

Program Name : Diploma in Production Engineering / Production Technology
Program Code : PG/ PT
Semester : Fifth
Course Title : Production and Operations Management
Course Code : 22569

1. RATIONALE

Industrial productivity depends on human and equipment resources. A technician should know various techniques of productivity enhancement. He/She has to plan the production schedule and manage inventory. Further, he / she should be trained for process planning, production planning and control along with modern production techniques. Hence this course intends to provide critical understanding of process management concepts that yield a competitive advantage through operational excellence.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of modern production and operation approaches for manufacturing.**

3. COURSE OUTCOMES (COs)

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

- a. Design process and plant layout for given product.
- b. Develop production plan and control.
- c. Use inventory control techniques.
- d. Apply work study techniques to optimize production processes.
- e. Select appropriate Advanced Production Technology.
- f. Use of the Operation Research technique.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
			Max		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

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

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

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)



This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

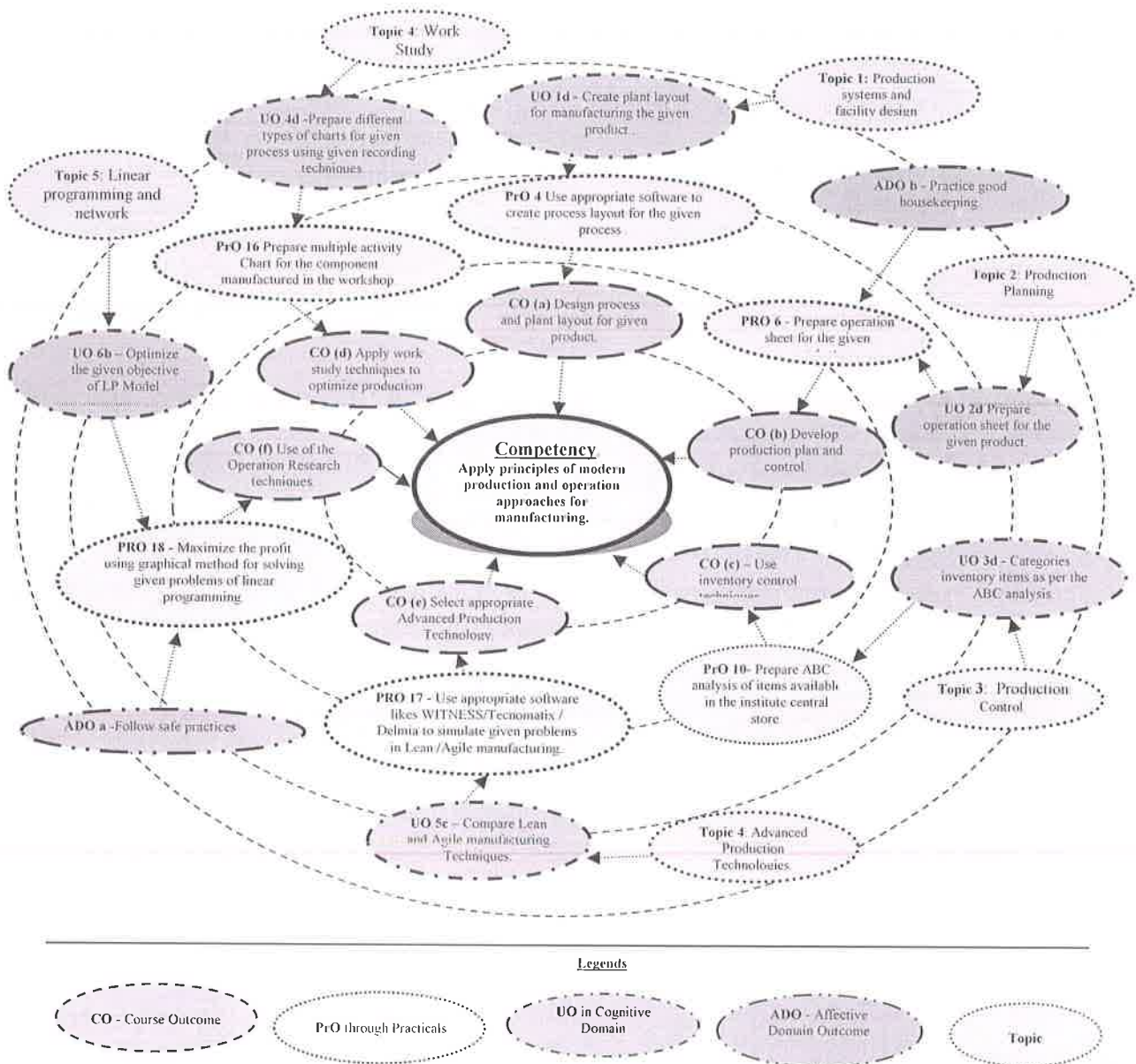


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use MS Excel software to create comparative statements for selecting plant location for given manufacturing industry.		02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2	Use MS Excel software to create comparative statements for selecting plant location for given service industry.	I	02
3	Use appropriate software to create product layout for the given product.	I	02*
4	Use appropriate software to create process layout for the given process.	I	02
5	Collect data of sales of any one automotive vehicle for past 5 years and forecast its sale in coming year.	II	02*
6	Prepare operation sheet for the given product.	II	02*
7	Generate MRP with ERP software for the given problem.	II	02
8	Balance an assembly line in a given situation.	III	02
9	Using simulation software to prepare schedule of manufacturing for the given product.	III	02*
10	Prepare ABC analysis of items available in the institute central store.	III	02*
