

Subject Code: 1ET4020601	Subject Title: Industrial Engineering
Pre-Requisite	--

RATIONALE

Prosperity of nation in general depends on the productivity of industries and quality of production. Technical managers, engineers, plant operators, machine operators, supervisors and workers working in industries have to compulsorily meet set standards of production in terms of quality, quantity and productivity so as to compete domestic and international market. This is possible for them only when they employ and exploit the principles of industrial engineering. Industrial engineering always aims to achieve higher productivity and better standards of quality through its constant endeavor in design, improvements and installation of integrated systems of human resource, machines and methods.

COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able: to acquire following competencies.

- Improve productivity and quality by applying industrial engineering, quality control and cost reduction/saving techniques.

COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Improve productivity using work study and method study techniques.
- Analyze work content and calculate standard time in a given situation.
- Apply Statistical Quality Control tools in a given situation.
- Select material handling equipment.
- Apply Ergonomics for human comfort at work place.
- Appreciate the emerging trends in industrial engineering.

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	-	2	4	60	40	20	30

COURSE DETAILS:

Sr. No.	Topic	Total Hrs.	Weightage %
1	Introduction to Industrial Engineering 1.1 Industrial engineering-definition, objectives and techniques. 1.2 Scope, importance and applications of industrial engineering. 1.3 Methodology and approach of Industrial engineering 1.4 Productivity-concept, definition, importance and ways to enhance it 1.5 Introduction to work study and statistical quality control (SQC).	4	10
2	Work Study 2.1 Work study -Definition, techniques and role to enhance productivity. 2.2 Importance of human factors in application of work study techniques. 2.3 Basic procedure of method study. 2.4 Methods of recording data for method study using standard symbols, process charts and diagrams. 2.5 Preparation of operation (outline) process chart for given mechanical assembly having 6-8 components. 2.6 Process planning-concept, meaning, importance, functions, procedure and forms used. 2.7 Information required for process planning and information available from process planning. 2.8 Prepare process plan for given mechanical components, take 2-3 components. 2.9 Preparation of flow process chart and flow diagram for given mechanical components. 2.10 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. 2.11 Principles of motion economy applied in (a) use of human body, (b) design of workplace layout (c) design of tools and equipment. 2.12 Principles of micro motion study, Therbligs and SIMO chart. 2.13 Man and machine chart. 2.14 Basic procedure of work measurement. 2.15 Equipment used in time study. 2.16 Job elements and their types. 2.17 Methods of measuring time- cumulative and flyback timing.	14	30

	2.18 Concept of rating and ratings scale. 2.19 Allowances-types, normal values and applications. 2.20 Calculation of basic time, standard time and work content. 2.21 Concept of work sampling/activity sampling.		
3	Quality Assurance 3.1 Definition of quality, quality control (QC), quality assurance (QA), statistical quality control (SQC) and reliability. 3.2 Importance of quality. 3.3 Difference between reliability and quality control. 3.4 Factors affecting and improving reliability. 3.5 QA tools. 3.6 Concept of total quality cycle, quality of design, quality of performance, quality of conformity and total quality. 3.7 Difference between inspection and quality control. 3.8 Fundamentals of statistics-types of variations, frequency, class boundary and midpoint, frequency distribution, frequency histogram, frequency bar chart and polygon chart. 3.9 Frequency distribution curve, central tendency, spread or dispersion and range, mode, median and mean, standard deviation and variance with numeric examples. 3.10 Concept of probability and normal distribution. 3.11 Area under normal distribution and examples on normal distribution. 3.12 Introduction to binomial and Poisson distribution.	6	15
4	Statistical Quality Control (SQC) 4.1 Concept of variability. 4.2 SQC tools and statistical fundamentals. 4.3 Concept and differences between variables and attributes. 4.4 Control charts for variable quality- types, objectives, applications, calculations of control limits and range /mean, methods to plot and interpretations (Xbar-R chart) and examples. 4.5 Control charts for attribute quality- types, objectives, applications, calculations of control limits and range/mean, methods to plot and interpretations (p, np, 100p and c chart) and examples. 4.6 Process capability – meaning, definition and method to calculate, numeric examples. 4.7 Acceptance sampling: i. Quality control of incoming raw material and components.	8	20

	ii. Concepts of random sampling. Iii. Sampling plans: definition, terminology, types (Single, double and multiple), implementing plans based on given input. iv. OC curve-concept, need, types and importance, interpretation of given OC curve.		
5	Plant layout and material handling equipment 5.1 Plant layout: Definition and concept. 5.2 Types of plant layout, their applications, advantages and limitations. 5.3 Role of material handling systems in industries. 5.4 Material handling equipment- Classification, types, specifications, applications and selection criteria.	4	10
6	Recent trends in industrial engineering 6.1 International Organization for standardization and its role, ISO standard series and quality managements system. 6.2 Total Quality Control (TQC) and Total Quality Management (TQM)- philosophical concepts. 6.3 Concept of six sigma and its applications. 6.4 Concept and applications of Kaizen. 6.5 Definition, objectives and applications of ergonomics. 6.6 Normal and maximum work area. 6.7 Environmental requirements of work place	6	15

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (outcomes in psychomotor and affective domain) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Sr. No.	Practical Exercises (Outcomes in Psychomotor Domain)	Approx. Hours. required
1	Preparatory Activity: a. Prepare the table for values of surface finishes achieved in manufacturing processes. b. Give examples of enhancing productivity. c. Sketch draftingsymbols. d. Given the readings, sketch how such can be shown using Vernier and micrometer.	02

