CO3: Develop production plan and control.

CO4: Use inventory control techniques.

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 WORK STUDY (METHOD STUDY & WORK MEASUREMENT) (CL Hrs-06, Marks-16)				
1.	TLO 1.1 Apply method to study for manufacturing of the given job. TLO 1.2 Apply time to study for manufacturing of the given job.	**1.1 Work study:** Method study(Motion Study) and Time study(Work Measurement) **1.2 Method study:** Definition, objectives, scope, steps involved in method study, selection of job **1.3 Time study / Work Measurement** Definition, Importance, Advantages, Steps, Time study equipment – Stopwatch.	Chalk-Board & Video, PPT	CO1
UNIT-II PROCESS ENGINEERING (CL Hrs- 10, Marks-20)				
2	TLO 2.1 Apply objectives of production in the given industrial/domestic application. TLO 2.2 Select the appropriate typeofproduction for manufacturingthe given simple job or component. TLO 2.3 Use line balancing as per the requirement of the industry.	**2.1 Production and production management:** - Concept, Objectives, Functions, Supply chain management. **2.2 Process Engineering-** Types of production - Make to stock, Make to order, Assemble to order. **2.3 Line Balancing:** Heuristic approach of line balancing.	Chalk-Board & Video, PPT	CO2
UNIT- III PRODUCTION PLANNING (CL Hrs- 06 , Marks-14)				
3	TLO 3.1 State theobjectives/functions of production planning and control TLO 3.2 Use steps in sales forecasting techniques for the given product with justification.	**3.1 Introduction -** Definition, functions and importance of PPC **3.2 Sales Forecasting** – Introduction, Purpose, basic steps in forecasting **3.3 Introduction to MRP, ERP,SAP**	Chalk-Board & Video, PPT	CO3
UNIT –IV Production Control (CL Hrs- 10 , Marks-20)				
4	TLO 4.1 Prepare different charts for the given type of production. TLO 4.2 Determine economic lot size. TLO 4.3 Determine batch size for EOQ.	**4.1** Meaning of control and progressive control **4.2** Shop floor control – Order release, loading and scheduling, routing, Sequencing, dispatching **4.3** Inventory control –Classification of inventory system, Economic order quantity (EOQ), Lead time, Safely stock.	Chalk-Board & Video, PPT	CO4

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 Measure thedimensions of simplecomponents LLO 1.2 Apply time to study for manufacturing of the given job.	Measure the dimensions of simple components. Apply time study using a stopwatch.	2	CO1
2	LLO 2.1Prepare flow process chart.	Prepare a flow process chart for any activity in the industry.	2	CO1
3	LLO 3.1 Prepare string diagram.	Prepare string diagram	2	CO1
4	LLO 4.1 Analyze the time components involved in the machining operation. LLO 4.2 Apply work measurement techniques.	Apply work measurement technique to analyze the time components involved machining operation of a given job using a stopwatch	2	CO1
5	LLO 5.1 Select steps in day-to-day situations of the supply chain. LLO 5.2 Prepare supply chain chart.	Prepare a supply chain chart in day-to-day situations like a supply of Cold drinks/toothpaste/ any grocery item.	2	CO2
6	LLO 6.1 Select steps for online purchase of goods/products. LLO 6.2 Prepare supply chain management chart.	Prepare supply chain management chart for online purchase of goods/products.	2	CO2
7	LLO 7.1 Prepare a list of operations of a manufacturing simple job. LLO 7.2 Prepare a chart of the sequence of operations for manufacturing of simple job.	Prepare a chart of the sequence of operations for manufacturing of simple jobs like manufacturing of hexagonal nuts& bolts / Manufacturing of V block on a shaper machine.	2	CO2
8	LLO 8.1 Identify different assembly stations. LLO 8.2 Balance an assembly line in a given situation.	Balance an assembly line in a given situation.	2	CO2
9	LLO 9.1 Identify maintenance activities for any machine in the workshop.	Develop maintenance schedule for a few machines in the workshop.	2	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
10	LLO 10.1 Collect data on sales. LLO 10.2 forecast sales in the coming year.	Collect data on sales of any one automotive vehicle for the past 5 years and forecast its sale in the coming year.	2	CO3
11	LLO 11.1 Identify components of the operation sheet. LLO 11.2 Prepare operation sheet.	Prepare an operation sheet for the given product.	2	CO3
12	LLO 12.1 Determine EOQ for the given problem. LLO 12.2 Plot graph for total cost versus EOQ.	Determine EOQ and plot graph for total cost versus EOQ for the given problem using MS Excel.	2	CO4
13	LLO 13.1 Prepare loading and scheduling.	Calculate the loading capacity of a specific workstation (Provide a production scenario)	2	CO4
14	LLO 14.1 Determine safety stock	In the workshop, a bar stock inventory is maintained.Calculate safety stock for the bar stock used for practicals of students.	2	CO4

