Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Production Engineering**		
Programme Code	**: PG**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 12 Weeks (Industry) + 10 Weeks (Institute)**
Semester	**: Fifth** **NCrF Entry Level : 4.0**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme											
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		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	
(All Compulsory)																							
1	EMERGING TRENDS IN MECHANICAL ENGINEERING	ETM	DSC	315363	-	3	-	-	-	3	1	1.5	30	70*#	100	40	-	-	-	-	-	-	100
2	PRODUCTION AND OPERATION MANAGEMENT	POM	DSC	315368	-	4	-	2	-	6	2	3	30	70	100	40	25	10	-	-	-	-	125
3	TOOL ENGINEERING	TEN	DSC	315369	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
4	SEMINAR AND PROJECT INITIATION COURSE	SPI	AEC	315003	-	-	-	1	2	3	1	-	-	-	-	-	25	10	25@	10	25	10	75
5	CNC PROGRAMMING	CNP	SEC	315010	-	2	-	4	-	6	2	-	-	-	-	-	25	10	25#	10	-	-	50
6	INTERNSHIP(12 WEEKS)	ITR	INP	315004	-	-	-	-	-	36 - 40	10	-	-	-	-	-	100	40	100#	40	-	-	200
Elective - I (Any - One)																							
7	PROCESS ENGINEERING	PEN	DSE	315366	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
	PRODUCT DESIGN AND DEVELOPMENT	PDD	DSE	315367	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
	MATERIAL HANDLING SYSTEMS	MHS	DSE	315370	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
Total						**17**		**11**	**2**		**20**		**120**	**280**	**400**		**225**		**200**		**25**		**850**

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						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		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	

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Note: Notional learning hours for **internship represents the student engagement hours.**

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

EMERGING TRENDS IN MECHANICAL ENGINEERING **Course Code : 315363**

Programme Name/s	**: Automobile Engineering./ Mechanical Engineering/ Mechatronics/ Production Engineering/**
Programme Code	**: AE/ ME/ MK/ PG**
Semester	**: Fifth**
Course Title	**: EMERGING TRENDS IN MECHANICAL ENGINEERING**
Course Code	**: 315363**

I. RATIONALE

As new technologies rapidly transform the manufacturing industry and related sectors, this course on Emerging Trends in Mechanical Engineering is designed to equip diploma pass outs with the latest knowledge essential for their professional growth. The course covers key areas such as green fuels, autonomous and sustainable maintenance practices, data analytics in manufacturing, and the integration of autonomous vehicles. It also explores the use of drones and autonomous technologies in agriculture. By focusing on these current trends, the course aims to enhance the skills of Mechanical, Automobile, Production, and Mechatronics diploma engineers, preparing them to excel in a rapidly evolving technological environment.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Adopt recent trends in mechanical engineering across various mechanical and allied industries.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select appropriate green fuels for various applications for considering environmental sustainability.
- CO2 - Apply the principles of Autonomous and Sustainable maintenance practices in industry to improve equipment reliability and efficiency.
- CO3 - Identify the levels of autonomy in various mobility systems.
- CO4 - Use data analytics techniques to improve manufacturing processes and systems.
- CO5 - Utilize automated equipment and technologies for various agricultural applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315363	EMERGING TRENDS IN MECHANICAL ENGINEERING	ETM	DSC	3	-	-	-	3	1	1.5	30	70*#	100	40	-	-	-	-	-	-	100

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the concept of green fuels, including their benefits and advantages. TLO 1.2 Differentiate between the various classes of green fuels based on their sources and production methods. TLO 1.3 Describe different types of green fuels derived from plants.	**Unit - I Green Fuels** 1.1 Green Fuels: Introduction, Characteristics, Benefits and advantages. 1.2 Classes of Green Fuels: 1st Generation, 2nd Generation, 3rd Generation and 4th Generation Green Fuels 1.3 Types and Applications of Green Fuels: Biofuel, Hydrogen fuel, Synthetic fuel, Algae fuel, Bio diesel from plants, Applications of Green Fuels in Automobile, Power and Heat, Aerospace sectors.	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Explain the concepts of data analytics, including its types and techniques. TLO 2.2 Describe the role of a data analyst in the manufacturing industry. TLO 2.3 Explain the characteristics of big data and its applications in manufacturing processes.	**Unit - II Recent trends in Manufacturing systems** 2.1 Big Data in Manufacturing: Introduction, Big Data Characteristics, Benefits 2.2 Data Analytics in manufacturing: Introduction, Steps in Data Analytics, Types of Data Analytics, Data Analytics techniques, Applications of Big Data analytics in Manufacturing – Preventive maintenance, Product Design, Production Management Automation, Customer Experience, Supply Chain Improvement, Benefits. 2.3 Data Analytics in Quality Control: Introduction, Applications, Benefits.	Lecture Using Chalk-Board Video Demonstrations Presentations
3	TLO 3.1 Explain the levels of autonomy in mobility systems. TLO 3.2 Describe the systems used in autonomous vehicles such as Advanced Driver Assistance Systems (ADAS) and Full Self-Driving (FSD) technologies. TLO 3.3 State the application of Autonomous Vehicles for given mobility system.	**Unit - III Autonomous Vehicles** 3.1 Autonomy in Mobility Systems (Autonomous Vehicle): Levels, Components, Benefits and Challenges. 3.2 Systems used in Autonomous Vehicles: Advanced Driver Assistance Systems (ADAS) and Full Self-Driving (FSD) 3.3 Applications of Autonomy in other Mobility Systems: Autonomous Trains, Autonomous Ships, Autonomous Aircrafts (Unmanned Aircraft Systems (UAS)	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Describe the concept of Autonomous and Sustainable Maintenance, including the pillars of Total Productive Maintenance (TPM). TLO 4.2 Explain the procedures of Autonomous and Sustainable Maintenance along with their benefits. TLO 4.3 Describe the role of data analytics in Predictive Maintenance. TLO 4.4 Explain the concept of Computerized Maintenance Management Systems (CMMS).	**Unit - IV Recent Trends in Maintenance** 4.1 Autonomous Maintenance: Concept, Pillars of TPM, Implementation steps, benefits. 4.2 Sustainable Maintenance: Concept, Importance, Implementation steps, benefits. 4.3 Data Analytics in Predictive Maintenance: Introduction, concept of Computerized Maintenance Management System (CMMS).	Lecture Using Chalk-Board Video Demonstrations Presentations
5	TLO 5.1 Explain the role of automation in agriculture field. TLO 5.2 Describe the benefits of automated farm equipment. TLO 5.3 Describe the features and advantages of autonomous tractors and their impact on enhancing agricultural practices. TLO 5.4 Describe the applications and advantages of using drones in agriculture sector. TLO 5.5 Explain significant features of government schemes supporting drone usage in agriculture field.	**Unit - V Recent Trends in Agriculture Engineering** 5.1 Automation in Agriculture: Introduction, Automated Farm Equipments - Agri-robots, Harvesting robots, Inspection and Monitoring Agriculture robots, Automatic Seeding and Planting Machine, AI Operated Irrigation Systems, Benefits 5.2 Autonomous Tractor: Self Driving Tractors, Features and Advantages 5.3 Agricultural Drones: Soil and Field Analysis, Crop Monitoring, Plantation, Crop Spraying, Advantages of Drones, Government Schemes for Drone Usage.	Lecture Using Chalk-Board Presentations Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Not Applicable	All

IX. SUGGESTED 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	Green Fuels	CO1	5	2	4	4	10
2	II	Recent trends in Manufacturing systems	CO2	6	4	4	8	16
3	III	Autonomous Vehicles	CO3	6	4	4	6	14
4	IV	Recent Trends in Maintenance	CO4	6	2	4	8	14

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Recent Trends in Agriculture Engineering	CO5	7	4	4	8	16
Grand Total				**30**	**16**	**20**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two Class test of 30 Marks and Average of two Class test

Summative Assessment (Assessment of Learning)

- Online MCQ based examination - 70 marks

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Carlos Ricardo Soccol, Satinder Kaur Brar, Craig Faulds, Luiz Pereira Ramos	Green Fuels Technology: Biofuels (Green Energy and Technology)	Springer International Publishing AG; 1st ed. 2016 edition (19 August 2016); 01149344934, ISBN-13: 978-3319302034
2	Fumio Gotoh	Autonomous Maintenance in Seven Steps: Implementing TPM on the Shop Floor	1st Edition, Productivity Press, ISBN-13: 978-0367199869
3	Samuel Theodore, Daniel Lucky	Autonomous Maintenance	Maintenance Pro, 2023, ISBN-13 ?:979-886417453
4	Matthias Hartwig	Self-driving cars	E-book, 2020, by BMW
5	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos	Autonomous Vehicles Technologies, Regulations, and Societal Impacts	Elsevier,2021, ISBN-13: 978-0323901376
6	Yan Li, Hualiang Shi	Advanced Driver Assistance Systems and Autonomous Vehicles	Springer, Singapore,2022, ISBN-13: 978-9811950520

Sr.No	Author	Title	Publisher with ISBN Number
7	P Suresh, T. Poongodi, B Balamurugan, Meenakshi Sharma	Big Data Analytics in Smart Manufacturing: Principles and Practices	December 14, 2022 by Chapman & Hall, ISBN-13: 978-1032065519
8	Rania I.M. AlmoselhyRania I.M. Almoselhy, Ravindran Chandran, Abisha Juliet Mary S J	Current Trends in Agriculture & Allied Sciences (Volume-1)	S. P. Publishing, Bhubaneshwar, Odisa,2023, ISBN-13: 978-9359061382
9	Dr. Suman Lata, Mamta J. Patange, Dr. Anand K. Gore, Suchibrata Chamuah and Dr. Chandana Behera	Recent Trends in Agriculture (Volume-5)	Integrated Publications, New Delhi,2023, ISBN-13: 978-9395118644

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.engieimpact.com/insights/green-fuels	Green Fuels
2	https://www.youtube.com/watch?v=T_S7Q3Uede4	Green Fuels
3	https://www.researchgate.net/publication/359732622_Green_fuels_concepts_benefits_and_studies_in_Nigeria/link/624c10bec7ab230e99cef13a/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19	Green Fuels
4	https://nitsri.ac.in/Department/Chemical%20Engineering/BRTL12.pdf	Green Fuels
5	https://www.youtube.com/watch?v=4-R5Sh-xSiI&t=5s	Autonomous Maintenance (Total Productive Maintenance Series TPM)
6	https://www.youtube.com/watch?v=ZJ6tr1kkRDg	Sustainability in Manufacturing
7	https://www.youtube.com/watch?v=HgF7E5q9sU4&t=1s	An introduction to autonomous vehicles
8	https://www.youtube.com/watch?v=gEy91PGGLR0	Autonomous car / self-driving car
9	https://www.youtube.com/watch?v=ACxTcsxSYvE	Data Analytics in Manufacturing
10	https://www.youtube.com/watch?v=31W0EzcfE74	Big data analytics for manufacturing
11	https://www.youtube.com/watch?v=P2YPG8PO9JU	Agricultural Wonder Drone
12	https://www.youtube.com/watch?v=8-uPCmHX3U0	Agricultural Drones
13	https://www.youtube.com/watch?v=JeU_EYFH1Jk	Artificial intelligence comes to farming in India
14	https://www.youtube.com/watch?v=tSdIgGin_rk	Fully autonomous tractor
15	https://www.skillindiadigital.gov.in/courses/detail/32d86c56-efc6-4c33-9c65-17901e296f8e	Kisan Drone Operator
16	https://www.youtube.com/watch?v=q7tFDw5SAAU	Farming with robots
17	https://www.youtube.com/watch?v=_Dmb1GN52no	Spraying robots

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

PRODUCTION AND OPERATION MANAGEMENT **Course Code : 315368**

Programme Name/s : **Production Engineering**
Programme Code : **PG**
Semester : **Fifth**
Course Title : **PRODUCTION AND OPERATION MANAGEMENT**
Course Code : **315368**

I. RATIONALE

Industrial productivity relies heavily on the effective utilization of human and equipment resources. To ensure high productivity levels, one must be proficient in planning production schedules, managing inventory and process control. Additionally, knowledge in production planning and control along with modern production techniques is crucial. This course aims to provide a critical understanding of process and operational management concepts, enabling learners to enhance productivity and operational efficiency and gain a competitive advantage in the industry.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use principles of modern production and operation approaches for manufacturing.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply concepts of production systems, plant location and plant layout to enhance productivity and facility design.
- CO2 - Develop production plan to optimize manufacturing operations.
- CO3 - Implement effective production control techniques to improve operational efficiency.
- CO4 - Apply work study techniques to optimize production processes.
- CO5 - Apply project management techniques to optimize schedule.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315368	PRODUCTION AND OPERATION MANAGEMENT	POM	DSC	4	-	2	-	6	2	3	30	70	100	40	25	10	-	-	-	-	125

