GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focusedOutcome-basedGreenCurriculum-2023(COGC-2023)
Semester-VI

Course Title: Production and Operation Management
(Course Code: 4362002)

Diploma program in which this course is offered	Semester in which offered
Mechatronics Engineering	6thSemester

1. RATIONALE

In today's era of globalization, productivity of organizations and quality of product are key indicators for growth of any nation. There is continuous demand from management to meet and improve set standards of production in terms of quality, quantity and productivity for competing not only domestic but also international market. It is necessary to implement and exploit principles of industrial engineering and management for optimum utilization of (6M) Men, Materials, Machines, Money, Methods and Management. Therefore, this course attempts to develop abilities in students to achieve higher productivity and better-quality tools/standards through constant endeavor in design and installation of integrated systems of 6M.

2. COMPETENCY

The course content should be taught and implemented to develop different skills so that students can acquire the following competencies.

- **To take the right decisions to optimize resources utilization by improving productivity of Men, Materials, Machines, Money, Methods and Management effectively.**
- **To eliminate unproductive activities under the control of the Management, Men and Design of Products and Processes.**

3. COURSEOUTCOMES(COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO-1	Acquire the necessary knowledge and experience in order to recognize the production management and planning problems.
CO-2	Analyze work content and calculate standard time in a given situation.
CO-3	Ability to analyse and select the most appropriate methods and tools for the solution of problems related to production planning, shop floor scheduling and statistical quality control.
CO-4	Appreciate the emerging trends in Production and Operation management.

4. TEACHINGANDEXAMINATIONSCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	0	2	3	30*	70	25	25	150

Legends: L-Lecture; T– Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, CA - Continuous Assessment; ESE -End Semester Examination.

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

5. SUGGESTED PRACTICAL EXERCISES

Following Practical Outcomes (PrOs) are the sub-components of the Course Outcomes (COs).Some **POs** marked **'*'**are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to the 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
01	To Study & Prepare Operation Process Chart (OPC) for given Assemblies.	II	04
02	To Study & Prepare Flow Diagram & Flow Process Chart for given assemblies.		02
03	To study & Prepare Man-Machine Chart for the given situation.		04
04	To study & calculate co-efficient of correlation for time study person using performance rating technique.		02
05	To study & calculate standard time for a given job.		02
06	To construct and interpret X bar &R chart for given data of production.	III	02
07	To construct and interpret & p chart for given data of production.		02
08	To prepare sampling plan & decide about acceptance or rejection of a particular product using specific sampling plans For given data.		04
09	Presentation/Seminar on any topics given in **Unit– I**.	I	02
10	To Study the product life cycle of various products/brands with strategies adopted at various level	IV	04
11	Industrial Visit: Visit at least one/two related industries. Prepare the report as per given guidelines provided in notes.	ALL	
	Total (Hours)		28

Notes:

I. More **Practical Exercises** can be designed and offered by the concerned course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a representative list**.**

II. It is compulsory to prepare log book/continuous records of exercises. It is also required to get each exercise recorded in log book/continuous records, checked and duly dated signed by teacher. CA component of practical marks is dependent on continuous and timely evaluation of exercises.

III. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.

   a. Brief details of industry visited.
   b. Type, location, products, rough layout, human resource, etc., of industry.
   c. Details, description and broad specifications of machineries/processes observed.
   d. Safety norms and precautions observed.
   e. Student's own observation on industrial environment, productivity concepts, quality consciousness and quality standards, cost effectiveness, culture and attitude.
   f. Any other details/ observations asked by accompanying faculty.

IV. For practical ESE part, students are to be assessed for competencies achieved. They should be assigned the necessary data and should be given any one experience to perform.

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above-listed **Practical Exercises** of this course required, which are embedded in the COs and, ultimately, the competency.