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

Micro project:- A suggested list of micro-projectsis given here. Similar micro-projects can be added by the concerned faculty:

a) Calculate the predetermined time and total time required for the delivery of food (pizza/burger) from fast food centers available in your city or town. Prepare a sequence of activities and represent them with Therbligs.

b) Visit any manufacturing industry and observe the various statistical Quality control techniques carried out. Prepare a related chart.

c) Visit any manufacturing local/nearby industry and observe the various types of production carried out in the particular industry.

d) Visit any manufacturing industry and observe and list down different ergonomics in the design of controls and Ergonomics in the design of information displays used in the industry. List advantages of the same.

e) Visit any manufacturing industry and observe steps in the forecasting process used in the industry with its needs.

Assignment: - A suggested list of assignments is given here. Similar assignments can be added by the concerned faculty:

a) Collect the information of work-study and method study applied in the automobile industry.

b) Prepare a list of types of production seen in the industry during industrial visits.

c) Justify the necessity of sales forecasting in industries.

d) Collect the information on inventory control systems used in industries.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Nil	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	Work Study (Method Study & Work Measurement)	CO1	6	6	4	6	16
2	II	Process Engineering	CO2	10	6	8	6	20
3	III	Production Planning	CO3	6	4	4	6	14
4	IV	Production Control	CO4	10	6	8	6	20
Grand Total				**32**	**22**	**24**	**24**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Tests 2. Seminar / Presentation 3. Term work	1. Practical 2. 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	3	2	2	--	--	2	3	--	1
CO2	3	2	2	--	--	2	3	--	--
CO3	3	2	2	--	--	2	3	2	--
CO4	3	2	2	--	--	2	3	2	----

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	Dr.O.P.Khanna	Industrial Engineering and Management	Dhanpat Rai & Sons, New Delhi ISBN-978-81-899-2835-3
2	MartandTelsang	Industrial Engineering and Production Management	S.Chand and Company Pvt. Ltd., New Delhi, ISBN -978-81-219-1773-5
3	P.K.Gupta and D.S.Hira	Operation Research	S.Chand and Company Pvt. Ltd., New Delhi, ISBN -978-81-219-0281-6
4	L.C.Jhamb	Production planning and control	Everest Publishing House ISBN - 9788186314722,8186314725
5	Samuel Eilon	Elements of production planning and control	Dhanpat Rai & Sons, New Delhi ISBN 978-81-899-2835-3
6	L.C.Jhamb	Work Study &Ergonomics	Everest Publishing House ISBN-1234567154030

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://youtu.be/nDUN_Kndxbc?feature=shared	What is Work-study? Method Study, Work measurement.
2.	https://youtu.be/O77clB7-CYE?feature=shared	Beginning Engineers Time and Motion Studies.
3.	https://youtu.be/G5PxuOEUWA8?feature=shared	Introduction to Human Factors Engineering / Ergonomics.
4.	https://youtu.be/JExh2DhqCG0?feature=shared	Production planning and control, Routing, Scheduling, loading, Dispatching, Business Operations,
5.	https://youtu.be/KiCFfD5zBWQ?feature=shared	Economic Order Quantity (EOQ) in Inventory Management

Name &Signature:

(Mr. S P Paranjape)
Lecturer in Mechanical Engineering

(Dr. S S.Panpatil)
Lecturer in Mechanical Engineering

(Course Experts)

Name & Signature:

Dr. N. G. Kulkrni
(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	SOLID MODELLING AND 3D PRINTING
COURSE CODE	ME51201
PREREQUISITE COURSE CODE & TITLE	ME31206 COMPUTER AIDED DRAFTING

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	
ME51201	SOLID MODELLING AND 3D PRINTING	AEC	–	–	4	0	4	2	--	--	--	--	--	50	20	50#	20	--	--	100

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:

Solid Modeling and 3D Printing are foundational technologies in modern mechanical engineering. This field equips students with the skills to create accurate 3D models through advanced CAD software and produce functional prototypes using 3D printing technologies. Mastery of these tools enhances design precision, minimizes production defects, and drives innovation across industries such as automotive, aerospace, and manufacturing. By gaining proficiency in these technologies, students can meet the growing demands of the industry, stay abreast of technological advancements, and unlock new opportunities in rapid prototyping and on-demand, customized manufacturing solutions.