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Select production system for the given product with justification. TLO 1.2 Apply productivity improvement technique for the given situation. TLO 1.3 Classify the plant location factors as suitable or unsuitable based on the product requirements. TLO 1.4 Prepare plant layout for manufacturing the given product.	**Unit - I Production system and facility design** 1.1 Production systems: Definition and types of Production Systems, significance of productivity and its measurement, techniques for improving productivity. 1.2 Plant Location: Importance of plant location selection, factors influencing plant location decisions. 1.3 Plant Layout: Objectives and principles of plant layout design, features of different layouts, factors affecting plant layout.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit Flipped Classroom
2	TLO 2.1 Explain the functions of production planning and control with reference to the given situation. TLO 2.2 Select sales forecasting techniques for the given product with justification. TLO 2.3 Predict sales demand for the given product. TLO 2.4 Prepare operation sheet for the given component/job. TLO 2.5 Prepare material requirement planning for the given product.	**Unit - II Production Planning** 2.1 Introduction: Definition, functions and importance of PPC. 2.2 Sales Forecasting: Overview and purpose of sales forecasting, basic forecasting methods: simple average, moving average, exponential smoothing. 2.3 Process Planning: Definition and concept, information required and procedure, development of Operation sheet and Process flow sheet. 2.4 Production Planning: Material Requirement Planning (MRP), Capacity planning, Bill of material, Manufacturing Resource Planning (MRP-II). 2.5 Computer aided process planning & scheduling software (like Enterprise resource planning (ERP), Advanced planning and scheduling (APS) etc;).	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Prepare different charts for the given type of production scheduling. TLO 3.2 Sequence 'n' number of jobs on two machines. TLO 3.3 Analyze the effect of demand on inventories. TLO 3.4 Determine economic lot size. TLO 3.5 Calculate batch size for EOQ. TLO 3.6 Apply ABC analysis for the given inventory. TLO 3.7 Write the steps to apply Just in Time (JIT) and lean manufacturing for the given situation. TLO 3.8 Develop the Gantt chart for the given situation.	**Unit - III Production Control** 3.1 Introduction of production control and progress control. 3.2 Inventory Control: Functions and classification of inventories, costs associated with inventory management, Economic Order Quantity (EOQ), lead time, safety stock, periodic review, ABC analysis. 3.3 Shop floor control: Order release, loading and scheduling, sequencing ('n' jobs, 2 machines), dispatching, routing, Gantt chart, Flow Process Sheet. 3.4 Just in Time (JIT) Production system: Philosophy, elements of JIT, seven wastes and benefits of JIT. 3.5 Lean Manufacturing: Concept, principles, advantages and limitations.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit
4	TLO 4.1 Apply method study for manufacturing of the given job. TLO 4.2 Apply time study for manufacturing of the given job. TLO 4.3 Select relevant recording techniques for the given process with justification. TLO 4.4 Prepare different types of charts for given process using given recording techniques. TLO 4.5 Calculate standard time for given activity using work measurement.	**Unit - IV Work Study** 4.1 Method study: Definition, objectives and basic procedure, Selection of work and Charting Techniques - Flow process chart, Outline process chart, Flow diagram and travel chart, Critical examination and analysis. 4.2 Principal of Motion economy: General considerations, Tools and equipment's, Two Handed process chart, Therbligs, cycle graph and Chronocycle graph, SIMO Chart. 4.3 Time study: Definition, procedure, factors affecting the rate of working, Time Study equipment's, Types of elements, Rating and allowances, calculation of standard time.	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 Formulate the linear programming model for the given problem. TLO 5.2 Optimize the given objective of LP Model. TLO 5.3 Construct the network diagram of the given project using project management techniques. TLO 5.4 Identify critical path and calculate total duration, float and slack of the given project.	**Unit - V Linear programming and network techniques** 5.1 Introduction: Concept and importance of Operation Research (OR), linear programming (LP) model formulation. 5.2 Graphical method for solving LP problems. 5.3 Project Management Techniques: Project evaluation and review technique (PERT) and critical path method (CPM), Comparison between CPM and PERT, Calculation of time estimate in PERT and CPM.	Lecture Using Chalk-Board Video Demonstrations Presentations Flipped Classroom

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare comparative statements for plant location using appropriate software, considering key criteria and constraint. LLO 1.2 Analyze the generated statements to select the optimal plant location.	1	Prepare comparative statements for plant location using software.	2	CO1
LLO 2.1 Use software for designing a product/process layout.	2	*Prepare product/process layout using appropriate software.	2	CO1
LLO 3.1 Prepare detailed operation sheet, specifying the sequence of operations, tools used, time and equipment required for efficient production.	3	*Prepare operation sheet for the given product/job.	2	CO2
LLO 4.1 Use software to generate Material Requirements Planning (MRP) data. LLO 4.2 Analyze MRP results to address the given problem.	4	Generate MRP with appropriate software for the given problem.	2	CO2
LLO 5.1 Conduct an ABC analysis to categorize items available in the laboratory or central store. LLO 5.2 Categorize items based on their importance and usage.	5	* Perform ABC analysis of inventory items.	2	CO3
LLO 6.1 Prepare two handed process chart for the given task. (e.g. measuring dimensions or assembling components).	6	*Prepare two handed process chart.	2	CO4
LLO 7.1 Prepare a string diagram for mapping a material handling movements in the institute laboratory, workshop, or industry. LLO 7.2 Analyze material handling movement.	7	Use a string diagram to analyze material handling movements.	2	CO4
LLO 8.1 Observe and record the motions involved in machining operations in the workshop. (Turning/Milling/Drilling etc.). LLO 8.2 Analyze the findings to enhance machining process efficiency to reduce unwanted motions. LLO 8.3 Develop a flow process chart/outline process chart to detail the sequence of steps and decision points involved in the given situation.	8	Apply method study approach.	2	CO4
LLO 9.1 Measure and record the time components of a machining operation (Turning/Milling/Drilling etc.) in the workshop using a stopwatch. LLO 9.2 Analyze the recorded time data and identify opportunities for improving machining efficiency.	9	Apply work measurement techniques.	2	CO4
LLO 10.1 Prepare a CPM/PERT network diagram for a given project task (e.g. machine maintenance). LLO 10.2 Identify critical path and calculate total duration, float and slack of the given project.	10	* Prepare CPM/PERT network diagram and analyze critical path.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

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

Micro project

- Design a layout for a small workshop or manufacturing unit using different layout types (Process, Product, and Cellular). Create layout diagrams and explain how each layout optimizes production efficiency for specific scenarios.
- Develop operation sheets and process flow sheets for a simple product. Detail the information required, the steps involved, and the rationale for each step. Create visual representations of the process.
- Create a simulation of Material Requirements Planning (MRP) for a small-scale production scenario. Calculate the Bill of Materials (BOM) and develop a capacity plan. Prepare a report on how MRP and MRP-II impact production planning.
- Develop a plan for implementing Just-in-Time (JIT) and Lean Manufacturing principles in a hypothetical or real company. Identify potential benefits and challenges, and propose strategies for overcoming limitations.
- Perform a time study on a specific task and use principles of motion economy to analyze the work. Create Two-Handed Process Charts, SIMO Charts, and calculate the standard time for the task. Present the findings and improvement suggestions.
- Create PERT and CPM network diagrams for a small project. Calculate the time estimates, identify the critical path, and compare the results of PERT and CPM. Prepare a report on the project scheduling and management insights.

Assignment

- Analyze a real-world company and identify the production system used (Job Shop, Batch, Mass, Continuous). Discuss how the system impacts productivity and suggest improvements.
- Select a manufacturing company and evaluate the factors influencing its plant location decision. Classify these factors as suitable or unsuitable based on the company's product requirements.
- Using historical sales data, apply different forecasting methods (Simple Average, Moving Average, Exponential Smoothing) to predict future sales. Compare the accuracy of each method.
- Develop an operation sheet and process flow sheet for a given product or job.
- Calculate the Economic Order Quantity (EOQ) and safety stock for a given set of inventory data. Prepare a report including EOQ calculations, cost analysis, and inventory management strategies.
- Conduct a motion economy study for a simple task. Prepare two-handed process charts, SIMO charts, and time study reports to identify and reduce unnecessary motions.
- Develop a PERT and CPM network diagram for any project. Calculate the time estimates and determine the critical path.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Any open-source CAD software	2,3,10
2	Department Laboratory	2,3,5,6,7,10,8,9
3	Institute Workshop	2,3,5,6,7,10,8,9
4	Computer Aided Process planning and Scheduling software. e.g., Enterprise Resource Planning (ERP), Advanced Planning and Scheduling (APS) Software	3,4,5
5	Standard samples like steel balls, bearings, turning operation jobs, gear samples for sample measurement.	5,6,7,8,9

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
6	Stop Watch :- Timing capacity: 23 hrs., 59 mins and 59.99 sec, Accuracy : ±3 seconds/day.	6,7,8,9
7	Display Wall chart showing Therbligs symbols.	6,7,8,9
8	Digital Video Camera for Micro Motion Analysis with following specification (i) ISO 100-12800 (ii) Focal length f = 3.5-5.6 (iii) 24.2 MP (iv) lenses 18-55 mm.	6,7,8,9

IX. SUGGESTED 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	Production system and facility design	CO1	6	2	4	4	10
2	II	Production Planning	CO2	8	2	6	6	14
3	III	Production Control	CO3	8	2	6	6	14
4	IV	Work Study	CO4	10	4	4	10	18
5	V	Linear programming and network techniques	CO5	8	4	4	6	14
Grand Total				**40**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 60% weightage to process 40% weightage to product A continuous assessment-based term work..

Summative Assessment (Assessment of Learning)

- End semester examination

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number

Sr.No	Author	Title	Publisher with ISBN Number
1	Dr. O. P. Khanna	Industrial Engineering and Management	Dhanpat Rai Publications Pvt. Ltd., New Delhi, 2018, ISBN-13: 978-8189928353.
2	Martand Telsang	Industrial Engineering and Production Management	S. Chand, 2006, 3rd Edition, ISBN-13: 978-8121917735.
3	L. C. Jhamb	Production planning and control	Everest Publishing House, 12th Edition, 2010, ISBN-13: 978-8186314722.
4	Samuel Eilon	Elements of Production planning and control	Colliern Macmillan Ltd., 2015, ISBN: 978-0023318009.
5	K. K. Ahuja	Production Management	CBS publishers and Distributers, New Delhi, 2016, ISBN-13: 978-8123901855.
6	L. C. Jhamb	Work Study and Ergonomics	Everest Publishing House, ISBN: 9788176601566, 9788176601566.
7	George Kanawaty	Introduction to Work Study	International Labour Office, 4th revised edition, 1992, ISBN-13: 978-9221071082.
8	P. K. Gupta and D. S. Hira	Operation Research	S. Chand and Company Pvt. Ltd., New Delhi, 2015, ISBN: 9788121902816.
9	Mikell P. Groover	Automation, Production systems, and Computer Integrated Manufacturing	Pearson Prentice Hall, fourth Edition, ISBN: 978-9332572492.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=OshyCwH3TJM	Plant location, Factors affecting Plant Location
2	https://www.youtube.com/watch?v=4vq0FKWYud8&t=63s	Plant Layout, Objectives of Plant Layout, Types of Plant Layout
3	https://www.youtube.com/watch?v=OLXq4nEWr9k	Plant Layout, Objectives of Plant Layout, Types of Plant Layout
4	https://www.youtube.com/watch?v=bjz4pKsXyMs	Production Planning and control
5	https://www.youtube.com/watch?v=9qBZyzjoqAo	Production Planning and control
6	https://www.youtube.com/watch?v=y24meNZbUoU	Process Planning
7	https://www.youtube.com/watch?v=ALIwbEvVl0M	Sales Forecasting methods
8	https://www.youtube.com/watch?v=ZpUD9kkPTiI	Inventory control
9	https://www.youtube.com/watch?v=SHXR6B90IfA	MRP
10	https://www.youtube.com/watch?v=6RFiU8j_PIA	MRP-II
11	https://www.youtube.com/watch?v=D2OJB1EgBSI	Cell Layout, Just-in-time manufacturing
12	https://www.youtube.com/watch?v=zWQovrjB7Uc&list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb	Work System Design
13	https://www.youtube.com/watch?v=66aKgySf9vo&list=PLLy_2iUCG87Bq8RGMTdeFZiB-87V4i9p1	Linear programming
14	https://www.youtube.com/watch?v=-TDh-5n90vk	PERT/CPM