2	Mini Project and presentation: a. Sketch the parts taken in Design of Machine Elements (DME) under Mini project. The batch of DME is to be continued. b. Prepare process plans for each part. c. Prepare flow diagram for each part. Assume institute's workshop layout. d. Present the work including work distribution, photographs and movies of actual project work using power point presentation.	04
3	Operation process chart (OPC): Given real mechanical assembly having 6-8 components, prepare operation process chart. (This has to be assigned by teacher). a. Sketch parts and assembly. b. Prepare OPC. c. Prepare process plans for all components. Use format given in Annexure-I.	06
4	Flow diagram (FD): Given real mechanical component having minimum 6-8 mechanical operations, prepare FD. (This has to be assigned by teacher). a. Sketch component. b. Sketch institute workshop layout. c. Prepare FD.	02
5	Man and machine chart: Prepare man and machine chart for given situation. Teacher will assign the real situation. This includes: a. List objectives of preparing man and machine chart. b. Describe the situation assigned by the teacher. c. Prepare the man and machine chart. d. Interpret the chart and suggest if any further improvements can be made with respect to enhance productivity.	02
6	Performance rating: Calculate co-efficient of co-relation for time study person using performance rating technique. Teacher will assign the situation. This includes: a. Define performance rating. b. Describe the situation assigned by the teacher. c. List the steps followed to perform the exercise. d. Observe and record the observations. e. Plot, interpret and calculate the co-efficient of co-relation.	02
7	Time study: Calculate standard time for a given job using decimal minute stop watch techniques. Teacher will assign the situation/job/elements to be recorded. This include: a. Sketch the part undertaken for time study. b. List elements to be considered.	02

	c. Observe and record elements time. d. List and justify allowances to be taken with values. e. Calculate standard time.	
8	Frequency distribution curve: a. Take live problem (may be measured variable dimension, result analysis, etc. (Teacher has to assign the live problem) and summarize the data. b. Perform and prepare frequency table. c. Determine central tendency, spread or dispersion and range, mode, median and mean standard deviation and variance. d. Prepare frequency bar, frequency polygon and frequency curve. e. Plot the areas under normal curve. f. Given the data (Teacher will assign the data), determine numbers /probabilities of acceptance/ rejection using normal distribution table-4 cases.	02
9	Control charts for variables: a. Define variable. Give five examples. b. For given live problem, determine sub group size, measure the variable and record the observations. c. Perform necessary calculations and determine control limits. d. Plot $\bar{X}$ – R chart and interpret the same.	02
10	Control charts for attributes: a. Define attribute. Give five examples. b. Explain binomial and Poisson distributions. c. For given live problems (different for different charts), determine parameters, record the observations of attribute. d. Perform necessary calculations and determine control limits. e. Plot p and c charts and interpret the same.	02
11	Acceptance sampling: a. Show double sampling plan using block diagram. b. Prepare/ operate double sampling plans on the basis of given lot size, AQL, inspection level and other input for a given problems. c. Record the observations and conclude the outcome.	02
Total Hours		28

8. SUGGESTED LEARNING RESOURCES

A. List of Books:

Sr.No.	Title of Book	Author	Publication
1.	Industrial Engineering (IE) and Management	C.Natha Muni Reddy	New age international Publishers.

2.	Handbook of IE: Technology and operations management.	Gavriel Salvendy	Institute of Industrial Engineers.
3.	Comprehensive Industrial Engineering.	M. J Manek	Laxmi Publications (P) Ltd., New Delhi.
4.	Introduction to Work-study. ISBN: 9221071081	George Kanawaty	International Labor Organisation, Geneva.
5.	Introduction to productivity	---	National Productivity Council (NPC).
6.	Method Study	---	NPC.
7.	Work Measurement	---	NPC.
8.	Introduction to Statistical quality control. 7th revised edition ISBN-13: 978-0078443541	Eugene Grant and Richard Leavenworth	McGraw-Hill Series in Industrial Engineering and Management

B) List of Major Equipment/ Instrument with Broad Specifications:

Sr.No.	Major equipment/ Instrument with Broad Specification.	
1	Decimal stopwatch (Non flyback type).	02 pcs.
2	Decimal stopwatch (Flyback type)	02 pcs.
3	Playing cards	2 sets.
4	M.S Pins 10mm dia X 15mm length with tolerance of ± 0.01 mm.	100 pcs.
5	Buttons of 6 different colors.	100 of each color.
6	Sampling rack with 1000 washers	1 set.

C. List of Software/Learning Websites.

- http://en.wikipedia.org/wiki/Industrial_engineering
- <http://www.iiie-india.com/IIIE/industrial-engineering.php>
- <http://www.youtube.com/watch?v=3WmfSfNjr4w>
 - (How Receiver Operating Characteristic Curves Work ...)
- <http://www.youtube.com/watch?v=J17SUDcrphw>
 - (How to construct an operating characteristic (OC) curve)
- <https://www.coursera.org/course/apstat> (basics of statistics)
- http://www.youtube.com/view_play_list?p=299B5CC87110A6E7
 - (Lecture Series on Industrial engineering NPTEL)
- <http://www.massey.ac.nz/~mbjones/Book/Chapter11.pdf>
 - (reading material on statistics)