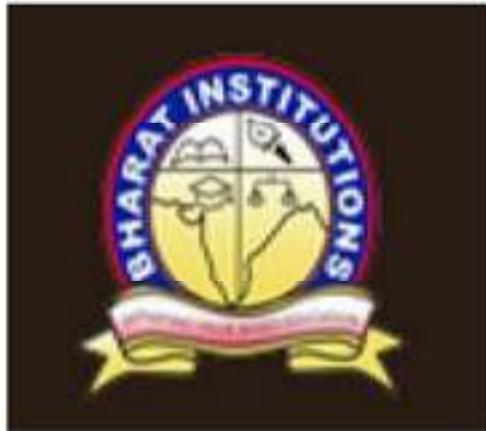


# **INDUSTRIAL MANAGEMENT**

**Subject code: A70332**

**Regulations: R15-JNTUH**

**Class: IV Year B. Tech MECH I Sem**



**Department of Mechanical Engineering  
BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY  
Ibrahimpattam - 501 510, Hyderabad**

# INDUSTRIAL MANAGEMENT (A70332)

## COURSE PLANNER

### I. COURSE OVERVIEW:

This course introduces the basic concepts of Industrial Management which is concerned with the design, improvement and installation of integrated systems of men, materials, equipment and energy. The emphasis of this course is laid on the basic analysis of designing organizational structures, plant layouts, inspection and quality control, work study, Project Management (PERT/CPM) & fundamental management principles and practices.

An engineer with industrial management background draws upon specialized knowledge and skill in mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such system. With the growing number of multinationals operating in India and Indian companies turning multinationals, the opportunities for the present generation are vast. Engineers who can apply concepts of management in practical aspects of business are the professionals most sought after as they are the embodiment of right mix of the skills of rationality and decision making.

### II. PREREQUISITE(S):

- Knowledge in basic manufacturing processes
- Basic Probability & Statistics
- Network Diagram

### III. COURSE OBJECTIVES:

- To provide brief introduction to the fundamental concepts, functions, nature and evolution of Management.
- To explain the basic principles of management, designing organization structures, operations management, value analysis, work study, statistical quality control, job evaluation and project management.

### IV. COURSE OUTCOMES:

Towards the end of the course it is expected that the student would be matured enough to apply the industrial management concepts and techniques in real life situations.

Course Outcomes: After learning the contents of this course, the student would be able to,

Sl.No.	Description	Bloom's Taxonomy level
CO1.	<b>Explain</b> the concepts of management and <b>Explore</b> the management practices in their domain area within society.	Understand (Level 2), Analyze (Level 4)
CO2.	<b>Evaluate</b> different types of organizational structures and <b>Design</b> them.	Evaluate (Level 5), Create (Level 6)
CO3.	<b>Explain</b> about product design process and <b>Design</b> product layout.	Understand (Level 2), Create (Level 6)
CO4.	<b>Explain</b> about method study and <b>Use</b> various work measurement methods.	Understand (Level 2), Apply (Level 3)
CO5.	<b>Draw</b> various statistical quality control charts and <b>Interpret</b> them.	Apply (Level 3)
CO6.	<b>Apply</b> the techniques of PERT/CPM in project.	Apply (Level 3)

### V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Problem based Assignments/ Exam
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Assignments/ Exam/ Case Studies
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments/ Open ended experiments/ Case Studies
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ Open ended experiments
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1	Mini Project
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	-	-
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	-
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Seminars
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design	2	Seminars / Term Paper

	documentation, make effective presentations, and give and receive clear instructions.		
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1	Assignments/ Open ended experiments/ Projects
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Projects/ Case Studies

1: Slight (Low)      2: Moderate (Medium)      3: Substantial (High)      - : None

#### VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO1	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyze and provide solutions for the problems related to Mechanical engineering and communicate them effectively to the concerned.	2	Lectures, Assignments
PSO2	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	2	Assignments / Mini Projects / Open ended experiments
PSO3	The ability to grasp the latest development, methodologies of mechanical engineering and possess competent knowledge of design process, practical proficiencies, skills and knowledge of programme and developing ideas towards research.	1	Open ended experiments / Projects

#### VII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Program Outcomes

CO's	Program Outcomes (PO's)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1.	1	2	2	-	-	1	1	1	3	3	1	1
CO2.	-	1	2	-	-	-	-	-	1	2	-	1
CO3.	3	3	3	1	1	-	-	-	-	1	-	2
CO4.	3	3	2	1	1	-	-	-	1	2	-	1
CO5.	3	3	1	3	1	-	-	-	1	1	-	1
CO6.	2	3	2	-	2	-	-	-	1	1	3	1