III. COURSE-LEVEL LEARNING OUTCOMES(COs)

Students will be able to achieve & demonstrate the following Cos on completion of course-based learning.

- **CO1**: Create and interpret 2D drawings using parametric CAD software.
- **CO2**: Design and develop 3D solid models from 2D sketches using parametric CAD/3D modeling software.
- **CO3**: Assemble individual part models into a complete assembly using the assembly features of parametric CAD software.
- **CO4**: Generate and print orthographic projections of 3D solid models and assemblies using parametric CAD software.
- **CO5**: Operate a 3D printer to fabricate models.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes(TLO) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I:INTRODUCTION TO MODELING SOFTWARE (CL HRS- NIL, MARKS- NIL)			
1.	**TLO 1.1:** Understand CAD, CAM, and CAE concepts, and explain the parametric, associative, and feature-based nature of CAD modeling. **TLO 1.2:** Use various CAD toolbars, including Standard, Sketch, Relationship, View, Drawing, Feature, and Annotation Toolbars. **TLO 1.3:** Navigate the Feature Manager Design Tree, utilizing the Design, Property, and Configuration Managers. **TLO 1.4:** Apply selection methods from the Design Tree and Graphic Area in CAD software.	**1.1 Overview of CAD, CAM, and CAE:** Introduction to the concepts of Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Computer-Aided Engineering (CAE), along with an exploration of various available CAD software. Understanding the parametric, associative, and feature-based nature of CAD modelling software. **1.2 Toolbars:** Introduction to various toolbars including the Standard Toolbar, Sketch Toolbar, Relationship Toolbar, View Toolbar, Drawing Toolbar, Feature Toolbar, and Annotation Toolbar. **1.3 Feature Manager Design Tree:** Exploration of the Feature Manager Design Tree, including the Design Manager, Property Manager, and Configuration Manager. **1.4 Selection Methods:** Overview of selection methods, including selection from the Design Tree and Graphic Area.	Demonstration and Simulation, Collaborative Learning	01
	UNIT-II : SKETCHING WITH MODELING SOFTWARE(CL HRS- NIL, MARKS- NIL)			
2	**TLO 2.1:** Identify and describe the functionality of drawing tools such as Line, Rectangle, Circle, Arc, Ellipse, and Spline for creating basic shapes. **TLO 2.2:** Analyze and interpret the purpose and usage of editing tools like Trim, Extend, Erase, and Mirror to refine and modify drawings. **TLO 2.3:** Employ modified tools such as Chamfer, Fillet, Copy, and Move to alter geometry based on design requirements. **TLO 2.4:** Use linear and angular dimensions to precisely define object sizes and spatial relationships within a drawing. **TLO 2.5:** Evaluate the effectiveness of dimensioning and geometrical constraints in ensuring design precision and consistency.	**2.1 Drawing Tools:** Includes tools such as Line, Rectangle, Circle, Arc, Ellipse, Spline, and others for creating basic shapes. **2.2 Editing Tools:** Tools like Trim, Extend, Erase, and Mirror for modifyingand refining drawings. **2.3 Modify Tools:** Features such asChamfer, Fillet, Copy, Move, and othersfor altering geometry. **2.4 Dimensions:** Applying linear and angular dimensions to accurately define object sizes and relationships. **2.5 Constraints:** Utilization of dimensioning and geometrical constraints to ensure precision and consistency in designs. **2.6 Drawing Template:** Creation of a	Demonstration and Simulation, Collaborative Learning	01