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

TOOL ENGINEERING **Course Code : 315369**

Programme Name/s : **Production Engineering**
Programme Code : **PG**
Semester : **Fifth**
Course Title : **TOOL ENGINEERING**
Course Code : **315369**

I. RATIONALE

Machining success hinges significantly on the quality of the tools employed. Optimal tool selection, considering factors such as shape, size, and material is paramount for achieving efficient and top-notch machining results. Employing jigs and fixtures facilitates swift and secure tool positioning, thereby enhancing machining outcomes. This course empowers students with the expertise to choose the best-suited tools for diverse machining assignments. Furthermore, it comprehensively covers the design aspects of cutting tools, jigs, and fixtures, imparting essential knowledge about these fundamental elements of machining.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use different tools, dies, jigs and fixtures as per the requirement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Evaluate cutting tool geometry and its tool signatures.
- CO2 - Apply locating and clamping concept to a given component.
- CO3 - Design a jig and fixture for a given component.
- CO4 - Analyze the press tool operation required for a specific component.
- CO5 - Compute parameters of bending and drawing dies.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315369	TOOL ENGINEERING	TEN	DSC	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the principles of metal cutting. TLO 1.2 Differentiate between orthogonal and oblique cutting processes as per given criteria. TLO 1.3 Calculate cutting forces in metal cutting. TLO 1.4 Describe the geometry of a single point cutting tool. TLO 1.5 Select a suitable cutting tool materials for specific applications. TLO 1.6 Interpret ISO designation for carbide inserts.	**Unit - I Fundamentals of cutting tool** 1.1 Mechanics of metal cuttings. 1.2 Types of metal cutting process: Orthogonal and Oblique. 1.3 Cutting Forces: shear angle and Merchant's Circle. 1.4 Cutting tool geometry: Single point cutting tool and its tool signature. 1.5 Cutting tool materials: Types, composition, properties and applications. 1.6 Carbide inserts: Types, ISO - designation and Applications.	Model Demonstration Video Demonstrations
2	TLO 2.1 Describe the concepts of locating and clamping in the context of manufacturing. TLO 2.2 Apply the 3-2-1 principle to constrain and position workpieces effectively for machining operations. TLO 2.3 Classify locators based on their types. TLO 2.4 Explain working mechanisms of clamping devices in securing workpieces during machining. TLO 2.5 Describe fool-proofing techniques used in locating and clamping devices.	**Unit - II Locating and clamping devices** 2.1 Locating and clamping: Concept, definition. 2.2 Degree of freedom: Concept, significance and 3-2-1 principle. 2.3 Locators: Type, construction, working and applications. 2.4 Clamping devices: Types, constructions, working and application, 2.5 Fool proofing and ejecting techniques.	Model Demonstration Video Demonstrations
3	TLO 3.1 Explain the importance of jigs and fixtures in machining operations. TLO 3.2 Describe applications of jigs in various machining operations. TLO 3.3 Describe applications of fixture in various machining operations. TLO 3.4 Explain factors to be considered while designing jigs and fixtures. TLO 3.5 Explain modular flexible fixture system design.	**Unit - III Jigs and fixtures** 3.1 Introduction to Jigs and fixtures, difference between jigs and fixtures. 3.2 Jigs: Types ,construction, working and applications. 3.3 Fixtures: Types , construction, working and Applications. 3.4 Design considerations for the jigs and fixtures. 3.5 Introduction to modular flexible fixture system design.	Model Demonstration Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Identify the components of press tools and their functions. TLO 4.2 Differentiate between cutting and non-cutting dies. TLO 4.3 Discuss reasons for providing die clearance and its effects. TLO 4.4 Calculate cutting forces in press operations. TLO 4.5 Evaluate strategies to reduce cutting forces and optimize efficiency. TLO 4.6 Calculate the percentage stock utilization in strip layouts.	**Unit - IV Press tools** 4.1 Press tools: Types, operations, components, functions and working. 4.2 Dies:Cutting, non-cutting dies and their terminologies. 4.3 Die clearance: Concept, meaning, definition, Reasons, effects and methods of application. 4.4 Cutting force: Methods to calculate cutting forces. 4.5 Methods of reducing cutting forces: Shear angle on punch and die, staggering of punches. 4.6 Strip layout: Concept, importance, method to prepare, and determining percentage stock utilization.	Demonstration Video Demonstrations
5	TLO 5.1 Describe the functions of each components / parts of the given die. TLO 5.2 Compute Bending Pressure for a given component. TLO 5.3 Describe the construction features of drawing dies. TLO 5.4 Calculate blank size for a given component.	**Unit - V Bending and Drawing dies** 5.1 Bending dies: Type, Parts and functions of bending die. Bending allowances and spring back. 5.2 Method to compute bending pressure. 5.3 Drawing dies: Types, construction, working and applications of drawing dies. 5.4 Method to determine blank size for drawing operation.	Demonstration Video Demonstrations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Interpret a tool signature. LLO 1.2 Re-sharpen a single point cutting tool.	1	Interpret a tool signature., Re-sharpen a single point cutting tool as per given tool signature.	2	CO1
LLO 2.1 Draw Merchant’s circle to illustrate the relationships between cutting force components LLO 2.2 Estimate magnitude of cutting forces developed during machining processes.	2	*Draw and analyze Merchant’s circle to understand the relationships between cutting force components.	2	CO1
LLO 3.1 Classify cutting tools based on geometry, application , material composition , and method of use	3	Categorize cutting tools on the basis of their geometry, application, material composition, and method of usage.	2	CO1
LLO 4.1 Identify different locating devices LLO 4.2 Illustrate different locating devices	4	*Enumerate and draw various locating devices utilized for securely positioning diverse work pieces.	2	CO2
LLO 5.1 Identify various clamping devices LLO 5.2 Illustrate various clamping devices	5	*Enumerate and draw various clamping devices employed to securely holding diverse work pieces.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Apply design principles to create a jig or fixture. LLO 6.2 Idenify devices used to accurately positions a specified component.	6	*Design a jig or fixture for a given simple component.	2	CO3
LLO 7.1 Draw a detailed assembly and part drawings of the designed jig. LLO 7.2 Specify all required dimensions, features, and annotations.	7	Draw assembly and detailed drawing of the designed jig.	2	CO3
LLO 8.1 Draw a detailed assembly and part drawings of the designed fixture. LLO 8.2 Specify all required dimensions, features, and annotations.	8	Draw assembly and detailed drawing of the designed fixture.	2	CO3
LLO 9.1 Identify various operations performed using press tools. LLO 9.2 Enumerate the applications of these operations in manufacturing.	9	List different operations performed using press tools, providing examples where applicable.	2	CO4
LLO 10.1 Draw a progressive cutting die design for a specific component. LLO 10.2 List multiple stages of operations.	10	*Design a progressive cutting die for a given component (example washer).	2	CO4
LLO 11.1 Design a strip layout that optimizes material usage for a given component. LLO 11.2 Understand alterante way of strip layout for maximum utilization of material.	11	*Prepare a Strip layout of a given component for maximum utilization of material.	2	CO4
LLO 12.1 Apply bending principles to design a die for a specified component. LLO 12.2 Understand the effect of spring back of material.	12	Design a bending die for a given Component.	2	CO5
LLO 13.1 Determine the initial blank size needed for a drawing operation. LLO 13.2 Comprehend the importance of the draw ratio	13	*Calculate a blank size for deep drawing a simple.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

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

Micro project

- Prepare a model of various dies/single point cutting tools
- Collect the various inserts and specify their ISO designation.
- Identify various clamping and locating device available in workshop of the institute.

Assignment

- Prepare or download specifications for the following:

i. Tools and equipment available in the Tool Engineering laboratory.

ii. Machinery available in the Tool Engineering laboratory.

- Conduct a market survey of local dealers for tools, equipment, machinery, and raw materials, and prepare a report.
- Visit an industrial press shop and compile a report that includes:

i. Safety precautions observed during the visit.
ii. Identification of challenges or problems encountered by the industry

No SLA

- NA

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Bench Grinder -1 Qty	1
2	Single point cutting tool- 2 Qty	1,3
3	Inserts of different geometries.	1,3
4	Locating and Clamping Devices for Lathe, drilling and milling machines.	4,5,6,7,8
5	Press Machine (maximum 1 Ton Capacity)	4,5,9,10
6	Press tool must include Die and Punch, Die holder, punch holder, tie rods.	4,5,9,10,12,13

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of cutting tool	CO1	10	4	6	6	16
2	II	Locating and clamping devices	CO2	6	4	4	4	12
3	III	Jigs and fixtures	CO3	8	4	4	6	14
4	IV	Press tools	CO4	10	4	6	6	16
5	V	Bending and Drawing dies	CO5	6	2	4	6	12
Grand Total				**40**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Test
- Term Work
- Seminar/Presentation

Summative Assessment (Assessment of Learning)

- Practical
- Theory
- End semester examination

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sharma, P C	A Textbook of machine tools and tool Design	S. Chand Limited (2021), ISBN:9788121923620, 812192362X
2	Nagpal, G H	Tool Engineering and Design	Khanna Publication (8th Edition, 2021), New Delhi ISBN : 817409203X
3	Donaldson, Cyrll	Tool Design	McGraw Hill Education, New Delhi (4th Edition, 2022),Edition3, ISBN: 9780070153929, 0070153922
4	Joshi, P H	Jigs and Fixtures	McGraw Hill Education, New Delhi, (6th Edition, 2020), ISBN:9780070680739
5	Sharma, P C	Production Engineering	S. Chand Limited (9th edition, 2021), ISBN:8121901111

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=2E1UW_MxSWg	Tool Geometry: Single Point Cutting Tool Specifications
2	https://www.youtube.com/watch?v=I0nIHfQ6E-E	Cutting Tools
3	https://www.youtube.com/watch?v=7yzvno4AvKw	Jigs and Fixtures For Machine Shops
4	https://www.youtube.com/watch?v=vOo2MCYPsm4	Design and Applications of Jigs and Fixtures
5	https://www.youtube.com/watch?v=PhIFSTj-8WU&list=PLwdnzlV3ogoVIP4OxvoWMZXQYJdHn5NE9&index=1	Mechanics of Sheet Metal Forming
6	https://www.youtube.com/watch?v=xz7fHwF8uVk	Modular flexible fixture systems

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ PG/ SE/ TE**
Semester	**: Fifth**
Course Title	**: SEMINAR AND PROJECT INITIATION COURSE**
Course Code	**: 315003**

I. RATIONALE

Most of the diploma graduates lack the confidence and fluency while presenting papers or interacting verbally and expressing themselves with a large gathering. Seminar presentation boosts the confidence of the students and prepares them precisely for facing the audience, interviews and group discussions. The course on seminar is to enhance student's ability in the art of academic writing and to present it. It also helps broaden the minds of the participants. Through this course on Seminar, students will develop new ideas and perspectives of the subject /themes of emerging technologies and services of their area of studies. Project initiation enhances project planning skill which establishes measurable objectives and interaction skills.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Present a seminar on the selected theme/area of study effectively and confidently to the specific audience and stakeholders. Plan innovative solutions independently or collaboratively to the identified problem statement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify topics of seminar presenting to the large gathering at the institute/conference.
- CO2 - Collect relevant and updated research-based data and information to prepare a paper of seminar presentation.
- CO3 - Apply presentation skills.
- CO4 - Create conducive environment for learning and discussion through seminar presentation.
- CO5 - Identify a problem statement and establish the action plan for the successful completion of the project.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315003	SEMINAR AND PROJECT INITIATION COURSE	SPI	AEC	-	-	1	2	3	1	-	-	-	-	-	25	10	25@	10	25	10	75

V. General guidelines for SEMINAR and Project Initiation

- The seminar must be related to emerging trends in engineering / technology programme or may be inter/ multi-disciplinary, based on the industry expected outcomes of the programme.
- The individual students have different aptitudes and strengths. Therefore, SEMINAR should match the strengths of students. For this purpose, students shall be asked to select the TITLE (Theme)of SEMINAR they would like to prepare and present.
- Seminar titles are to be finalized in consultation with the faculty mentor.
- Seminar must involve logic development of applications of various technologies/ processes applicable in industry.
- Seminar must be assigned to the single student. However, support of other students may be sorted while presenting the seminar
- Students are required to prepare using relevant software tools, write ups for presentation
- Students shall submit One Hard copy and one Soft copy each of the presentation and may be encouraged to keep a recorded copy of the presentation made during the seminar.
- Batch of 3-4 students shall be formed for project initiation.
- Projects give a platform for the students to showcase an attitude of inquiry to identify the problem statement related to the programme. Students shall Identify the information suggesting the cause of the problem and possible solutions
- Students shall study and assess the feasibility of different solutions and the financial implications.