<b>Average (Rounded)</b>	2	3	2	1	1	0	0	0	1	2	1	1
--------------------------	---	---	---	---	---	---	---	---	---	---	---	---

Program Specific Outcomes

CO's	Program Specific Outcomes (PSO's)		
	PSO1	PSO2	PSO3
<b>CO1.</b> Explain the concepts of management and Explore the management practices in their domain area within society.	2	1	1
<b>CO2.</b> Evaluate different types of organizational structures and Design them.	1	1	-
<b>CO3.</b> Explain about product design process and Design product layout.	3	3	3
<b>CO4.</b> Explain about method study and Use various work measurement methods.	3	3	2
<b>CO5.</b> Draw various statistical quality control charts and Interpret them.	2	2	1
<b>CO6.</b> Apply the techniques of PERT/CPM in project.	2	1	1
<b>Average (Rounded)</b>	2	2	1

**VIII. SYLLABUS:**

**COURSE CONTENTS – AS PER JNTUH SYLLABUS:**

**Unit I: Introduction to Management:**

Entrepreneurship and organization-Nature and importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

**Unit II: Designing Organizational Structures:**

Departmentation and Decentralization, Types of organization structure - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

**Unit III: Operations Management:** Objectives-Product design process-Process selection-Types of production system (Job, Batch and Mass Production). Plant location-factors-Urban & Rural sites comparison-Types of plant layouts-Design of product layout-Line balancing (RPW method).

**Value analysis:** Definition-types of values-objectives-phase of value analysis-Fast diagram.

**Unit IV: Work Study:** Introduction-definition-Objectives-Steps in work study- Method Study – definition- objectives- steps of method study. Work measurement - purpose –types of study-stop watch methods-steps –key rating-allowances-standard time calculations-work sampling.

**Statistical Quality Control:** Variables - attributes, Shewart control chart for variables -  $\bar{X}$  chart, R chart, - Attributes-Defective-Defect Charts for attributes-p chart, c chart (simple problems). Acceptance Sampling-Single sampling-double sampling plans-OC curves.

**Unit V: Job Evaluation:** methods of job evaluation-simple routing objective systems-classification method-factor comparison method-point method –benefits of job evaluation and limitations.

**Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

**SUGGESTED BOOKS/RESOURCES:**

**TEXT BOOKS:**

- 1.Aryasri: Management Science, TMH, New Delhi.
- 2.O.P.Khanna: Industrial Engineering and Management, Dhanpat Rai Publishers.

**REFERENCE BOOKS:**

- 3.K.C.Jain and L.N.Agarwal: Production Planning Control & Industrial Management, Khanna Publishers.
- 4.R Paneerselvam: Production and Operations Management, 2<sup>nd</sup> edition, PHI Publications.
- 5.Anil Kumar Mukhopadhyay: Value Engineering Concept Technique and Application, SAGE Publishing.
- 6.T.R.Banga and S.C.Sarma: Industrial Engineering and Management Science, Khanna Publishers.
- 7.R. Dan Reid, Nada R. Sanders: Operations Management, 4<sup>th</sup> edition, Wiley.
- 8.Ralph M Barnes: Motion and Time Study, John Wiley & Sons Publishers.
- 9.NVS Raju: Industrial Engineering Management, Cengage Learning.
- 10.Ravi Shankar: Industrial Engineering Management, Galgotia Publications.

**NPTEL Web Course:**

- <http://nptel.ac.in/courses/112107217/>
- <http://nptel.ac.in/courses/112107143/>
- <http://nptel.ac.in/courses/110105067/>
- <http://nptel.ac.in/courses/110105088/>

**NPTEL Video Course:**

- [http://nptel.ac.in/courses/nptel\\_download.php?subjectid=112107217](http://nptel.ac.in/courses/nptel_download.php?subjectid=112107217)
- [http://nptel.ac.in/courses/nptel\\_download.php?subjectid=112107143](http://nptel.ac.in/courses/nptel_download.php?subjectid=112107143)
- [http://nptel.ac.in/courses/nptel\\_download.php?subjectid=110105067](http://nptel.ac.in/courses/nptel_download.php?subjectid=110105067)
- [http://nptel.ac.in/courses/nptel\\_download.php?subjectid=110105088](http://nptel.ac.in/courses/nptel_download.php?subjectid=110105088)

**GATE SYLLABUS:**

Line Balancing, Network flow models, PERT and CPM.