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in%
For study type		
1	Knowledge	30
2	Quality of Report	30
3	Participation	20
4	Punctuality	20
Total		**100**
For experiment type		
1	Knowledge	20
2	Procedure follows	30
3	Observation Skill	20
4	Conclusion/Summary	10
5	Quality of Report	10
6	Punctuality	10

Total	**100**

+

Sample rubrics Performance Indicators for the PrOs

For study type PrOs					
Criteria	**%**	**10**	**9-8**	**7-6**	**5**
Knowledge	30%	Student give the correct answers90% or more	Student give the correct answers between70-89%	Student give the correct answers between50-69%	Student give the correct answers less than 50%
		3	2.7-2.4	2.1-1.8	1.5
Quality of Report	30%	Neat Hand writing ,figure and table. complete labeling of figure and table.	Only formatting is not proper	Few required elements are missing	Several require elements are missing
		3	2.7-2.4	2.1-1.8	1.5
Participation	20%	Used time well in lab focused attention in exercise	Used time mostly in lab focused attention in exercise	Used time moderate in lab focused attention in exercise	Participation is minimum
		2	1.8-1.6	1.4-1.2	1
Punctuality	20%	Timely Submission	Submission late by 1 laboratory	Submission late by 2 laboratories	Submission late by more than 2 laboratories
		2	1.8-1.6	1.4-1.2	1

For experiment type PrOs					
Criteria	**%**	**10**	**9-8**	**7-6**	**5**
Knowledge	20%	Student give The correct answers90% Or more	Student give the correct answers between70-89%	Student give the correct answers between50-69%	Student give The correct Answers less than50%
		2	1.8-1.6	1.4-1.2	1
Procedure follows	30%	Student Follow all the Procedure with	Student Follow all the Procedure With some	Student Follow all the Procedure without	Student Follow all the Procedure without

		Precaution in logical order	Precaution in logical order	Precaution in logical order	Precaution in illogical order
		3	2.7-2.4	2.1-1.8	1.5
Observation skill	20%	Used time well in lab focused attention in exercise	Used time mostly in lab focused attention in exercise	Used time moderate in lab focused attention in exercise	Participation is minimum
		2	1.8-1.6	1.4-1.2	1
Conclusion/ Summary	10%	Student concept is mostly clear	Student concept is partly clear	Student concept is somewhat clear	Student concept is not clear
		1	0.9-0.8	0.7-0.6	0.5
Quality of Report	10%	Neat Hand writing ,figure and table. complete labeling of figure and table.	Only formatting is not proper	Few required elements are missing	Several require elements are missing
		1	0.9-0.8	0.7-0.6	0.5
Punctuality	10%	Timely Submission	Submission late by 1 laboratory	Submission late by 2 laboratories	Submission late by more than 2 laboratories
		1	0.9-0.8	0.7-0.6	0.5

6. MAJOREQUIPMENT/INSTRUMENTSREQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to a user in uniformity of practice in all institutions across the state.

Sr. No.	Equipment/instrument name with broad specification	Qty.
1.	Decimal stopwatch(Non fly back type)	02pcs.
2.	Decimal stop watch(Fly back type)	02pcs.
3.	Playing cards	2 sets
4.	MSPins10mmdiameter×15mmlengthwithtoleranceof± 0.01mm	100pcs.
5.	Buttonsof6differentcolors	100ofeach
6.	Sampling rackwith1000washers	1set

7. AFFECTIVEDOMAINOUTCOMES

The following ***sample*** Affective Domain Out comes (ADOs)are embedded in many of the above COs and PrOs. More can be added to fulfill the development of this course competency.

a. Workasaleader/teammember.

b. Followsafetypracticesasperstandardacts/rules.

c. Followethicalpractices.

d. Maintaintoolsandequipment.

e. Practiceenvironment-friendlymethodsandprocesses(Environmentrelated).