11	Determine EOQ and plot graph for total cost versus EOQ for the given problem using MS Excel.	III	02*
12	Prepare two handed process chart for simple activity like measuring dimensions of simple component, assembly of nut and bolt etc.	IV	02*
13	Develop string diagram for tracing material handling movement in institute workshop/laboratory.	IV	02*
14	Prepare Outline process chart, Flow process chart, for a given situation like replacing punctured tyre of four wheeler.	IV	02
15	Prepare Flow diagram, Travel chart for a given situation like replacing worn-out bearing of four wheeler.	IV	02
16	Prepare multiple activity chart for the component manufactured in the workshop.	IV	02
17	Use appropriate software likes WITNESS/Tecnomatix / Delmia to simulate given problems in Lean /Agile manufacturing.	V	02*
18	Maximize the profit using graphical method for solving given problems of linear programming.	VI	02*
19	Use appropriate software likes WITNESS/Tecnomatix / Delmia to simulate given problems of linear programming.	VI	02
20	Develop PERT/CPM network diagram for maintenance of any machine available in workshop.	VI	02*
Total			40

Note

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. All the above listed practical need to be performed compulsorily, so that the student reaches the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Performing practical's in laboratory.	60



S. No.	Performance Indicators	Weightage in %
b.	Submission of assignments in given time.	15
c.	Topic content and presentation skill.	10
d.	Answer to sample questions.	15
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safety practices.
- b. Practice good housekeeping.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No	Equipment Name with Broad Specifications	Exp. S. No.
1.	Machine shop	All
2.	Computer laboratory	All

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Production systems and facility design	1a. Select production system for the given product with justification. 1b. Apply productivity improvement technique for the given situation. 1c. Classify the given factors in plant locations as suitable and unsuitable on basis of product requirement. 1d. Create plant layout for manufacturing the given product.	1.1 Production systems: Definition, Types of production systems, Productivity and its significance, measurement of productivity, Productivity improvement techniques. 1.2 Plant Location: Need of selection, factors influencing plant location. 1.3 Plant Layout: Objectives, design principles, features of different layouts, factor affecting plant layout.