**IES SYLLABUS:**

Line balancing, PERT and CPM. Job design, Job standards, Work measurement, Quality Management - Quality analysis and control, Value Engineering: Value analysis for cost/value.

**IX. COURSE PLAN:**

Lecture No.	Week No.	TOPIC	Reference
<b>UNIT - 1</b>			

1.	1	Introduction to the course	Book No. 1, 2, 3, 6, 9, 10	
2.		Management – Introduction, Nature & Importance		
3.		Entrepreneurship and organization, Functions		
4.		Evolution of Management - Taylors scientific management theory,		
5.	2	Fayol's Principles of Management, Systems Approach,		
6.		Maslow's theory of human needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two- Factor Theory of motivation		
7.		Leadership Styles, Social responsibilities of management		
8.		Review		
<b>UNIT – 2</b>				
9.	3	Introduction to Designing Organizational Structures		Book No. 1, 2, 3, 9
10.		Departmentation, matrix organization, Decentralization		
11.		Lean & flat organization structure, Types of organization structures- Line organization		
12.		<b>Mock Test – I</b>		
13.	4	Line & staff organization, Functional organization, Committee organization		
14.		Boundary less organization, Virtual organization		
15.		Team structure, Cellular Organization, Inverted pyramid structure, - merits, demerits & suitability		
16.		Review		
		<b>Tutorial / Bridge Class # 1</b>		
<b>UNIT – 3</b>				
17.	5	Operations Management: Introduction, Objectives	Book No. 2, 3, 4, 5, 7, 10	
18.		Product design process		
19.		Process selection		
20.		Types of production system (Job, Batch and Mass Production)		
		<b>Tutorial / Bridge Class # 2</b>		
21.	6	Plant location factors, Urban-Rural site comparison		
22.		Types of plant layout		
23.		Design of product layout		
24.		Line balancing (RPW Method)		
		<b>Tutorial / Bridge Class # 3</b>		
25.	7	Review		
26.		Value analysis-definition, Types of values-objectives		
27.		Phase of value analysis		
28.		Fast diagram		
		<b>Tutorial / Bridge Class # 4</b>		
29.	8	Review		
30.		Review		
31.		Review		
32.		Review		

		<b>Tutorial / Bridge Class # 5</b>	
<b>I Mid Examinations (Week 9)</b>			
<b>UNIT – 4</b>			
33.	10	Work study –Introduction, Definition, Objectives,	Book No. 1, 2, 3, 4, 6, 7, 8
34.		Steps in work study	
35.		Method study-Introduction, Definition, Objectives	
36.		Steps of method study	
		<b>Tutorial / Bridge Class # 6</b>	
37.	11	Review	
38.		Work measurement	
39.		Types of study-Stop watch method,	
40.		Step key rating, Allowances, Standard time calculations,	
		<b>Tutorial / Bridge Class # 7</b>	
41.	12	Work sampling, Problems	
42.		Problems	
43.		Statistical quality control- Variables - attributes	
44.		Shewart control chart for variables - X-bar chart, R chart	
		<b>Tutorial / Bridge Class # 8</b>	
45.	13	Attributes-Defective-Defect Charts for attributes-p chart, c chart	
46.		Acceptance Sampling-Single sampling-double sampling plans	
47.		OC curves, Problems	
48.		Review	
		<b>Mock Test - II</b>	
<b>UNIT – 5</b>			
49.	14	Job evaluation – Definition, Methods, benefits, limitations	Book No. 1, 2, 3, 6, 9, 10
50.		simple routing objective systems-classification method	
51.		Factor comparison method-point method	
52.		Review	
		<b>Tutorial / Bridge Class # 9</b>	
53.	15	Introduction to Project Management	
54.		Network Analysis	
55.		Network Analysis	
56.		PERT , CPM, Identifying critical path	
		<b>Tutorial / Bridge Class # 10</b>	
57.	16	Probability of completing project in given time problems	
58.		Project cost analysis and project crashing	
59.		Problems	
60.		Problems	
		<b>Tutorial / Bridge Class # 11</b>	
61.	17	Review	
62.		Review	
63.		Review	

64.	Review	
	<i>Tutorial / Bridge Class # 12</i>	
<b>II Mid Examinations (Week 18)</b>		

Note: Lecture learning outcomes for all the topics are detailed in the form of relevant descriptive and objective questions.