Sr. No	Theory Learning Outcomes(TLO) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	TLO2.6: Develop a drawing template that includes essential elements such as nameplates, boundary lines, and projection symbols.	drawing template that includes essential elements like the nameplate, boundary lines, and projection symbols.		
	UNIT-III:PART MODELING (CL -Hrs -NIL, MARKS-NIL)			
3	**TLO 3.1: Identify** the basic tools for creating 3D solid models, such as Extrude, Revolve, and Sweep. **TLO 3.2: Describe** the process of creating reference geometry, including axes and planes, to aid in 3D modelling. **TLO 3.3: Demonstrate** the use of editing tools like Trim, Extend, and Mirror to modify 3D components. **TLO 3.4: Apply** Boolean operations (Union, Subtract, Intersection) to combine or separate solid components. **TLO 3.5: Create** a 3D model of a simple machine part by using part tools, editing tools, and reference geometry.	**3.1 Working in a 3D environment:** Creating 3D Solid Models of simple machine parts. **3.2 Reference Geometry:** Creating axis, Creating reference planes **3.3 Part tool:** Extrude, Revolve, Sweep, Swept blend,loft,Rectangular and circular Pattern, Hole and Rib etc. **3.4 Part Editing tool:** Trim, Extend, Erase, Mirror, **3.5 Part Modify tool:** Chamfer, Round, Copy, Move, Draft, Shell etc. **3.6** Intersect two solid components by inserting a new body option. Boolean operations: Union, subtract, intersection.	Demonstration and Simulation, Collaborative Learning	02
	UNIT- IV : ASSEMBLY OF PARTS (CL Hrs- NIL, MARKS- NIL)			
4	**TLO 4.1:**Use assembly tools to create an assembly of parts. **TLO 4.2:**Usethe explodes command to get the exploded view of the assembly.	**4.1** Overview of the Assembly Environment, Configuring the Assembly Setup **4.2** Creating a Bottom-Up Assembly Placing the First Component in an Assembly, Adding the Second Component to the Assembly **4.3**Defining Assembly RelationshipsAssembly toolbar, Feature manager design tree conventions.	Demonstration and Simulation, Collaborative Learning	03

UNIT –V:DRAWING ENVIRONMENT(CL Hrs- NIL, Marks- NIL)				
5	**TLO 5.1:**Use a drawing module to create orthographic views of part models. **TLO 5.2:**Use a drawing module to create orthographic views of a given assembly. **TLO 5.3:**Prepare a bill of material	**5.1** Drawing Environment. Using templates in Drawing. **5.2** Add Model/assembly in drawing module. **5.3** Generating Orthographic views, and isometric views. Creating sectional views, auxiliary views, detailed views, and exploded views. **5.4** Add dimensions, notes, tolerances, surface	Demonstration and Simulation, Collaborative Learning	04
UNIT –VI:PRINTING AND ADDITIVE MANUFACTURING(CL Hrs- NIL, Marks- NIL				
	TLO 6.1: Plot / Print the Drawing on a sheet. **TLO 6.2:** Print the 3D Model using a 3D printer.	**6.1** Plotters- Types of Plotters and Printers. **6.2** Sheet setup. Page setup. Print selection, Print Preview and print document. **6.3** Additive manufacturing: 3D printing, Rapid prototyping. **6.4** Construction and working of 3D printer and Rapid prototyping machine. **6.5**Type and properties of the material for 3D printer and Rapid prototyping machine. **6.6** File format: STL (Stereo Lithography). **6.7**3D printer software: part import, orientation, processing and printing.	Demonstration and Simulation, Collaborative Learning	04, 05