<i>Unit</i>	<i>Unit Outcomes (UOs)</i> (in cognitive domain)	<i>Topics and Sub-topics</i>
Unit II- Production Planning	<p>2a. State the objectives/functions of production planning and control.</p> <p>2b. Select sales forecasting techniques for the given product with justification.</p> <p>2c. Calculate sales demand for the given product.</p> <p>2d. Prepare operation sheet for the given product.</p> <p>2e. Prepare Aggregate and master production plan for the give product.</p>	<p>2.1 Introduction: Definition, functions and importance of PPC.</p> <p>2.2 Sales Forecasting: Introduction, purpose, basic steps in forecasting, simple average method, moving average, exponential smoothing.</p> <p>2.3 Process Planning: make or buy decision, Process planning from raw material to finish product, sequence of operation, operation sheet, combine operations and determination of inspection stages.</p> <p>2.4 Production Planning: Aggregate and master production planning, Material Requirement Planning (MRP), Capacity planning, Manufacturing Resource Planning (MRP-II).</p>
Unit –III Production Control	<p>3a. Prepare different charts for the given type of production scheduling.</p> <p>3b. Sequence n number of jobs on two machines.</p> <p>3c. Analyze the effect of demand on inventories.</p> <p>3d. Determine economic lot size.</p> <p>3e. Calculate batch size for EOQ.</p> <p>3f. Categories inventory items as per the ABC analysis.</p> <p>3g. Explain Just in Time (JIT) and pull type production control system.</p>	<p>3.1 Meaning of control and Progressive control.</p> <p>3.2 Shop floor control: Order release, loading and scheduling - Master Scheduling, Scheduling rules, routing, sequencing (n jobs, 2 machines), dispatching, Gantt chart, Flow Process Sheet, Line balancing.</p> <p>3.3 Inventory Control: Inventories and their functions, classification of Inventory systems, costs associated with inventory, Economic Order Quantity (EOQ), lead time, safety stock, periodic review, ABC analysis.</p> <p>3.4 Just in Time (JIT) Production system: Philosophy, elements of JIT, seven wastes and benefits of JIT.</p> <p>3.5 Pull system of Production Control.</p>
Unit – IV Work Study	<p>4a. Apply method study for manufacturing of the given job.</p> <p>4b. Apply time study for manufacturing of the given job.</p> <p>4c. Select relevant recording techniques for the given process with justification.</p> <p>4d. Prepare different types of charts for given process using given recording techniques.</p> <p>4e. Calculate standard time for</p>	<p>4.1 Method study: Definition and objectives, basic procedure, Selection of work, Charting Techniques - Flow process chart, Outline process chart, Flow diagram and travel chart, Critical examination and analysis.</p> <p>4.2 Principal of Motion economy: General considerations, Tools and equipments, Two Handed process chart, multiple activity Chart, Therbligs, cycle graph and Chronocycle graph, SIMO chart.</p> <p>4.3 Time study: Definition, procedure, factors affecting the rate of working,</p>

<i>Unit</i>	<i>Unit Outcomes (UOs)</i> (in cognitive domain)	<i>Topics and Sub-topics</i>
	given activity using work measurement.	Time Study equipments, Types of elements, Rating and allowances, calculation of standard time. 4.4 Work sampling: Synthesis from standard data - Predetermined motion time standards, MOST.
Unit-V Advanced production technologies	5a. Describe the need of advanced production technology with justification. 5b. Select advanced production Technologies for the given situation with justification. 5c. Compare Lean and Agile manufacturing Techniques. 5d. State merits and demerits of advanced production technologies.	5.1 Introduction: need and applications 5.2 Lean manufacturing: concept, principles, advantages and limitations. 5.3 Agile manufacturing: concept, principles, advantages and limitations. 5.4 Comparison of mass production and lean production, Comparison of lean production and agile manufacturing.
Unit –VI Linear programming and network techniques	6a. Formulate the linear programming model for the given problem. 6b. Optimize the given objective of LP Model. 6c. Construct the network diagram of the given project using project management techniques. 6d. Identify critical path and Calculate total duration, float and slack of the given project.	6.1 Introduction: concept and importance of Operation Research (OR), linear programming (LP) model formulation. 6.2 Linear Programming: Graphical methods only. 6.3 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.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL) DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Production systems and facility design	08	04	06	-	10
II	Production planning	12	04	04	04	12
III	Production control	12	04	04	04	12
IV	Work Study	14	04	06	06	16
V	Advanced production technologies	06	04	04	-	08
VI	Linear programming and network techniques	12	04	04	04	12
Total		64	24	28		70