- Students should collect relevant data from different sources (books/internet/market/suppliers/experts through surveys/interviews).
- Students shall prepare required drawings/ designs and detailed plan for the successful execution of the work.
- Students may visit the organisation pertaining to the problem statement as part of initial study.

VI.Guidelines for Seminar preparation and presentation :

Once the title/topic of a seminar has been finalized and allotted to the student, the teacher's role is important as guide, mentor and motivator, to promote learning and sustain the interest of the students.

Following should be kept in mind while preparing and presenting the seminar:

- **Seminar Orientation cum -briefing**: the seminar topics/themes should be innovative, novel and relevant to the curriculum of the programme, and also aligned to the expectations of industry.
- **Seminar Literature surve**y: Information search and data collection: the information and data should be authentic, realistic and relevant to the curriculum of the programme.
- **Seminar Preparation, and presentation**: The seminar shall be present with suitable software tools and supporting handout/notes. The presentation of seminar should not be more than 20 minutes including Q-A session.

The following guidelines may be followed for Project Initiation

- **Establishing project scope:** Determine the boundaries of the project.
- **Defining project objectives:** Set clear and measurable objectives that align with the project's purpose.
- **Stakeholder identification and analysis:** Perform an exercise in identifying all stakeholders involved in the project and analyzing their needs and expectations.
- **Team Formation:** Carefully build a team with the necessary skills and expertise to execute the project successfully.
- **Documentation.** Create a project planner showcasing the action plan, define the project's scope, outline the project definition, and design of the project. The document has to be made available to all stakeholders

VII. Criteria of Assessment /Evaluation of Seminar

A. Formative Assessment (FA) criteria

The assessment of the students in the fifth semester Progressive Assessment (PA) for 50 marks is to be done based on following criteria.

A. Suggestive RUBRICS for assessment

Sr. No.	Criteria	Marks
1	Selection Topic/Theme of seminar	05
2	Literature review and data presentation	05
3	Quality of Preparation and innovativeness	05
4	Q-A handling	05
5	Time Management	05
6	Seminar Presentation report	10

Rubrics for assessment of Project Initiation

Sr. No.	Criteria	Marks
1	Selection of Theme of Problem Statement and its innovativeness	05
2	Stages of development of Action plan	05
3	Prototyping	05

The total marks as per above out of 50, shall be converted in proportion of 25 marks.

B. Summative Assessment criteria/

The summative assessment of the students in the fifth semester End-Semester-Examination (ESE) for 50 marks is to be done based on following criteria.
This assessment shall be done by the Faculty.

Suggestive **RUBRICS** may be developed by the faculty

Sr. No.	Criteria	Marks
1	Quality of information/Knowledge presented in SEMINAR	10
2	Creativity, Innovation in SEMINAR presentation	10
3	Response to the question during seminar presentation	10
4	Establishment of Innovative Problem Statement and its presentation	10
5	Objectives of the project and action plan	10

The total obtained marks shall be converted in proportion of 25 marks.

VIII. Suggestive CO-PO Mapping

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**
CO-1	3	1	0	-	2	2	3		
CO-2	2		2	-	2	1	3		
CO-3	3	1	1	2	1	2	3		
CO-4	2	0	0	2	1	2	3		
CO-5	3	3	3	2	2	3	3		

VIII.Typographical instructions/guidelines for seminar preparation & presentation

- The seminar PPT shall be computer typed (English- British)
- Text Font -Times New Roman (TNR), Size-12 point
- Subsection heading TNR- 12 point bold normal
- Section heading TNR- 12 capital bold
- Chapter Name/ Topic Name – TNR- 14 Capital
- All text should be justified. (Settings in the Paragraph)
- Different colors text/diagrams /tables may used
- The name of the candidate, diploma (department), year of submission,name of the institute shall be printed on the first slide of PPT.

IX.Seminar and Project Initiation Report

On completion and presentation of Seminar, every student will submit a brief report which should contain the following:

- Cover Page (as per annexure 1)
- Title page (as per annexure 2)
- Certificate by the Guide (as per annexure 3)
- Acknowledgment (The candidate may thank all those who helped in the execution of the project).
- Abstract of Paper presented in the seminar (It should be in one page and include the purpose of the seminar & methodology if any .)
- Index
- List of Figures
- Introduction
- Literature Review
- Information/Chapters related to Seminar topic
- Advantages and Disadvantages
- Conclusion
- Project Initiation : a) Description of problem statement. b) Scope and objectives. c) State holder d) Platform/ Equipment/ Resources identification.
- Bibliography
- References

NOTE: Seminar report must contain only relevant – technology or platform or OS or tools used and shall not exceed 25-30 pages.

Details of Softcopy to be submitted:
The soft copy of seminar presentation is required to be provided on the back cover of the seminar report in clear packet, which should include the following folders and contents:

1.Presentation (should include a PPT about project in not more than 15 slides)
2.Documentation (should include a word file of the project report)

NOTE: Soft copy must be checked for any harmful viruses before submission.

X. Sample Formats

1) Cover Page - Annexure-I

2) Index - Annexure-II

3) Assessment - Annexure-III

Annexure - I

MSBTE LOGO

SEMINAR Report

Institute Logo

"SEMINAR Title_ _ _ _ _ _ _ _ _ _ _ _ _"

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

Name of Student **Enrollment Number**

FOR THE ACADEMIC YEAR 20___20___

(H.O.D) **(Principal)**

(Internal Guide) **(External Examiner)**

Annexure - II

Institute Name

(An Affiliated Institute of Maharashtra State Board of Technical Education)

Table of Contents

INDEX

***Students can add/remove/edit chapter names as per the discussion with their guide**

Annexure - III

Format for SEMINAR and PROJECT INITIATION Assessment /Evaluation

Formative Assessment

CRITERIA AND WEIGHTAGE

Enrollment No	**1** Selection Topic/Theme of seminar (5)	**2** Literature review and data presentation (5)	**3**. Quality of Preparation and innovativeness (5)	**4** Q-A handling (5)	**5** Time Management (5)	6. Seminar Presentation report (10)	**7** Selection of Theme of Problem Statement and its innovativeness (5)	**8** Stages of development of Action plan (5)	**9.** Prototyping (5)	**10.** Total (50)	Scaled to (25)

SummativeAssessment

CRITERIA AND WEIGHTAGE

Enrollment No	**1.** Quality of information/Knowledge presented in SEMINAR **10**	**2** Creativity, Innovation in SEMINAR presentation 10	**3**. Response to the question during seminar presentation 10	**4** Establishment of Innovative Problem Statement and its presentation 10	**5** Objectives of the project and action plan 10	Total **(50)**	Scaled to **(25)**

Sign: **Name: ----------** **(Course Expert/s)**	**Sign:** **Name: ----------** **(Program Head)** **(Information Technology)**

CNC PROGRAMMING **Course Code : 315010**

Programme Name/s : **Production Engineering**
Programme Code : **PG**
Semester : **Fifth**
Course Title : **CNC PROGRAMMING**
Course Code : **315010**

I. RATIONALE

The integration of CNC technology with CAD and CAM software further enhances manufacturers to achieve higher levels of automation, precision, efficiency, and flexibility in their machining operations. Job opportunities for CNC programmers are fairly plentiful, and likely to increase as the technology will integrate with of artificial intelligence (AI) in future. The course will impart knowledge & skills necessary for develop CNC part programme, it will help in further industry revolution.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Execute part program to produce job using CNC machine.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select machine setting parameters to produce given component.
- CO2 - Develop manual part program for CNC lathe and milling machine using linear and circular interpolation function.
- CO3 - Develop manual part program for CNC lathe and milling machine using canned cycle and sub routine call function.
- CO4 - Produce job on CNC lathe and milling machine using CNC machine.
- CO5 - Interface CAM software with CNC machine.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315010	CNC PROGRAMMING	CNP	SEC	2	-	4	-	6	2	-	-	-	-	-	25	10	25#	10	-	-	50