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIALEXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome(LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
1	**LLO1.1:**Apply knowledge of modeling software to navigate its interface and utilize various environments for sketching and modeling. **LLO1.2:**Create accurate 2D sketches of machine parts using the tools and features available in 3D modeling software. **LLO1.3:** Interpret technical drawings and replicate them as 2D sketches in the modeling software.	Introduction to Modeling software & its environments. Draw 2D sketches of the machine parts using 3-D modeling software (Minimum -05)	08	CO1
2	**LLO2.1:** Utilize CAD tools to develop 3D parts by applying features like extrude, revolve, ribs, chamfer, fillet, hole, and pattern	Create simple parts using features like extrude, revolve, ribs, chamfer, fillet, hole, pattern etc., from the given orthographic views. (Minimum-05)	08	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome(LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
	based on the given orthographic views. **LLO2.2:** Convert 2D orthographic views into precise 3D models by employing suitable modeling techniques.			
3	**LLO3.1:** Create a customized drawing template with a formatted nameplate, clear boundary lines, and appropriate projection symbols using CAD tools. **LLO3.2:** Develop a professional drawing template that complies with industry standards and fulfils documentation requirements.	Prepare a drawing template consisting of a nameplate, boundary lines and projection symbol.	04	CO4
4	**LLO4.1:** Create detailed and dimensioned drawing views of parts using the given drawing template. **LLO4.2:** Prepare and print professional-quality drawings on A4-size paper, ensuring compliance with technical standards.	Generate drawing views of Parts created in Ex. No.-02 on the drawing template giving all dimensions and Print on A4 size paper	04	CO4
5	**LLO5.1:** Design complex 3D partsusing advanced CAD features from a given pictorial view. **LLO5.2:** Create a 3D printable model of one part, ensuring design accuracy and dimensional integrity. **LLO5.3:** Collaborate with group members to finalize the design and print the model using a 3D printer.	Create complex 3D parts using features extrude, revolve, sweep, ribs, chamfer, fillet, hole, pattern, draft, shell etc., from the given pictorial view (Minimum -05) and print anyone with a 3D printer in a group of 5 students.	08	CO2, CO5
6	**LLO6.1:**Generate different views and sectional views on the template.	Generate drawing views of Parts created in Ex. No.-05 on the drawing template giving all dimensions and Printed on A4 size paper.	04	CO4
7	**LLO7.1:** Create 3D models of individual components for two assemblies, each with at least five parts, using CAD tools. **LLO7.2:** Generate detailed, dimensioned drawing views of the parts using drawing templates. **LLO7.3:** Organize and print drawing views on A4-size paper with accurate scaling and layout.	Create 3D part models of individual components of any TWO assemblies consisting of at least five parts. (e.g. assembly of Bench Vice, Drill Jig, Joints, Couplings, Bearings, Valves, Screw Jack, Lathe Tool Post, I.C.Engine piston and connecting rod etc). Generate drawing views of the parts on the drawing template with dimensions and Print on A4 size paper.	16	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome(LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
8	**LLO 8.1:**Learn the assembly feature of the software.	Assemble parts created in Ex. No. 07. Generate and print orthographic views of assembly using the drawing template with one of the views as a sectional view along with a Bill of material on A4 size paper.	04	CO3
9	**LLO 9.1:**Create an exploded view of assemblies generate detailed views, and print them on A4-size paper.	Create an exploded view of assemblies created in Ex. No. 07. Generate view and print on A4 size paper.	04	CO3, CO4
10	**LLO 10.1:** Generate a ready-to-print STL file from the designed part. **LLO10.2**Produce a 3D-printed model using the available machine and validate its functionality.	Save a part file created in Exercise No. 02 in STL (Stereolithography/Standard Triangle Language) format. Open the saved file in the 3D printing machine software. Use the available menus to align and orient the model for processing. Proceed to 3D print the model using the available machine.	04	CO5

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

Suggested Co-Curricular Activities:

To complement classroom and laboratory learning and accelerate the achievement of course outcomes, students are encouraged to engage in the following group activities. Each group should prepare a five-page report for each activity and collect relevant physical evidence to include in their portfolios, which will support them during placement interviews:

a. Document practical performance in the laboratory by preparing detailed journals.
b. Research and gather information about various CAD, CAM, and CAE software used in the industry, including their applications and benefits.

Micro-Project Guidelines:

Each student is required to undertake one micro-project during the semester. In cases where group work is necessary, groups should have no more than three students. The micro-project should integrate two or more Course Outcomes (COs) and align with related PrOs, UOs, and Affective Domain Outcomes (ADOs).

Micro-Project Requirements:

- Projects can be based on industry applications, internet research, workshops, laboratories, or fieldwork.
- Students must maintain a dated work diary to document their contributions.
- Each project should culminate in a seminar presentation before submission.
- The completed micro-project should be submitted by the end of the semester, focusing on industry-relevant CO development.

Representative Micro-Projects:

a. **2D Drawing:** Collect one or two drawings from a nearby industry or workshop, develop a CAD model, and generate production drawings.
b. **3D Model:** Identify a minor assembly in the institute workshop or laboratory, measure the dimensions of each part, and prepare sketches. Use these sketches to create 3D models of the parts and assembly. Generate and plot assembly and detailed drawings (e.g., Bench Vice, Machine Vice, Tool Post, Couplings, Joints, Bearings).
c. **Manufacturing-Based Models:** Create 3D models for parts intended for manufacturing. Develop assembly and detailed drawings for these parts.