The ADOs are best developed through laboratory/field-based exercises. Moreover, the level of achievement of the ADOs, according to Krathwohl's 'Affective Domain Taxonomy,' should gradually increase as planned below:

I. 'ValuingLevel'in1st year

II. 'OrganizationLevel'in2nd year.

III. 'CharacterizationLevel'in3rd year.

8. UNDER PINNING THEORY

Based on the higher-level UOs of Revised Bloom's taxonomy formulated for developing COs and competency, the primary underpinning theory is given below. If required, more such UOs could be included by the course teacher to focus on attaining COs and competency.

Unit	Unit Outcomes(UOs) (1 to 4 UOs at different levels)	Topics and Sub-topics
Unit– I Introduction to Production and Operation Management	1.a Define Production and operation Management 1.b System and function view of organizations, scope, Evolution and future of production and operation management . 1.c Explain Concept of process design 1.c Evolution of Product design	1.1: Introduction of Production & Operation Management; 1.2: System and function view of organizations, scope, Evolution and future of production and operation management; 1.3: Process design-different types of process with its. merits and demerits, 1.4: process classification based on order, process selection, different type of manufacturing process, process performance and evaluation etc. 1.5: Product design; types of products and designing, evaluation of design
Unit– II Work Study	2.a Define work study, method study and work measurement. 2.b State the basic procedure of work study, method study and work measurement.	2.1 Work study- Introduction, definition, techniques and role to enhance productivity. Basic procedure of method study. 2.2 Methods of recording data for method study using standard symbols, process charts and diagrams.

Unit– II Work Study	2.c Prepare in the standard formats the outline Process chart, flow Process chart, flow diagrams, man machine chart and process plan for given data. 2.d Modify given process plan and flow diagram for improvements. 2.e State principles of motion economy. 2.f Analyze work content and calculate standard time in a given situation.	2.3 Preparation of operation (outline) process chart for given mechanical assembly having 6-8 components. 2.4 Preparation of flow process chart and flow diagram for given mechanical components having at least 6-8 major operations. 2.5 Given the process plan, operation process chart and flow diagram, develop questioning techniques in analyzing data for method study. Also develop and improve the method, based on analysis of given data. 2.6 Principles of motion economy applied in (a) use of human body, (b) design of work place layout (c) design of tools and equipment. 2.7 Man-machine chart. 2.8 Basic procedure of work measurement and equipments used in time study. 2.9 Job elements and their types. 2.10 Methods of measuring time cumulative and fly back timing. 2.11 Concept of rating & rating scale and calculation of basic time. 2.12 Calculation of standard time and work content. 2.13 Allowances-types, normal values and applications. 2.14 Concept of work sampling/ activity Sampling.
Unit–III PPC and Quality Control	3.a Establish importance of process planning and control with types of production. 3.b Appreciate importance of quality control and inspection. 3.c Explain Statistical Quality Control (SQC) and control charts used for it. State the importance of OC curve and interpret OC curves in a given situation.	3.1 Production Planning and Control (PPC): Introduction, Major functions, Pre planning, Methods of forecasting. 3.2 Routing and Scheduling, Dispatching and Controlling, Concept of Critical Path Method (CPM). 3.3 Types of Production, Mass Production, Batch Production and Job Order Production, Characteristics. 3.4 Economic Batch Quantity (EBQ),Principles of Product and Process Planning, Make or Buy decision, Numerical problems. 3.5 Quality Control: Definition, Objectives, Types of Inspection: First piece, Floor and Centralized Inspection, Advantages and Disadvantages.