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Identify different axes and their nomenclature of CNC lathe and Milling. TLO 1.2 Explain Importance of tool offsetting and presetting. TLO 1.3 Use of word address format (WAF) for programming. TLO 1.4 Explain stepwise procedure for programming.	**Unit - I Fundamentals of CNC programming** 1.1 Definition: program, programmer and programming. 1.2 Axes identification and nomenclature for CNC lathe and CNC milling. 1.3 Concept of tool offsetting and presetting for lathe and milling. 1.4 Terminology used for program in Word Address Format (WAF). 1.5 Stepwise procedure for programming: study the given part drawing, list of instructions to the machine, problem definition, sequence of machining operation and process sheet, decide- material & stock size, work zero, unit, coordinate system (Absolute & Incremental), tool, cutting parameters and coordinate points.	Demonstration Lecture Using Chalk-Board
2	TLO 2.1 Explain linear and circular path operations for the given job. TLO 2.2 Calculate cutting parameters of linear and circular path for the given job. TLO 2.3 Select appropriate G & M codes for linear and circular path for the given job. TLO 2.4 Prepare program for linear and circular path for the given job. TLO 2.5 Simulate the program for linear and circular path by using software and conduct dry-run test on machine.	**Unit - II Linear & circular path programming** 2.1 Concept: linear and circular path operations in lathe and milling machine. 2.2 Calculate: Cutting parameter, address parameter I, J, K, co-ordinates. 2.3 Respective G and M codes. 2.4 Develop program as per given job drawing. 2.5 Concept of simulation and DRY-Run test. 2.6 Steps- Feeding program in CPU, loading and Un-loading job on CNC machine.	Lecture Using Chalk-Board Demonstration
3	TLO 3.1 Distinguish between canned cycle and Sub routine call. TLO 3.2 Develop part program of canned cycle for the given job. TLO 3.3 Develop part program of Subroutine call for the given job.	**Unit - III Canned & sub-routine call programming** 3.1 Concept: Canned cycle and subroutine call. 3.2 Canned cycle: Multiple repetitive cycle on CNC lathe, Multiple repetitive cycle for pocket or slot on CNC milling, respective G & M codes, procedure to write canned cycle program. 3.3 Sub-routine call: its concept, respective G & M code, procedure to write Sub-routine call program on CNC lathe and milling.	Lecture Using Chalk-Board Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Distinguish between CAD and CAM. TLO 4.2 Prepare 3D model by using CAD software. TLO 4.3 Import and set CAD model in CAM software for simulation. TLO 4.4 Interface CAD/CAM software with CNC machines.	**Unit - IV Interface CNC machines** 4.1 Concept: CAD-CAM and software's. 4.2 CAD modelling: Create simple 3D model of turning and milling components 4.3 CAM: Procedure to set the 3D model for machining in CAM software. 4.4 CNC Interface: Procedure to machining of component by interfacing with CNC machine.	Lecture Using Chalk-Board Demonstration Demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare manual part program of linear and circular interpolation function for the given turning job and simulate it by using simulation software. LLO 1.2 Write manual part program of linear and circular interpolation function on CNC lathe for the given job.	1	*Manual part program of linear and circular interpolation function on CNC lathe.	2	CO1
LLO 2.1 Check CNC machine and machine setting before start the operation. LLO 2.2 Identify axis and its nomenclature for CNC lathe. LLO 2.3 Select appropriate cutting tool and their presetting and offsetting parameters.	2	Setting and pre- preparations of CNC lathe machine for linear and circular interpolation function for the given job.	2	CO2
LLO 3.1 Perform loading and unloading of the given job on CNC lathe. LLO 3.2 Set the work zero co-ordinate for the given job. LLO 3.3 Measure the finished job using suitable measuring instrument.	3	*Perform linear and circular interpolation function on CNC lathe.	4	CO4
LLO 4.1 Prepare manual part program of linear and circular interpolation function for the given milling job and simulate it by using simulation software. LLO 4.2 Write manual part program of linear and circular interpolation function on CNC milling for the given job.	4	*Manual part program of linear and circular interpolation function on CNC Milling.	2	CO2
LLO 5.1 Check CNC machine and machine setting before start the operation. LLO 5.2 Identify axes and its nomenclature for CNC milling. LLO 5.3 Select appropriate cutting tool and their presetting and offsetting parameters.	5	Setting and pre- preparations of CNC milling machine for linear and circular interpolation function for the given job.	2	CO2
LLO 6.1 Perform loading and unloading of the given job on CNC milling. LLO 6.2 Set the work zero co-ordinate for the given job. LLO 6.3 Measure the finished job using suitable measuring instrument.	6	*Perform linear and circular interpolation function on CNC milling.	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Prepare manual part program of repetitive canned cycle the given turning job and simulate it by using simulation software. LLO 7.2 Write manual part program of repetitive canned cycle on CNC lathe for the given job.	7	Manual part program of multiple repetitive canned cycle on CNC lathe.	2	CO3
LLO 8.1 Check CNC machine and machine setting before start the operation. LLO 8.2 Identify axes and its nomenclature for CNC lathe. LLO 8.3 Select appropriate cutting tool and their presetting and offsetting parameters.	8	Setting and pre- preparations of CNC lathe for multiple repetitive canned cycle operation for the given job.	2	CO3
LLO 9.1 Perform loading and unloading of the given job on CNC lathe. LLO 9.2 Set the work zero co-ordinate for the given job. LLO 9.3 Measure the finished job using suitable measuring instrument.	9	*Perform of multiple repetitive canned cycle on CNC lathe.	4	CO4
LLO 10.1 Prepare manual part program of Pocket/Slotting operation by multiple repetitive canned cycle for the given milling job and simulate it by using simulation software. LLO 10.2 Write manual part program of multiple repetitive canned cycle on CNC milling for the given job.	10	*Manual part program of Pocket/Slotting operation by multiple repetitive canned cycle on CNC Milling.	2	CO3
LLO 11.1 Check CNC machine and machine setting before start the operation. LLO 11.2 Identify axis and its nomenclature for CNC milling. LLO 11.3 Select appropriate cutting tool and their presetting and offsetting parameters.	11	Setting and pre- preparations of CNC milling machine for Pocket/Slotting operation by multiple repetitive canned cycle for the given job.	2	CO3
LLO 12.1 Perform loading and unloading of the given job on CNC lathe. LLO 12.2 Set the work zero co-ordinate for the given job. LLO 12.3 Measure the finished job using suitable measuring instrument.	12	Perform Pocket/Slotting operation by multiple repetitive canned cycle on CNC milling.	4	CO4
LLO 13.1 Prepare manual part program of Pocket/Slotting operation by subroutine call CNC milling for the given milling job and simulate it by using simulation software LLO 13.2 Write manual part program of multiple repetitive canned cycle on CNC milling for the given job.	13	Manual part program of Pocket/Slotting operation by subroutine call on CNC Milling.	2	CO3
LLO 14.1 Perform loading and unloading of the given job on CNC milling. LLO 14.2 Set the work zero co-ordinate for the given job. LLO 14.3 Measure the finished job using suitable measuring instrument.	14	Perform Pocket/Slotting operation by subroutine call on CNC Milling.	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Prepare 3D model by using suitable modelling software for the given job. LLO 15.2 Simulate the machining for 3D model by CAD/CAM software.	15	*Simulation for machining of 3D model .	2	CO5
LLO 16.1 Interface the CAD/CAM software with CNC machine for the given job.	16	Interface CAD/CAM software with CNC machine.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	CNC Simulation software and control pads (CAMLAB CNC Software, MasterCAM/NXCAM/, DONC CNC machine simulator, PRO, SWANSOFT, CAPSMILL and CAPSTURN IN cam software, DONCMILL AND DONCTURN software), CutViewer Turn& Mill, Sinewave Turn& Mill or equivalent simulation software.	1,3,5,7,9,11,13,15
2	Windows 10 Home Intel Core i5 HDD Capacity 500 GB RAM 8 GB DDR3 18.5 inch Display, Dedicated Graphic Memory 512 MB, USB 1x3.0 Front 6 Back.	1,3,5,7,9,11,13,15
3	Any suitable CAD-CAM software's with basic feature.	15,16
4	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 along with essential accessories.	2,6,10
5	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 along with essential accessories	4,8,12,14

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of CNC programming	CO1	4	0	0	0	0
2	II	Linear & circular path programming	CO2,CO4	6	0	0	0	0
3	III	Canned & sub-routine call programming	CO3,CO4	6	0	0	0	0
4	IV	Interface CNC machines	CO5	4	0	0	0	0
Grand Total				**20**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Lab work, viva

Summative Assessment (Assessment of Learning)

- End semester practical examination.

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P. M. Agrawal And V. J. Patel	CNC Fundamentals and Programming	Charotar Publishing House Pvt. Limited.ISBN:9788185594989 ,Edition-2009
2	Pawan Negi, Mangey Ram, Om Prakash Yadav	Basics of CNC Programming	River Publishers.ISBN:9781000792911,Edition-2022
3	Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim	CNC Programming for Machining	Springer International Publishing.ISBN:9783030412791,Edition-2020
4	Binit Kumar Jha	CNC Programming Made Easy	Vikas Publishing House.ISBN: 9788125911807,Edition 2003
5	Ibrahim Zeid	CAD/CAM Theory and Practice	McGraw Hill Education.ISBN:0070151342,Edition 2009
6	Pabla B. S. & M. Adithan	CNC Machines	New Age International Private Limited.ISBN:978-9388818445,Edition-2023.
7	Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz	The CNC Handbook : Digital Manufacturing and Automation from CNC to Industry 4.0	Industrial Press.ISBN:0831136367 Edition:2022
8	Ken Evans	Student Workbook for Programming of CNC Machines	Industrial Press,ISBN: 0831136006, 4th Edition-2016

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=ih4Q8TJOI5I	How to create your first turning program in CNC Simulator
2	https://www.youtube.com/watch?v=m_FVE4Q59gU	CNC Milling Simulator

CNC PROGRAMMING **Course Code : 315010**

Sr.No	Link / Portal	Description
3	https://www.youtube.com/watch?v=_5r2XR1h1aQ	CNC programming
4	https://www.youtube.com/watch?v=PN_tGm5Gip4	CNC machines and Interpolation
5	https://www.youtube.com/watch?v=B7MM5M7DzpM	Introduction to CNC machines
6	https://www.youtube.com/watch?v=Gi42gKGiCl0	Introduction to CNC machines.
7	https://www.youtube.com/watch?v=YpQMUpWOgbE&t=2s	Programming a CNC Lathe to make a bush - part 1 G71 roughing cycle
8	https://www.youtube.com/watch?v=wYebU4JSkGQ	Step Turning With Simulation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ PG/ SE/ TE**
Semester	**: Fifth**
Course Title	**: INTERNSHIP(12 WEEKS)**
Course Code	**: 315004**

I. RATIONALE

Globalization has prompted organizations to encourage skilled and innovative workforce. Internships are educational and career development opportunities, providing practical/ hands-on experience in a field or discipline. Summer internship is an opportunity for students to get accustomed to modern industry practices, apply the knowledge and skills they've acquired in the classroom to real-world situations and become familiar with industry environments before they enter the professional world. Keeping this in mind, industrial training is incorporated to all diploma programmes as it enables the student to get equipped with practical skills, soft skills and life skills

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Apply skills and practices to industrial processes.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Observe time/resource management and industrial safety aspects.
- CO2 - Acquire professional experience of industry environment .
- CO3 - Establish effective communication in working environment.
- CO4 - Prepare report of assigned activities and accomplishments.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315004	INTERNSHIP(12 WEEKS)	ITR	INP	-	-	-	-	36 - 40	10	-	-	-	-	-	100	40	100#	40	-	-	200

Legends: # External Assessment
Note: Credits for Industrial Training are in-line of guidelines of NCrF : The industrial training is of 12 weeks considering 36-40 hours per week engagement of students (as per Guidlines of GR of Maharashtra Govt.) under Self Learning with guidance of industry supervisor / Mentor

V General guidelines for organizing Industrial training

The Industry/organization selected for Industrial training/ internships shall be Government/Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

1. Duration of Training - 12 weeks students engagement time
2. Period of Time slot - Between 4th and 5th semester (12 weeks) i.e. commencement of internships will be immediately following the 4th semester exams.
3. Industry area - Engineering Programme Allied industries of large, medium or small-scale, Organization/Govt./ Semi Govt Sectors.

VI Role(s) of Department at the Institute:

Following activities are expected to be performed by the concerned department at the Polytechnics.

Table of activities to be completed for Internship

S.No	Activity	Suggested Schedule WEEKS
1	Collection of information about industry available and ready for extending training with its offered capacity of students (**Sample Format 1**)	1st to 3rd week of 4th Semester
2	Allocations of Student and Mentor as per availability (Mentor: Student Ratio (1:15)	4th to 6th week of 4th semester
3	Communication with Industry and obtaining its confirmation Sample letter Format	6th to 8th week of 4th semester
4	Securing consent letter from parents/guardians of students (Sample Format 2)	Before 10th week of 4th semester
5	Enrollment of Students for industrial training (Format 3)	Before 12th week of 4rd semester
6	Issue of letter to industry for training along with details of students and mentor (Format 4)	Before 14th week of 4th Semester
7	Organize Internship Orientation session for students	Before end of 4th Semester
8	Progressive Assessment of industry training by Mentor	Each week during training period
9	Assessment of training by institutional mentor and Industry mentor	5th Semester ESE

Suggestions-

1. Department can take help of alumina or parents of students having contact in different industries for securing placement.

2. Students would normally be placed as per their choices, in case of more demand for a particular industry, students would be allocated considering their potentials. However preference for placement would be given to students who have arranged placement in company with the help of their parents or relatives.

3. Principal/HOD/Faculty should address students about industrial safety norms, rules and discipline to be maintained in the industry during training before relieving students for training.

4. The faculty members during the visit to industry or sometimes through online mode will check the progress of the student in the training, student attendance, discipline, and project report preparation each week.

VII Roles and Responsibilities of students:

1. Students may interact with the mentor to suggest choices for suitable industry, if any. If students have any contact in industry through their parents or relatives then the same may be utilized for securing placement for themselves and their peers.

2. Students have to fill the forms/formats duly signed by institutional authorities along with a training letter and submit it to a training officer/mentor in the industry on the first day of training.

3. Students must carry with him/her Identity card issued by the institute during the training period.

4. Students should follow industrial dressing protocols, if any. In absence of specific protocol students must wear college uniform compulsorily.

5. Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures.

6. Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken .

7. Students must maintain a weekly diary (**Format 6**) by noting daily activities undertaken and get it duly signed from industry mentor or Industrial training in charge.

8. In case students face any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to the mentor at the institute.

9. Prepare a final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from a mentor as well as industry training in charge.

10. Students must submit the undertaking as provided in **Format 5**.

VIII Typographical guidelines for Industry Training report

Following is the suggestive format for preparing the training report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following

1. The training report shall be computer typed (English- British) and printed on A4 size paper.

2. Text Font -Times New Roman (TNR), Size-12 point

3. Subsection heading TNR- 12 point bold normal

4. Section heading TNR- 12 capital bold

5. Chapter Name/ Topic Name – TNR- 14 Capital

6. All text should be justified. (Settings in the Paragraph)

7. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.

8. The training report must be hardbound/ Spiralbound with a cover page in black color. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover.

9. The training report, the title page should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

IX Suggestive format of industrial training report

Following format may be used for training report. Actual format may differ slightly depending upon the nature of Industry/ Organization.

- Title Page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1	Organization structure of Industry and general layout.
Chapter 2	Introduction to Industry / Organization (history, type of products and services, turn over and number of employees etc.)
Chapter 3	Types of Major Equipments/raw materials/ instruments/machines/ hardware/software used in industry with their specifications, approximate cost, specific use and routine maintenance done
Chapter 4	Processes/ Manufacturing Manufacturing techniques and methodologies and material handling procedures
Chapter 5	Testing of Hardware/Software/ Raw materials/ Major material handling product (lifts, cranes, slings, pulleys, jacks, conveyor belts etc.) and material handling procedures.
Chapter 6	Safety procedures followed and safety gears used by industry.
Chapter 7	Particulars of Practical Experiences in Industry/Organization if any in Production/Assembly/Testing/Maintenance
Chapter 8	Detailed report of the tasks undertaken (during the training).
Chapter 9	Special/challenging experiences encountered during training if any (may include students liking & disliking of workplaces).
Chapter 10	Conclusion
Chapter 11	References / sources of information

X Suggested learning strategies during training at Industry

- Students should visit the website of the industry where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover etc.
- They should also refer to the handbook of the major machines and operations, testing, quality control and testing manuals.
- Students may also visit websites related to other industries wherein similar products are being manufactured.