Assignment: -NA

VII. LABORATORYEQUIPMENT/INSTRUMENTS/TOOLS/SOFTWAREREQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hardware: Desktop P.C. IntelCore i3 has Windows10 Pro 64 Bit OS with 8 GB RAM and a 1 TB hard disk.	All
2	Software: Any parametric solid modelling software.	All
3	Printer/ Plotter	8, 9
4	3D printing machine	10

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(SpecificationTable)

Sr.No	Unit	UnitTitle	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction To Modeling Software	01,02	12	--	--	--	--
2	II	Sketching With Modeling Software	01	12	--	--	--	--
3	III	Part Modeling	02	16	--	--	--	--
4	IV	Assembly Of Parts	03	12	--	--	--	--
5	V	Drawing Environment	04	08	--	--	--	--
6	VI	Printing And Additive Manufacturing	04, 05	08	--	--	--	--
Grand Total				**64**				**50**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessmentfor Learning)	Summative Assessment (Assessmentof Learning)
1. Interactive Questioning 2. Practical Demonstrations 3. Checkpoints with Milestones	1. Practical Examination (Hands-on Assessment)

X. SUGGESTED COs- POs MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes*(PSOs)	
	PO-1 Basicand Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ DevelopmentofSolutions	PO-4 EngineeringTools	PO-5 EngineeringPracticesforSociety,Sustainabilityand Environment	PO-6 ProjectManagement	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	2	2	1	-	-	-	2	3	-
CO2	3	3	1	2	-	-	2	3	-
CO3	3	3	1	2	-	-	2	3	-
CO4	3	3	1	2	-	-	2	3	-
CO5	3	2	-	3	-	-	2	3	2

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	CATIA for Designers.	Sham Tickoo	18th Edition, Softcover, Cadcim Technologies, ISBN 978-1-64057-108-2
2	Pro/Engineer Wildfire 5.0 for Designers	Sham Tickoo	2012 edition, Dream Tech Publications, New Delhi, ISBN 978-93-5004-044-7
3	Solid Works for Designers	Sham Tickoo	Softcover, Cadcim Technologies
4	CREO Parametric 6.0 for engineers and designers	Sham Tickoo	2019 edition, BPB Publications, ISBN 978-93-89423-13-6

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	Solid Edge Official Website	The official site for Solid Edge, providing access to resources, tutorials, and guides for learning Solid Edge 3D modeling, sheet metal design, and product lifecycle management
2	Siemens Solid Edge Tutorials	Official tutorial portal for Solid Edge users, offering beginner to advanced learning paths, covering parametric design, assembly modeling, and sheet metal designusing Solid Edge.
3	www.slideshare.net/	SlideShare is a platform where users upload presentations, documents, and other resources. It provides a wide range of presentations, including those on 3D modeling, CAD, and related topics.
4	https://www.youtube.com/watch?v=X32zRZWALTM	This video provides a comprehensive tutorial on advanced 3D solid modeling using CAD software. It focuses on creating complex geometries, refining designs, and utilizing advanced features like parametric constraints, lofting, and filleting. Suitable for intermediate to advanced users looking to enhance their modeling expertise.
5	https:llwww.youtube.com/watch?v=vjX4PDJcFOI	This video demonstrates the step-by-step process of creating 3D solid models in CAD software. It covers basic to intermediate modeling techniques, including sketching, extrusion, and creating assemblies. Ideal for beginners and students aiming to build foundational skills in CAD modeling.
6	https://www.youtube.com/watch?v=OgYDUwh4dMI	This tutorial focuses on designing and assembling a complex 3D model in a CAD environment. The video highlights the use of assembly constraints, part creation, and rendering tools, making it ideal for users aiming to develop professional-level modeling skills.
7	https://www.youtube.com/watch?v=PHU9evBqCN4	This video tutorial demonstrates the creation of a detailed 3D model using advanced CAD techniques. It covers step-by-step part modeling, dimensioning, and assembly processes while emphasizing practical tips for achieving industry-standard designs. The content is suitable for learners seeking to enhance their skills in professional 3D modeling workflows.
8	https://www.youtube.com/watch?v=ANhf__Sg3mE	This video offers a comprehensive guide to creating complex 3D CAD models, focusing on the use of SolidWorks software. It explains critical features such as extrusions, fillets, and assemblies while highlighting efficient techniques for part design and integration. Ideal for beginners and intermediate users, it provides practical insights for mastering CAD workflows.
9	https://www.youtube.com/watch?v=8bc9i80PqlY	This video demonstrates step-by-step instructions for designing 3D parts using advanced Solid Edge features. It covers essential modeling techniques like sketching, extrusion, and creating assemblies, making it suitable for learners aiming to improve their CAD modeling skills.

Name &Signature:	
(A.M. JOSHI) Lecturer in Mechanical Engineering	**(S.B. KULKARNI)** Lecturer in Mechanical Engineering
(Course Experts)	
Name & Signature: **Dr.N.G.Kulkarni** (Programme Head)	Name & Signature: **Shri.S.B.Kulkarni** (CDC In-charge)

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