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											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	
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

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

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 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
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

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