XI Tentative week wise schedule of Industry Training

Industrial training is a common course to all Diploma programmes , therefore the industry selection will depend upon the nature of the programme and its related industry. The training activity may vary according to nature and size of industry.

The following table details of activities to be completed during industrial training.

Details of Activities to be completed during Industry training
Introduction of Industry and departments.
Study of Layout of Industry, Specifications of Machines , raw materials, components available in the industry

Study of setup and manufacturing processes
Execute given project or work assigned to the students, study of safety and maintenance procedures
Validation from industry mentor regarding project or work allocated
Report writing

XII CO-PO Mapping Table to be created by respective Department/faculty.

XIII. Formative Assessment of training : Suggested RUBRIC
(Note : Allot the marks in proportion of presentations and outcome observed. Marks excluding component of week 11 are to be filled by Institute mentor)

Week No	Task to be assessed	Outcome Achievement - Poor	Outcome Achievement - Moderate	Outcome Achievement - High		Week-wise total Marks
		Poor Marks	Average Marks	Good Marks	Excellent Marks	
1	Introduction of Industry	Minimal Knowledge of Departments, processes, products and work culture of the company **(Marks –1)**	Moderate Knowledge of Departments, processes, products and work culture of the company **(Marks –2)**	Good Knowledge of Departments, processes, products and work culture of the company **(Marks –3/4)**	Extensive Knowledge of Departments, processes, products and work culture of the company **(Marks –5)**	
2	Presentation of Layout of Industry, Specifications of Machines, raw materials, components available in the industry	Minimal w.r.t. tasks **(Marks –1)**	Moderate w.r.t. tasks **(Marks –2)**	Good w.r.t. tasks **(Marks –3/4)**	Extensive w.r.t. tasks **(Marks –5)**	
3	Participation in setup and manufacturing processes/platforms	Minimal Participation with poor understanding **(Marks –1-8)**	Moderate Participation with poor understanding **(Marks –9-12)**	Good Participation with poor understanding **(Marks –13-17)**	Extensive Participation with poor understanding **(Marks –18-20)**	
4 to 10	Execution of given project or work to the students, Follow of safety and maintenance procedures	Minimal Participation with poor understanding **(Marks –1-8)**	Moderate Participation with lower level understanding **(Marks – 9-12)**	Good Participation with Good understanding **(Marks – 13-17)**	Extensive Participation with excellent understanding **(Marks – 18-20)**	
11	Validation by industry mentor regarding project or work allocated	Minimal Participation with poor performance **(Marks –1-10)**	Moderate Participation with acceptable performance **(Marks – 11-15)**	Good Participation with Good performance **(Marks – 16-20)**	Extensive Participation with excellent performance **(Marks – 21-25)**	

12	Diary writing	• Results are not Presented properly, • Project work is summarized and concluded not acceptable • Future extensions are not specified **(Marks –1-10)**	• Results are Presented just casually • Project work is summarized and concluded casually • Future extensions are casually specified **(Marks –11-15)**	• Results are Presented well and properly, • Project work is summarized and concluded to a Good level • Future extensions are well specified **(Marks –16-20)**	• Results are Presented exhaustively • Project work is summarized and elaborated in excellent manner , concluded • Future extensions are excellently specified **(Marks –21-25)**	
Total Out of :100						

Marks for (FA) are to be awarded for each week considering the level of completeness of activity observed as per table specified in Sr.No. XIII above, from the daily diary maintained . Feedback from industry supervisor shall also be considered.

XIV Summative Assessment (SA) of training:

Academic year : 20 -20

i) Suggested RUBRIC for SA

	Observations from Orals				**Presentations**				**Total (100)**
Enrollment Number	Tasks undertaken (20)	Overall Understanding (20)	Creativity /Innovation demonstrated (10)	Knowledge acquired (10)	Speech Clarity (10)	Body Language (10)	Presentations (10)	Diary , Report writing and / Product (10)	

Name of mentor:
Signature of Mentor

XV FORMATS

Format-1: Collecting Information about Industry/Organization available for training along with capacity

1) Name of the industry/organization:
2) Address/communication details with email :
3) Contact person details:
   a) Name:
   b) Designation:
   c) Email
   d) Contact number/s:

4) Type:

   Govt / PSU / Pvt /

   Large scale / Medium scale / Small scale …..

5) Products/services offered by industry:

6) a) Whether willing to offer Industrial training facility during May/ June for Diploma in Engineering students: **Yes / No.**
   b) If yes, whether you offer 12 weeks training: **Yes/No**
   c) Possible Industrial Capacity:

Students	Programme name/ Title					Total
	Civil	Mechanical	Chemical			
Male						
Female						
Total						

7) Whether accommodation available for interns **Yes / No.**
If yes capacity:_____

8) Whether internship is charged or free:
If charged please specify amount per candidate: _____

Signature of responsible person at Industry:

Format-2: Obtaining Consent Letter from parents/guardians

(Undertaking from Parents)

To,

The Principal,
_____,

Subject: Consent for Industrial Training.
Sir/Madam,

I am fully aware that -
i) My ward studying in _____ semester at your _____ institute has to undergo 12 weeks of Industrial training for partial fulfillment towards completion of Diploma in _____ Engineering.
ii) For this fulfillment he/she has been deputed at_____ industry, located at _____ for Industrial training /internship for the period from _____ to _____ .
With respect to above I give my full consent for my ward to travel to and from the mentioned industry. Further I undertake that –
a) My ward will undergo the training at his/her own cost and risk during training and/or stay.
b) My ward will be entirely under the discipline of the organization where he/she will be placed and will abide by the rules and regulations in face of the said organization.
c) My ward is NOT entitled to any leave during the training period.
d) My ward will regularly submit a prescribed weekly diary, duly filled and countersigned by the training supervisor of the organization to the mentor faculty of the polytechnic.

I have explained the contents of the letter to my ward, who has also promised to adhere strictly to the requirements. I assure that my ward will be properly instructed to take his own care to avoid any accidents/injuries in the industry. In case of any accident neither industry nor the institute will be held responsible.

Signature :
Name : _____
Address : _____

Phone Number :

Format-3: Students Enrollment for Industrial Training

(Academic Year –)

Sr No	Enrollment Number	Name of Student	Name of Industry	Name of Mentor at Institute

Format-4: Issue Letter to the Industry/Organization for the training along with details of students and mentors

To,

The HR Manager,

_____

Subject: Placement for Industrial training of ___ weeks in your organization….

Reference: Your consent letter no: ….

Sir,

With reference to the above we are honored to place the following students from this institute for Industrial training in your esteemed organization as per the arrangement arrived at.

The purpose of this training is to equip the student with some essential skills relevant to the demands of the industry and world of work, as well as to provide exposure to the professional environment and work culture. It is hoped that this training may enhance his/her employability and livelihood opportunities. In view of the above, we kindly request your support in facilitating this Industrial Training for the student. He/she has been adequately oriented and guided on the expectations of this training, including the maintenance of a daily diary during the training period. Additionally, the institute has secured the necessary consent and undertaking from the parent/guardian regarding the guidelines for exit training. In view of all the above industry shall refrain from involving students into the mundane and housekeeping activities. Your cooperation in this regard will be highly appreciated.

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and designation of Mentor

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and Designation of Mentor

Kindly extend all possible cooperation to the students for above.

Thanking you

Yours sincerely,

(Principal)
Name of the Institute:
with Seal

Cc- To HoD/Mentor

Format-5: Undertaking by the students

TO

Principal

Subject: Undertaking regarding Placement for Industrial training of 12/16/18 weeks duration

I …….Reg No:…….. S/o/D/o. ……Studying in ---------- ---------- at ---------- Institute at ----------fully aware of the Industrial Training requirement and related responsibilities and participation in the ……, Industrial training between From: …… To……..

I assure you that I will be of good behavior and be obedient to the staff and mentor during the ……/Industrial training. I will also abide and will not participate in all activity. I will also discipline myself within the rules and regulations of the Institution. I am also aware that I am participating in the …….. at my own risk and I will not hold the ----------Institute responsible in any way in any eventuality namely Accident /Injury/death or whatever mishap and I myself will be solely responsible for my safety.

Place :Signature of the student

Date :Reg. No.

Format-6: Internships Daily Diary

Name of the Student: _____ Name of the mentor (Faculty) : _____

Enrollment Number: _____ Semester: _____ Academic Year _____

Week	Day & Date	Discussion Topics/Activity	Details of Work Allotted Till Next Session /Corrections Suggested/Faculty Remarks	Signature of Industry Mentor
Week 01	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
.	Mon, Date			
	Tue, Date			
.	Wed, Date			
	Thu, Date			
.	Fri, Date			
.	Sat, Date			
Week n	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			

PROCESS ENGINEERING **Course Code : 315366**

Programme Name/s : **Mechatronics/ Production Engineering**
Programme Code : **MK/ PG**
Semester : **Fifth**
Course Title : **PROCESS ENGINEERING**
Course Code : **315366**

I. RATIONALE

Process engineering is the intermediate stage between design and manufacturing of a component. This course focus on the planning, design, development, operations and control of manufacturing processes in an industry. A diploma engineer should understand basic concepts and apply advanced tools and techniques employed in the field of process engineering, so as to achieve the best possible planning and control in a manufacturing environment with continuous improvements.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Prepare process plan sheet for manufacturing of components.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Evaluate a product using various criteria.
- CO2 - Prepare bill of material for a given assembly.
- CO3 - Prepare process plan for a given engineering component.
- CO4 - Construct a part family using group technology.
- CO5 - Select relevant CAPP system for a given engineering component.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315366	PROCESS ENGINEERING	PEN	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

