



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Mechanical, Mechatronics, Production and Manufacturing

Subject Code: BE05000321

Subject Name: Basics of Industrial Engineering

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 1

Prerequisite:	Nil
Rationale:	Basics of Industrial Engineering course is to prepare students to understand different aspects like: Plant location and its selection, Plant layout within the plant. Study of productivity and Work-study are important tools; after studying it, students are able to apply it in the industry for productivity improvement. This course gives idea about how to prepare job plan, and also gives knowledge of industrial legislation. Inspection and Statistical quality control plays major role in Industrial Engineering which helps in productivity improvement and different standards followed by industries. Finally, it provides knowledge about Lean Manufacturing and waste management.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Analyze plant location factors and design suitable for plant layouts using qualitative and quantitative techniques such as CRAFT and CORELAP.	15
CO-2	Analyze productivity improvement techniques and work study methods, including method study and work measurement, to enhance industrial efficiency.	25
CO-3	Analyse key industrial legislations and their impact on workplace safety, employee welfare, and organizational compliance.	20
CO-4	Analyse inspection methods and statistical quality control tools, including control charts and acceptance sampling, to ensure product quality and process capability.	25
CO-5	Evaluate lean manufacturing principles, agile practices, and waste management strategies to improve operational efficiency and sustainability.	15

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

* *Problem-Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.*



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Content:

Sr. No.	Content	Total Hrs
1	Location Selection and Plant Layout: Nature of Location Decision, Importance of Plant Location, Dynamic Nature of Plant Location, Choice of site for selection, Comparison of location. Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors and process plant. Quantitative methods of Plant layout: CRAFT and CORELAP, Relationship diagrams	7
2	Productivity and Work Study: Definition of productivity, application and advantages of productivity improvement tools, reasons for increase and decreases in productivity. Areas of application of work study in industry. Reaction of management and labour to work study. Method Study: Objectives and procedure for methods analysis, Recording techniques, Operations Process Chart, Flow Process Chart, Man-Machine, Multiple Activity Chart, Travel Chart, and Two-Handed process chart, String Diagram, Therbligs, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design. Work Measurement: Objectives, Work measurement techniques – time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, and standard time. Introduction to ergonomics.	10
3	Industrial Legislation: Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952.	10
4	Inspection and Quality Control: Inspection – functions, types, objectives and benefits, quality control principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, Basic Concept ISO 9000, ISO 14000 and QS 9000, Six sigma: Concept, Principle, Methodology, Scope, Advantage and limitations. Statistical Quality Control: SQC Concept, variable and attributes, normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability. Acceptance sampling, sampling plans, OC curves and AOQ curves.	10



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5	<p>Principles of Lean and Waste Management: Principles of Lean Manufacturing (LM) – Basic elements of LM– Introduction to LM Tools- Concept of wastes in LM and their narration - stages of 5S and waste elimination – Conventional Manufacturing versus Lean Manufacturing - Need for LM. Agile manufacturing - Definition, business need, conceptual frame work, characteristics, and generic features - Approaches to enhance ability in manufacturing - Managing people in agile organization.</p> <p>Waste Management: Introduction and meaning of waste, Reasons for generation and accumulation of obsolete, Surplus and scrap Items, Identification and control of waste, disposal of scrap.</p>	8
TOTAL		45

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	25	15	10	10

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

The syllabus of Basics of Industrial Engineering directly contributes to

SDG 1	No Poverty
SDG 3	Good health and well-being
SDG 4	Quality Education
SDG 6	Clean water and Sanitation
SDG 8	Decent work and Economic growth
SDG 9	Industry Innovation and Infrastructure
SDG 16	Peace and Justice
SDG 17	Partnerships

Reference Books:

1. Work study by International Labour Organization, ILO
2. Manufacturing Organization and Management, Harold Amrine, John Ritchey, Moodie, Kmec, 6ht Ed., Pearson
3. Industrial Engineering and Management, by Praveenkumar, Pearson
4. Production System, Planning, Analysis and Control – By J.L. Riggs 3rd ed. Wiley
5. Production and Operations Management – By R. Panneerselvam, PHI Private Ltd.,
6. Production and Operations management by S Anilkumar, Suresh, New Age International Publications.
7. Philips E. Hicks, “Industrial Engineering and Management – A new perspective”, McGraw Hill International Editions, New York, 1994.