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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare journals based on practical performed in laboratory.
- b. Give seminar on relevant topic.
- c. Undertake micro-projects.
- d. Prepare a report of a small-scale industry to maximize the profit or minimize the loss.
- e. Collect a data and prepare a report where industry has used therbligs to improve productivity.

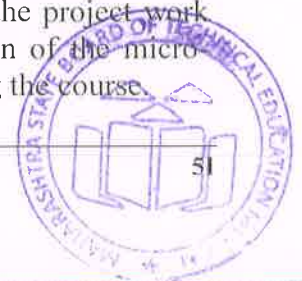
11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- a. Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b. '**L**' in **item No. 4** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice.
- g. Encourage students to refer different websites to have deeper understanding of the subject.
- h. Observe continuously and monitor the performance of students in Lab.
- i. Demonstrate students thoroughly before they start doing the practice.
- j. Encourage students to refer different websites to have deeper understanding of the subject.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro project should not be less than **16 (sixteen) student engagement hours** during the course.



In the first two semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here:

- Analyze and redevelop laboratory/workshop layout with justification.
- Perform Method study and work study for the activities performed in nearby visited industry/Institute workshop.
- Conduct demand survey for given consumer product.
- Apply latest techniques of inventory control such as JIT, MRP, ERP etc. in given situation.
- Apply Agile and Lean manufacturing techniques in given situation.
- Solving any real time practical problems by using linear programming and/or project management technique.

13. SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1	Industrial Engineering and Management	Dr. O. P. Khanna	Dhanpat Rai & Sons, New Delhi ISBN-978-81-899-2835-3
2	Elements of production planning and control	Samuel Eilon	Collier Macmillan Ltd. ISBN- 978-0023318009
3	Industrial Engineering and Production Management	Martand Telsang	S. Chand and Company Pvt. Ltd., New Delhi, ISBN-978-81-219-1773-5
4	Operation Research	P. K. Gupta and D. S. Hira	S. Chand and Company Pvt. Ltd. New Delhi, ISBN-978-81-219-0281-6
5	Production Management	K. K. Ahuja	CBS publishers and Distributors, New Delhi, ISBN-978-81-239-0185-5
6	production planning and control	L. C. Jhamb	Everest Publishing House ISBN: 9788186314722, 8186314725
7	Work Study & Ergnomics	L. C. Jhamb	Everest Publishing House ISBN-1234567154030
8	Automation, Production systems, and Computer Integrated Manufacturing	Mikell P. Groover	Pearson Prentice Hall, Second Edition, ISBN – 81-317-0227-8
9	Introduction to Work Study	George Kanawaty	International Labour Office, Geneva ISBN – 92-2-107108-1

14. SOFTWARE/LEARNING WEBSITES

- <https://www.youtube.com/watch?v=yYIVumq6sVM>
https://www.youtube.com/watch?v=s_G-SZgPINE
https://en.wikipedia.org/wiki/Operations_research#References
<https://www.slideshare.net/.../group-technology-flexible-manufacturing-systemscm>
<https://www.scribd.com/doc/49856035/INVENTORY-MANAGEMENT-ppt>
<https://www.slideshare.net/anks2027/plant-layout-ppt-by-me>
<https://www.slideshare.net/thushan89/material-handling-equipment-10215672>