PROCESS ENGINEERING **Course Code : 315366**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe procedure of design for manufacturing and assembly. TLO 1.2 Analyze various criteria for the given product. TLO 1.3 Explain functions of process engineering department. TLO 1.4 Prepare organizational flow chart for the development of process plans.	**Unit - I Introduction to Product engineering and Process engineering** 1.1 Functions of product engineering department 1.2 Design for Manufacturing and Assembly (DFMA): Definition, Procedure, Guidelines 1.3 Criteria for product analysis (aesthetics, cost, environment, safety, function, material, ergonomics) 1.4 Functions of process engineering department 1.5 Organizational flow chart for development of process plans	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Analyze the given assembly using dimensional tolerance stack up methods. TLO 2.2 Select relevant surface finish roughness grade for the given operation. TLO 2.3 Explain bill of materials. TLO 2.4 Select appropriate inspection method for the given component.	**Unit - II Interpretation of part drawing** 2.1 Dimensional tolerance: Tolerance Stack up analysis (Worst case scenario analysis, Statistical analysis), ISO 2768-1: General tolerances values 2.2 Surface Finish: Three elements of surface finish, Surface finish symbols, Roughness grade numbers and it's finish marks 2.3 Bill of materials (BOM): Define, Importance of BOM, Types of BOM (Engineering BOM, Manufacturing BOM) 2.4 Inspection methods: Need of inspection methods, Types of inspection (based on timing, based on place, based on contact, based on number of samples inspected, based on application)	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Describe process planning procedure. TLO 3.2 Identify the factors affecting make or buy decision during process planning for the given component. TLO 3.3 Choose a specific process for manufacturing of the given component. TLO 3.4 Prepare process flow chart for manufacturing of the given component. TLO 3.5 Explain machine and tool selection procedure. TLO 3.6 Specify different manufacturing parameters for the preparation of operation sheet and route sheet.	**Unit - III Process planning** 3.1 Information required to do process planning 3.2 Process planning procedure: Make or Buy Design- factors affecting make or buy decision 3.3 Process selection procedure 3.4 Process analysis: Process flow chart 3.5 Machine and tool selection procedure 3.6 Process plan: Operation sheet and Route sheet	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit
4	TLO 4.1 Identify different applications of group technology. TLO 4.2 Differentiate between functional layout and group layout. TLO 4.3 Select various methods for construction of a part family for the set of similar components.	**Unit - IV Group Technology** 4.1 Introduction to Group technology, definitions and applications 4.2 Functional layout and group layout 4.3 Part family construction methods: Visual method, Production flow analysis 4.4 Basic requirement for part family coding system	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Draw framework of computer aided process planning. TLO 5.2 Compare types of CAPP systems for given set of criteria. TLO 5.3 Justify role of CAPP in implementation of CIM. TLO 5.4 Describe contribution of artificial intelligence in process planning.	**Unit - V Automation in process planning** 5.1 Framework of computer aided process planning 5.2 Types of CAPP: Generative type and Variant type 5.3 CAPP software systems available in market, programming language used in CAPP software systems 5.4 Contribution of CAPP to CIM 5.5 Artificial intelligence in process planning	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Measure dimensions of the given component. (e.g. Cotter key or Knuckle pin or square / hexagonal headed bolt/ nut) LLO 1.2 Create CAD model of the given component. (e.g. Cotter key or Knuckle pin or square / hexagonal headed bolt/ nut)	1	Measurement and CAD modelling of the given component.	2	CO1
LLO 2.1 Collect the given job from your institute workshop. LLO 2.2 Perform product analysis on the given job using various criteria.	2	* Analysis of the given job using various criteria.	2	CO1
LLO 3.1 List down different components of lathe machine tool post available in your institute workshop. LLO 3.2 Prepare Bill of material for the lathe machine tool post.	3	* Preparation of Bill of material for the given assembly.	2	CO2
LLO 4.1 Identify different standards for selection of dimensional tolerance values. LLO 4.2 Collect samples of industrial drawings of the components from nearest workshop. LLO 4.3 Prepare dimensional tolerance chart for the given industrial drawing using standard ISO 2768-1.	4	Preparation of dimensional tolerance chart for the given industrial drawing of component.	2	CO2
LLO 5.1 Collect samples of industrial drawings of the components from nearest workshop. LLO 5.2 Prepare operation sheet for the given component. LLO 5.3 Prepare route sheet for the given component.	5	* Preparation of operation sheet and route sheet for the given component.	2	CO3
LLO 6.1 Identify the job to be machined on lathe. LLO 6.2 Select manufacturing process parameters for the given job by using production technology handbook.	6	Selection of manufacturing process parameters by using production technology handbook.	2	CO3
LLO 7.1 Prepare process flow chart for manufacturing of the given component. (e.g. nut/bolt/knuckle pin/cotter key,etc)	7	Preparation of process flow chart for manufacturing of the given component.	2	CO3
LLO 8.1 Perform production flow analysis to create part family for the given set of similar components.	8	* Design part family using group technology methods.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Prepare machining parameters table for the given component using CAPP software. (speed, feed, depth of cut, machining time,etc)	9	* Prepare a machining parameters table using CAPP software	2	CO5
LLO 10.1 Generate a process plan sheet for the given component using CAPP software.	10	Generation of a process plan sheet using CAPP software.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Measuring Instruments: - Digital Vernier Caliper (Resolution 0.1 mm, Measuring Range 0-150 mm), Screw pitch gauge(52 Leaves , Narrow design, 4 to 62 TPI, 0.25 to 6.0 mm thread), Profile projector(Light axis: Vertical, Workstage size: 410 x 310 mm, Measuring range: 100 x 100 mm)	1
2	2D CAD software	1
3	Sample industrial assembly and part drawings	2,3,4,5
4	Process plan CAPP software	9,10

IX. SUGGESTED 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	Introduction to Product engineering and Process engineering	CO1	6	4	4	4	12
2	II	Interpretation of part drawing	CO2	8	4	4	6	14
3	III	Process planning	CO3	12	4	6	8	18
4	IV	Group Technology	CO4	6	2	4	6	12
5	V	Automation in process planning	CO5	8	4	4	6	14
Grand Total				**40**	**18**	**22**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks and average of two-unit tests.
- For laboratory learning 25 Marks.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.
- End semester assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Khanna O.P.	Industrial Engineering and Management	Dhanpat Rai Publications New Delhi (2018) ISBN-13:9788189928353
2	Samuel Eilon	Production Planning and Control	Collier Macmillan Ltd New Delhi (2015) ISBN-13: 9780023318009
3	Scallan Peter	Process Planning: The Design/Manufacture Interface	Butterworth-Heinemann (2003) ISBN-13: 9780750651295
4	Stephen N. Chapman	Fundamentals of Production Planning and Control	Pearson Education (2007) ISBN-13:9788131717394
5	Hwaiyu Geng	Manufacturing Engineering Handbook	McGraw-Hill Education (2016) ISBN-13:9780071839778

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/110/105/110105155/	Automation In Production Systems and Management SWAYAM NPTEL course
2	https://archive.nptel.ac.in/courses/112/107/112107238/	Operations Management SWAYAM NPTEL course
3	https://www.youtube.com/watch?v=20_K7c65Swg	Computer aided process planning-SWAYAM NPTEL
4	https://egyankosh.ac.in/bitstream/123456789/27107/1/Unit-9.pdf	Computer aided process planning- PDF IGNOU
5	https://egyankosh.ac.in/bitstream/123456789/27217/1/Unit-1.pdf	Process planning- PDF IGNOU
6	https://egyankosh.ac.in/bitstream/123456789/27220/1/Unit-4.pdf	CAPP techniques-PDF IGNOU

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

PRODUCT DESIGN AND DEVELOPMENT **Course Code : 315367**

Programme Name/s : **Mechanical Engineering/ Mechatronics/ Production Engineering**
Programme Code : **ME/ MK/ PG**
Semester : **Fifth**
Course Title : **PRODUCT DESIGN AND DEVELOPMENT**
Course Code : **315367**

I. RATIONALE

Design and development are two key elements necessary to create any product. From start to finish, each phase of the product's lifecycle needs careful coordination between these two disciplines for a successful outcome.Each organization should come with innovative ideas to bring up a new product, to maintain a top position in the market. Product design and development is a complete cycle to launch of new industrial products i.e from conceptualization to product realization.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use principles of product design and development for launching new products in the market.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply principles to develop new small industrial products according to customer's requirement for launching.
- CO2 - Use aesthetics and ergonomics principles for developing new products
- CO3 - Apply DFM principles for development of new product
- CO4 - Apply principles of QFD for Quality of new product
- CO5 - Use relevant rapid prototyping methods for development of new product along-with IPR process.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315367	PRODUCT DESIGN AND DEVELOPMENT	PDD	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the criteria of customer's need identification for designing new product. TLO 1.2 Explain principles of product design TLO 1.3 Explain product development process. TLO 1.4 State concept of product development TLO 1.5 Explain Seven step method for testing of product concept with example TLO 1.6 Explain process of implementing customer need for designing new product	**Unit - I Product Development** 1.1 Characteristics of successful product development, Customer need identification 1.2 Definition of product design, principles of good product design, Design by evolution, design by innovation 1.3 Product development process, Phases of process development. flow chart of product development. Tyco product development process 1.4 Concept development- different phases of concept development process, five step concept generation method, Concept classification tree, Concept combination table 1.5 Concept selection- Concept screening, Concept scoring, Seven step method for testing of product concept 1.6 Identification of customer need, Data collection from customer, organize collected data, Establishing relative importance of customer need for designing product with example	Lecture using media Lecture using Chalk-Board
2	TLO 2.1 Define product architecture TLO 2.2 Classify Modularity TLO 2.3 List different design considerations for machine controls using ergonomics principle. TLO 2.4 Apply relevant aesthetics and ergonomics principles in given situation. . TLO 2.5 List different aspects of aesthetics in product design	**Unit - II Product Architecture** 2.1 Definition of product architecture, Modular and Integral product architecture, its types, Component standardization, Steps for establishing the architecture with example like trailer, Spanners etc 2.2 Ergonomics- definition, necessity of ergonomics in product design. Design consideration for qualitative and quantitative display, Design considerations for controls like knob, levers, handwheel, toggle switch. 2.3 Aesthetics Principles- definition, necessity of aesthetics in product design, consideration of aesthetics in product design, Aspects of Aesthetics in Product Design - form, symmetry, color, continuity, proportion, contrast, impression, surface finish	Lecture using media Model Demonstration
3	TLO 3.1 State importance of Industrial design TLO 3.2 Explain term Design For Manufacturability (DFM) TLO 3.3 State necessity of Product Life Cycle TLO 3.4 Explain the procedure to determine 'Product Life Cycle' for given product.	**Unit - III Industrial Design** 3.1 Importance of industrial design, Industrial design process 3.2 Design for manufacturability (DFM), steps for DFM, design principles for manufacturability , Factors affect on DFM,.Impact of DFM on cost, quality and Time 3.3 Product Life Cycle- definition, importance, stages of Product life cycle, examples for determining product life cycle of Motorcycle, electrical vehicle etc	Lecture Using Chalk-Board Lecture ueing media

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain term Value engineering TLO 4.2 State procedure of Problem identification related to value engineering. TLO 4.3 State importance of QFD TLO 4.4 Explain QFD with suitable example. TLO 4.5 Draw House of Quality relationship Matrix for given product.	**Unit - IV Value Engineering** 4.1 Concept, Steps in value engineering, creative thinking, problem identification and value engineering job plan (VEJP). 4.2 Quality Function deployment (QFD) process-need, importance with example, symbols of QFD, voice of customer (VOC),VOC analysis, Quality QFD relationship matrix, roof ranking, Body ranking , importance of QFD 4.3 House of Quality linking customer complaints to technical requirements	Lecture Using Chalk-Board Case Study
5	TLO 5.1 List different types of Rapid prototyping TLO 5.2 Explain working and constructions of 3-D printer. TLO 5.3 Differentiate FDM and SLA 3 - D printer TLO 5.4 Overview of Patents and IPR (Intellectual Property Right) - Importance of patent, patent rights, criteria for patent, process for filing patents. TLO 5.5 Elaborate the benefits of Patent and IPR TLO 5.6 Explain procedure for filing patent.	**Unit - V Rapid Prototyping and Patent Filing** 5.1 Rapid Prototyping- concepts, principles of rapid prototyping, Types of Rapid Prototyping- Proof of concept prototype, Looks like prototype, Works like prototype 5.2 3-D printer types – Fused deposition Modeling (FDM), Stereolithography (SLA), Selective Laser sintering (SLS), construction and working-. Comparison between different types of 3-D printer 5.3 Planning for prototyping-steps for planning for prototyping, define purpose, establish level of approximation, experimental plan, schedule for procurement, production and testing 5.4 Patents and intellectual property- Importance of patent, patent rights, criteria for patent, process for filing patents.	Lecture using Chalk-Board Video Demonstrations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw layout of Simple product evolution diagram	1	*Layout of simple product evolution diagram	2	CO1
LLO 2.1 Draw diagram of existing bench available in the classroom. LLO 2.2 Apply ergonomics principle to classroom bench LLO 2.3 Draw diagram of modified / developed bench using ergonomic principle.	2	*Development of existing Classroom bench/Chair/Drawing table/Laboratory table using relavant ergonomics principles.	4	CO2
LLO 3.1 Draw sketch of any component available in the laboratory LLO 3.2 Apply aesthetic principles to the development of a given product. LLO 3.3 Draw sketch of modified product	3	Development of product using aspects of aesthetics in product designing	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Select any simple product from Market LLO 4.2 Apply DFM principle for development of identified product as per requirement LLO 4.3 Write a report of identified product using DFM	4	Draw flow chart for accepting design of new product using DFM principle	2	CO3
LLO 5.1 Collect specification of bicycle using manufacturer's catalogue. LLO 5.2 Determine product life cycle of identified bicycle LLO 5.3 Draw product life cycle diagram of identified bicycle	5	*Determination of product life cycle of Bicycle	2	CO2 CO3
LLO 6.1 Draw Roof and Body of House of Quality. LLO 6.2 Prepare questionnaire for customers/users to know technical requirements. LLO 6.3 Apply principles of QFD for drawing House of Quality. LLO 6.4 Draw House of Quality diagram for given product	6	*Build House of Quality for steel cupboard / computer bench/ furniture available in the laboratory	4	CO1 CO4
LLO 7.1 Draw diagram of developed product LLO 7.2 Produce prototype of developed product	7	Development of prototype of any simple object using cardboard/plywood etc	2	CO1 CO2 CO5
LLO 8.1 Draw flow chart for filing a patent using Governemnt website	8	* Draw flow chart for filing patent (IPR act 2005)for given product usiing Government of India website.	2	CO5
LLO 9.1 Develop model using solid modeling software	9	Use of 3-D printer	4	CO1 CO5
LLO 10.1 Draw diagram of identified product LLO 10.2 Produce prototype of identified product	10	Development of prototype of any identified product from the market	2	CO1 CO2 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