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Standards and Act:

1. Factories act 1948,
2. Industrial dispute act 1947,
3. The Indian trade unions act 1926,
4. Industrial employment act 1946,
5. Payment of wage act 1936,
6. Workmen compensation act 1923,
7. Payment of bonus act 1965,
8. Employees provident fund scheme 1952
9. ISO 9000,
10. ISO 14000 and
11. QS 9000

List of Experiments:

1. Case study demonstration on location decision and site selection
2. Case study on plant layout problem
3. Exercise on OPC, FPC, Travel chart
4. Exercise on Method study, Motion Study and work measurement
5. Problems on wage and incentive plans
6. Exercise on statistical quality control techniques
7. Case study analysis of 5S
8. Exercise on Lean Manufacturing
9. Exercise on Waste management
10. Review report on different Industrial Act
11. Review report on ISO 9000, ISO 14000 and QS 9000

Major Equipment:

Nil

List of Open Source Software

1. Scilab
2. ERPNext and Odoo

List of learning website:

1. <http://nptel.ac.in/courses/>



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Note:

List of suggested activities for Problem-based Learning (PBL):

Sr. No.	PBL category	Name of the activity	No. of hours	Evaluation Criteria
1.	Complex Problem-Solving targeting relevant SDGs / Mini Project	Mini Project	15h (need to be changed as per total PBL hours)	Based on the novelty of project, technical understanding, report quality and presentation
2.	Case Study Analysis / Seminar	Seminar	15h (need to be changed as per total PBL hours)	Based on the quality of report and presentation, technical understanding
3.	Micro project	Micro project	8h (need to be changed as per total PBL hours)	Based on the novelty of project, technical understanding, quality of report and demonstration
4.	Industry/Research laboratory visit	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
5.	Video Based Learning	Technical video-based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
6.	Assignment / Technical Writing / Research Writing	Assignment writing. Numerical based assignment is preferable.	5 assignments of 4 h each Total = 20h	Based on the correctness of submitted assignment
7.	Group Discussion / Quiz / Simulation	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB, modeling and Analysis software or any other software	5 small coding-based assignment of 2h each Total = 10h	Based on the coding solution submitted.
8.	Video Based Learning	Self-learning online course	Minimum duration of the course should be 10h	Examination based assessment at the end of course. Based on the certificate produced.
9.	Complex Problem-Solving targeting relevant SDGs / Mini Project	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
10.	Video Based Learning	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
11.	Research Paper Review / Analysis	Technical paper reading and summarization of research papers based on relevant	5 research papers = 20h	Summarize research paper and evaluation critical parameters



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12.	Poster / Chart / PowerPoint presentation	Poster/chart/power point preparation on technical topics	Duration = 6h	Based on poster/chart preparation and presentation skills
13.	Industry/Research laboratory visit	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15h for industrial exposure Problem identification and tentative solution = 10h Total = 20h	Based on evaluation of critical problems and solutions
14.	Group Discussion / Quiz / Simulation	Group Discussion on emerging/trending technical topics based on subject	Duration = 1h – 3h per topic	Based on performance in group discussion, technical depth, knowledge etc.
15.	Case Study Analysis / Seminar	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
16.	Group Discussion / Quiz / Simulation	Application/Software development	Duration = 10h	Depending on the complexity of the Application/Software
17.	Assignment / Technical Writing / Research Writing	Research paper publication	Duration = 10h	Based on submission of proof of publication
18.	Micro project	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10h	Based on the performance of the equipment
19.	Industry/Research laboratory visit	Expert lecture/session	Duration 3h For attending the lecture/session– 2h and for report writing 1h	Based on the proof of attendance and report submitted
20.	Video Based Learning	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
21.	Assignment / Technical Writing / Research Writing	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.
22.	Assignment / Technical Writing / Research Writing	Preparation of a report on Indian Standard(s)	10h (study of Indian Standard(s) + report	Based on report quality and understanding of the relevant Indian Standard(s).

Note:

- In alignment with Outcome-Based Education (OBE) and NBA accreditation requirements, the subject **Basics of Industrial Engineering compulsorily incorporates Micro Project and 5 marks as PBL activities for PEC.**

These activities are incorporated as integral Project-Based Learning (PBL) components. These activities are designed to foster experiential learning, encourage innovation, and strengthen problem-solving skills by



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engaging students in practical applications of power converter design, simulation, and analysis. The inclusion of PBL ensures that learners develop higher-order cognitive abilities mapped to Bloom's taxonomy, while simultaneously enhancing teamwork, communication, and research competencies essential for professional engineering practice.

2. The hours allocated to specific activities should be proportionate to the total no. of PBL hours and marks.
3. All the suggested activity should be related to the subject.
4. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
5. Rubrics for the evaluation can be prepared by the faculty.
6. Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.