		3.5 Statistical Quality Control (SQC), Types of Measurements, Method of Variables, Method of Attributes, Uses of X bar & R chart interpretations & examples. Uses of p and c charts, interpretations & examples. Application of software tool for SQC like Minitab, MS Excel etc. 3.8 Operating Characteristics curve (O.C. curve), Sampling Inspection, Single and Double Sampling plan. 3.9 Concept of ISO 9001:2008 Quality Management System Registration/ 3.6 Certification procedure, Benefits of ISO to the organization.
Unit–IV Recent trends in Production and Management	4.a State Modern techniques for Production and Operation managements 4.b. Explain six sigma and Reliability with their applications. 4.b Explain Sustainable Manufacturing and its dimensions. 4.c Appreciate importance of Product Life Cycle and Product Lifecycle Management (PLM).	4.1 Modern Management Techniques: Just In Time; Total Quality Management (TQM). 4.2 Quality circle, zero defect concept, 5S Concept 4.3 Concept of six sigma and its applications. 4.4 Sustainable Manufacturing: Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability. 4.5 Product life cycle: New product introduction, early introduction, increased product life, Life cycle management tool. 4.6 Product Life cycle Management (PLM): Importance, Implementation, Responsibility, Benefits to different.

9. SUGGESTEDSPECIFICATIONTABLEFORQUESTIONPAPERDESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Production and Operation Management	4	5	4	2	10
II	Work Study	12	10	10	8	28
III	PPC and Quality Control	8	4	6	8	18
IV	Recent trends in Production and Operation Management	4	3	6	4	14
Total		**28**	**22**	**26**	**22**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

10. SUGGESTEDSTUDENTACTIVITIES

Sr. No.	Activity.
1.	During Industrial visit for other subjects, students should be made familiar with various types of management practices, safety rules and quality control tools used in the industry. They should be encouraged to write special reports on regarding these topics in the industries they visited.
2.	VisitnearbymanufacturingunitandpreparereportonSQCtoolsusedandbest management practices followed in the industries they visited.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies that the course teacher can use to accelerate the attainment of the various outcomes in this course.

Sr. No.	Unit	Unit Name	Strategies
1	I	Introduction to Production and Operation Management	Videos on topics of principles of management, industrial visits, power point presentations.
2	II	Work Study	Videos on work study, live discussion at workshop place, presentations.
3	III	PPC and Quality Control	Videos on QC, live cases during industrial visits, power point presentations, failure analysis with rejected live parts.
4	IV	Recent trends in Production Management	Videos on trends and presentations.

12. SUGGESTEDMICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned at the beginning of the semester. The number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass at least COs with in integration of PrOs, UOs, and ADOs. The duration of the micro project should be about **4-5*(four to five) student engagement hours*** during the course. The students ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A representative list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher or using suggested student activity.

A representative list of micro-projects is given here. The concerned faculty can add similar micro-projects based on student activities (chart/presentation/report/model/animation):

1. Prepare a display chart of OPC, FD, FPC & Man-machine chart (anyone chart).
2. Case study on Critical Path Method (CPM) for projects / tasks used in industry (like https://blacksmithint.com/understanding-critical-path-in-manufacturing/).
3. Application of TQM in any industry.
4. Case study on application of Quality circle, zero defect concept and 5S Concept in organization (anyone concept).
5. Make a Power Point presentation on any one recent trend applied in industry relevant to subject.
6. Application of Industrial Engineering& Management techniques and tools in any service sector.

13. SUGGESTEDLEARNINGRESOURCES

Sr. No.	Title of Book	Author	Publication
1.	Production and operation Management	R Panner Selvam	Prentice Hall India Learning Private Limited, New Delhi
2.	Industrial Engineering and Management	O.P.Khanna	Dhanpat Rai Publications(P)Ltd., New Delhi
3.	Method Study	-	National Productivity Council https://npcindia.gov.in/NPC/Files/Publication/Other%20Publications/Method-Study-MG4.pdf
4.	Work Measurement	-	National Productivity Council http://www.npcindia.org.in/wp-content/uploads/2017/04/Work-Measurement-MG5.pdf
5.	Statistical Quality Control	Eugene Grant, Richard Leavenworth	McGraw Hill Education (India) Private Limited, Noida
6.	Management: A Global, Innovative and Entrepreneurial Perspective	Heinz Weihrich, Mark V. Cannice, Harold Koontz	McGraw Hill Education (India) Private Limited, Noida