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

Activity based on voice of customer

- Prepare a brief report based on voice of customer through survey

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	3 D printer (FDM)- size- 200x200x250 mm, layer resolution 0.08 mmto 0.4 mm,print speed 40-120 mm/sec,Nozzle size 0.4mm,Filament- ABS/PLA/Composit	12,13
2	Computer systems and peripherials-2GB RAM,CPU1GHz,Disk Space-1.2 GB for 64 bit platform,OS ,minimum .single core ,Graphic card, sound card	All
3	Solid Modeling software such as Creo,Solid Edge, Solid works or equivalent	All

IX. SUGGESTED 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	Product Development	CO1	9	4	4	8	16
2	II	Product Architecture	CO2	6	2	4	6	12
3	III	Industrial Design	CO3	9	4	4	8	16
4	IV	Value Engineering	CO4	10	4	4	8	16
5	V	Rapid Prototyping and Patent Filing	CO5	6	2	2	6	10
Grand Total				**40**	**16**	**18**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Mid term tests Rubrics for COs Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of Learning)

- End of Term Examination Viva-voce Lab. performance

XI. SUGGESTED COS - POS MATRIX FORM

PRODUCT DESIGN AND DEVELOPMENT **Course Code : 315367**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K.T.Ulrich	Product Design and Development	6th edition, McGrawhill Publication, 2023 ISBN 9780071086950
2	A.K.Chitale, R.C.Gupta	Product Design and Manufacturing	7th edition, PHI publication 2023, ISBN-13-978-9391818722
3	Richard Morris	Fundamentals of Product Design	2nd edition,2023, Bloomsbury Visual Arts Publication, ISBN 13- 978-1350398856
4	M.M.Soreas	Ergonomics in Design	1st edition,2016 CRC Press Publication, ISBN13- 978-0367356903

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on product design steps and analysis
2	https://www.youtube.com/watch?v=mqC4Wn_OK-I	Value engineering
3	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Ergonomics for Product Design
4	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on QFD
5	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Functional Analysis Technique
6	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Rapid Prototyping
7	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Rapid Prototyping Processes
8	https://www.youtube.com/watch?v=dYPW5Rlwn8g	Working of 3 D printer
9	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on product life cycle
10	https://www.youtube.com/watch?v=X1KONQw02H8	Quality of House
11	https://www.youtube.com/watch?v=Lo-AFCv2ggE	Product design and development
12	https://onlinecourses.nptel.ac.in/noc21_me83/preview	NPTEL lecture on product design and development
13	https://www.youtube.com/watch?v=iRMsd-X_e-0	QFD Analysis
14	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on VEJP
15	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on Value engineering Concepts

PRODUCT DESIGN AND DEVELOPMENT **Course Code : 315367**

Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MATERIAL HANDLING SYSTEMS **Course Code : 315370**

Programme Name/s : Production Engineering
Programme Code : PG
Semester : Fifth
Course Title : MATERIAL HANDLING SYSTEMS
Course Code : 315370

I. RATIONALE

Study of material handling systems is the crucial need for optimizing operational efficiency, reducing costs, ensuring workplace safety, and enhancing logistical and manufacturing processes through systematic management of material flow and storage. This course will give insights to diploma production engineer for selection and use of appropriate material handling system in various industries.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Select efficient material handling systems to optimize logistics, minimize costs, and ensure safe and effective movement of goods.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop plant layout for minimum material handling.
- CO2 - Select relevant material handling and lifting equipment.
- CO3 - Select relevant hoisting machinery and equipment.
- CO4 - Select relevant conveyer system.
- CO5 - Select relevant advance material handling system.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				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	
315370	MATERIAL HANDLING SYSTEMS	MHS	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 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, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Apply principles of material handling equipment in the given situation. TLO 1.2 Draw plant layout for minimum material handling for the given application. TLO 1.3 Explain different factors of engineering and economic for material handling equipment selection. TLO 1.4 Compare different material handling equipment. TLO 1.5 Maintenance of the given material handling equipment.	**Unit - I Introduction to material handling** 1.1 Introduction of material handling equipment (MHE), Functions and Principles of material handling. 1.2 Relationship to plant layouts (Product layout, Process layout) 1.3 Engineering and economic factors for selection of Material Handling Equipment 1.4 Maintenance procedure of MHE 1.5 Classification according to applications of MHE	Lecture using chalk-board PPT presentations Video Demonstrations
2	TLO 2.1 Select the components of material lifting systems for the given application with justification. TLO 2.2 Explain lifting and rigging load handling attachments. TLO 2.3 Explain working of different types of lifters.	**Unit - II Materials lifting equipment** 2.1 Components of material lifting equipment: Flexible hoisting appliances such as welded chains, roller chains, hemp ropes, and steel wire ropes, fastening methods of wire and chains as per IS code 12735 (1994) (Westerman table) 2.2 Attachments: Lifting tackles, lifting and rigging load handling attachments, Various types of hooks-forged, eye bolts, eye hook, electric lifting magnet, vacuum lifter, grabbing attachment for loose materials, crane attachment for handling liquids/ molten metal, fork lift.	Lecture Using Chalk-Board PPT presentations Video Demonstrations Site/Industry Visit
3	TLO 3.1 Explain the Working and operation of different types of hoist. TLO 3.2 Explain the Working and operation of different types of crane. TLO 3.3 Explain the Working and operation of different types of lift. TLO 3.4 Select relevant hoist for the given application with justification. TLO 3.5 Select relevant crane for the given application with justification.	**Unit - III Hoisting machinery and equipment** 3.1 Working of Hoisting machinery and equipment: Working of different type of hoists such as lever operated hoist, differential hoist, electric and pneumatic hoists. 3.2 Working of different types of Cranes and Industrial Lifts: Working of rotary cranes, trackless cranes, bridge cranes, cable cranes, Introduction to types of Industrial Lifts and hydraulic Jack.	Lecture Using Chalk-Board PPT presentations Video Demonstrations Demonstrations model Site/Industry Visit

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain different types of conveyor. TLO 4.2 Explain working and operation of surface transport equipment. TLO 4.3 Select relevant conveyor system for the given situation with justification. TLO 4.4 Select surface transport equipment for the given situation with justification.	**Unit - IV Conveying machinery** 4.1 Working of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators; Working of traction less type conveyors such as gravity type conveyors, screw conveyors hoppers, gates and feeders. 4.2 Surface transport equipment–working & functions of trackless equipment such as hand operated trucks, powered trucks, tractors, industrial trailers Function. 4.3 Wagon tipplers, stackers, reclaimers, their constructional details, pneumatic and hydraulic conveyors.	Lecture Using Chalk-Board PPT presentations Video Demonstrations Site/Industry Visit
5	TLO 5.1 Explain working and operation of AGV. TLO 5.2 Explain working and operation of ASRS. TLO 5.3 Explain the ergonomic consideration for selection of MHE. TLO 5.4 Select advance material handling equipment for the given situation with justifiction.	**Unit - V Advanced material handling equipment** 5.1 Special Material Handling Equipment: Working and benefits of AGV (Automated Guided vehicle), Automated storage and retrieval system (ASRS); selection criteria 5.2 Ergonomic considerations	Lecture Using Chalk-Board PPT presentations Video Demonstrations Site/Industry Visit Flipped Classroom

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify different components of MHS. LLO 1.2 Ckeck the condition of chains, ropes and hooks. LLO 1.3 Detect faults in chains, ropes and hooks.	1	*Maintenance of chains, ropes, and hooks	2	CO2
LLO 2.1 Identify different types of lifting components. LLO 2.2 Operate different lifting machine components and attachments. LLO 2.3 Analyse material handling equipment for workshop.	2	Safety of lifting machine	2	CO2
LLO 3.1 Dismantle crane using proper tools. LLO 3.2 Assemble crane using proper tools. LLO 3.3 Calculate working load carrying capacity.	3	Dismantle and assemble of Cranes	2	CO3
LLO 4.1 Operate different types of hoists LLO 4.2 Operate different types of cranes LLO 4.3 Operate different types of lifts	4	*Operate hoisting machine and equipment	2	CO3
LLO 5.1 Dismantle hydraulic jack. LLO 5.2 Assemble hydraulic jack. LLO 5.3 Calculate working height and load carrying capacity.	5	*Dismantle and assemble of hydraulic Jack (hydraulic lift)	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Check relationship between driver and driven shaft of the given belt conveyor system. LLO 6.2 Calculate slack of the given belt conveyor system. LLO 6.3 Calculate speed of the driver and driven shaft for the given belt conveyor system; also calculate power transmission capacity.	6	Belt conveyors system	2	CO4
LLO 7.1 Dismantle a chain conveyor. LLO 7.2 Assemble chain conveyor.	7	*Dismantle and assemble of chain conveyor	2	CO4
LLO 8.1 Dismantle a gravity type conveyor. LLO 8.2 Assemble a gravity type conveyor.	8	Dismantle and assemble of gravity type conveyor	2	CO4
LLO 9.1 Identify various parts of the AGV/ASRS. LLO 9.2 Operate AGV/ASRS LLO 9.3 Program AGV/ASRS for the given application.	9	*Programming of AGV/ASRS	2	CO5
LLO 10.1 Calculate the dimensions like height of base for keeping the box of material for unloading and loading to cleaning the applied oil of door inner panels in stores.	10	Ergonomic considerations of material handling system	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Model of Chains (1.5 meter load carrying capacity 500 kg), Ropes (10-20 mm 1000 mm/reel Elevator Rope) and Hooks (150 kg Load Bearing Stainless Steel Rotatable Fork Hoist Chain Lifting Hook)	1,4
2	Working model of hydraulic lift (height 1 meter, 50 kg load), Pneumatic lift (height 30cm, 50 kg load), Hydraulic jack(Height 10cm, 2 Ton load)	2,4,5
3	Crane components (hoist lifting capacity 100 kg)	3,4
4	Working model of belt conveyors (length 1.5 meter and velocity 20-50 mm/sec for transporting small objects)	6,7,8
5	Working model of chain conveyor (length 1.5 Meter, Load 20 kg) for transporting small objects	6,7,8
6	Automatic Guided Vehicle With Conveyors (Lifting Capacity: 25 kg to 2000 kg, Loading And Unloading : Automated, Automation Grade : Automatic)	9
7	Automated Storage Retrieval System for laboratory	9

IX. SUGGESTED 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	Introduction to material handling	CO1	10	4	4	8	16
2	II	Materials lifting equipment	CO2	8	4	4	6	14
3	III	Hoisting machinery and equipment	CO3	8	4	4	6	14

MATERIAL HANDLING SYSTEMS **Course Code : 315370**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
4	IV	Conveying machinery	CO4	8	4	4	6	14
5	V	Advanced material handling equipment	CO5	6	2	4	6	12
Grand Total				**40**	**18**	**20**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks and average of two-unit tests.
- For laboratory learning 25 Marks

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks.

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	N. Rundenko	Material Handling Equipment	Peace Publisher, Moscow ISBN-13 : 978-0714702858 (2007)
2	M. P. Alexandrow	Material Handling Equipment	MIR Publishers, Moscow ISBN-0714717452 (1981)
3	R.B. Chowdary & G.N.R.Tagore	Material Handling Equipment	Khanna Publishers, Delhi ISBN-978-81-7409-105-5 (1986)
4	Apple J. M.	Plant layout & Material Handling	John Wiley Publishers ISBN-13 : 978-0471071716 (1977)
5	Immer J. R.	Material Handling	McGraw Hill, New York ISBN-13 : 978-0070316775 (1953)
6	Dr. O. P. Khanna	Industrial Engineering and Management	Dhanpat Rai publications (P) Ltd. New Delhi ISBN-13 : 978-8189928353 (2004)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/Up1oSSJn6oM?si=3J8eks-DjBfOxYZT	Material handling systems
2	https://youtu.be/NDTyxwU7rXs?si=kMcOuP37bZdV6Ufa	Material handling safety
3	https://youtu.be/PusvVnC_4Uc?si=w4uwpeOtdjSKKiYW	Material handling
4	https://youtu.be/1Oiu_vRPpnA	Cranes
5	https://youtu.be/tDK48Hpbxk0	Lifting tools & tackles safety
6	https://youtu.be/cocQN63hNMg	Lifting Tools & Tackles
7	https://youtu.be/WLZyfeTRUVs	Pneumatic Conveyer
8	https://youtu.be/pSspz70MoFA	Bucket Conveyer
9	https://youtu.be/H0PB2g0FdHE	Stackers, reclaimers

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students