7.	Essentials of Management	Joseph L. Massie	Prentice Hall India Learning Private Limited, New Delhi
8.	Principles of Management	Premvir Kapoor	Khanna Publishing House, New Delhi

14. SOFTWARE/LEARNINGWEBSITES

1. https://www.minitab.com/en-us/products/minitab/free-trial/(MinitabFreeTrial)
2. https://maitri.mahaonline.gov.in/pdf/factories-act-1948.pdf(IndianFactoriesAct1948)
3. https://www.youtube.com/watch?v=qliO4B_ZQko(PlantSafety)
4. https://tinyurl.com/ycybfkuj(WorkStudy)
5. https://youtu.be/5V84h5PAjAQ?si=3mh9S5XE33ejFdLF(MethodStudy)
6. https://youtu.be/TlPJPJfstB8?si=sL4yqzsQqAfqfJSL(Time&MotionStudy)
7. https://www.youtube.com/watch?v=0ufrez3JMIQ(WorkMeasurement&methods)
8. https://www.youtube.com/watch?v=1GjR6zySO04(Standardtimecalculation)
9. https://www.youtube.com/watch?v=7y-Iom0RTO4(CriticalPathMethod)
10. https://www.youtube.com/watch?v=dDzsFuOR-8o(EconomicBatchQuantity)
11. https://www.youtube.com/watch?v=n8VeldCFea4(O.C.Curve)
12. https://www.youtube.com/watch?v=ZaHiNsloTm0(AcceptanceSampling)
13. https://www.youtube.com/watch?v=68rI_EP-c4w(VestibuleTraining)
14. https://www.youtube.com/watch?v=4EDYfSl-fmc(SixSigma)
15. https://www.youtube.com/watch?v=7YZaWarCrpQ(SustainableManufacturing)

15. PO-COMPETENCY-COMAPPING

Semester VI	Production and Operation Management (4362002)						
	POs						
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
Competency & Course Outcomes	Basic &Discipline-specific knowledge	Problem Analysis	Design/development of solutions	Engineering Tools, Experimentation& Testing	Engineering pratices for society, sustainability & environment	ProjectManagement	Life-long Learning
Competency	• To take the right decisions to optimize resources utilization by improving productivity of Men, Materials, Machines, Money, Methods and Management effectively. • To eliminate unproductive activities under the control of the Management, Men and Design of Products and Processes.						
CO-1: Acquire the necessary knowledge and experience in order to recognize the production management and planning problems.	3	-	-	-	-	2	2
CO-2: Analyze work content and calculate standard time in a given situation.	-	3	-	2	-	2	-
CO-3: Ability to analyze and select the most appropriate methods and tools for the solution of problems related to production planning, shop floor scheduling and statistical quality control.	3	2	-	2	-	2	2
CO-4: Appreciate the emerging trends in Production and Operation management.	2	2	2	-	2	-	-

Legend:'3'forhigh,'2'formedium,'1'forlow,and'-'fornocorrelationofeachCOwithPO

16. COURSECURRICULUMDEVELOPMENTCOMMITTEE(GTURESOURCEPERSONS)

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Prof. B. V. Patel	B & B Institute of Technology, Vallabh Vidyanagar	9925232822	bvpatel@bbit.ac.in
2.	Prof. H J Soni	B & B Institute of Technology, Vallabh Vidyanagar	9924177967	hjsoni@bbit.ac.in

17. BOSRESOURCEPERSONS

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr. S.H. Sundarani, BOS Chairman& HOD Mechanical	Government Polytechnic, Ahmadabad	9227200147	gpasiraj@gmail.com
2.	Dr. Rakesh D. Patel, BOS Member & HOD Mechanical	B. & B. Institute of Technology, V.V.Nagar	9825523982	rakeshgtu@gmail.com
3.	Dr. Atul S. Shah, BOS Member & Principal	B. V. Patel Institute of Technology, Bardoli	7567421337	asshah97@yahoo.in