### **X. QUESTION BANK: (JNTUH)**

#### **DESCRIPTIVE QUESTIONS:**

Definitions of the different levels of cognitive skills in Bloom's taxonomy marked in descriptive questions (where the highest level in question bits is only marked) are as follows:

BLOOMS LEVEL	COGNITIVE SKILL	DEFINITION
Level-1 (L1) : REMEMBER	Knowledge	Recalling/Retrieving relevant terminology, specific facts, or different procedures related to information and/or course topics. (At this level, student remembers something, but may not really understand it fully.)
Level-2 (L2) : UNDERSTAND	Comprehension	Determining the meaning of instructional messages (facts, definitions, concepts, graphics etc.)
Level-3 (L3) : APPLY	Application	Carrying out or use previously learned information in another familiar situations or in problem solving
Level-4 (L4) : ANALYZE	Analysis	Breaking information into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. Analysis refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments
Level-5 (L5) : EVALUATE	Evaluation	Making judgment's based on criteria and standards, personal values or opinions
Level-6 (L6) : CREATE	Synthesis	Create or uniquely apply prior knowledge and/or skills to form a novel, coherent whole or original product or produce new and original thoughts, ideas, processes,...

### **UNIT -I**

**{Relates to CO1.}**

#### **Short Answer Questions-**

- 1) Define Management. Describe the importance of Management in an Organization. (L2)
- 2) What is system? Discuss Management as a system by bringing out its basic features. (L4)
- 3) Define Entrepreneurship and state the functions of an Entrepreneur. (L1)
- 4) Explain the nature and features of Management. (L2)
- 5) State the functions of the Management in an organization. (L1)
- 6) Define 'Planning' and explain the steps involved before finalizing a plan. (L2)
- 7) What are the appreciations of Fayol's functional school of Management theory? (L4)
- 8) Define Scientific Management and explain its importance. (L2)
- 9) Write short notes on Maslow's theory of human needs. (L2)
- 10) Write briefly about Douglas McGregor's theory X and theory Y. (L4)
- 11) Explain types of leadership styles. (L2)
- 12) State the salient features of Herzberg's two factor theory of motivation. (L1)
- 13) Explain about Systems approach to Management. (L2)
- 14) What are the social responsibilities of Management? (L1)

15) Why social responsibility of Management has become an important facet of management in present times? (L5)

**Long Answer Questions-**

- 1) Explain Fayol's Principles of Management and Taylor's Scientific Management Theory. (L2)
- 2) In what aspects have Fayol's principles of management resulted in contributions to management methods that are different from the techniques of Taylor's scientific management? (L4)
- 3) Discuss in detail the various functions of management. (L2)
- 4) Explain different views expressed on the functions of management. (L2)
- 5) (a) Discuss management as a process. (b) Discuss the challenges to management in the new millennium. (L2)
- 6) Discuss the characteristics of management as a profession. To what extent has India's management been professionalized? (L5)
- 7) "Management is the art of getting things done through and with people in formally organized groups." Explain. (L5)
- 8) Management can be studied under two categories as 'Management before Taylor' and 'Management after Taylor'. Analyze the statement critically. (L4)
- 9) Discuss the various theories of Motivation. (L2)
- 10) (a) Explain the key features of McGregor's theory X and theory Y. How do these theories help to motivate the employees? (b) Explain Maslow's need hierarchy theory. Is hierarchy rigid? Explain. (L4)
- 11) (a) How does the job situation affect the application of McGregor's theory X and theory Y? What are its implications? (b) Critically examine Herzberg's two factor theory. Make a comparison between theories of Herzberg and Maslow. Which of these theories do you prefer in Indian context? Give reasons. (L5)
- 12) (a) What are the basic elements of hierarchical need approach? What are the effects of these elements on the management style? (b) Elton Mayo projected a new angle of management. What is this angle? Explain. (L5)
- 13) (a) What are managerial functions? How are they integrated? (b) Examine the scientific nature in Taylor's scientific management. (L4)
- 14) What is the role of Entrepreneurial stage in Organizational life cycle? Explain it. (L2)
- 15) (a) Describe the nature and importance of management in modern business organization. (b) Explain the systems approach and contingency approach to management. (L2)
- 16) (a) Name and describe the various levels of management with their functions. (b) Give a brief note on: i. Classical theory of management ii. Scientific management. (L2)
- 17) (a) Describe the various stages of evolution of management. (b) State and describe the Fayol's principles of management. (L2)
- 18) (a) State and describe the characteristics of modern management. (b) Describe the principles of scientific management in brief. (L2)
- 19) Explain the functions of management listed below: Planning, Organizing, Staffing, Direction, Co-ordination, Co-operation, and Control. (L2)
- 20) Explain the F. W Taylor's Theory of management. How does it differ from Henry Fayol's theory? (L4)

- 21) (a) Define leadership. What are the characteristics of leadership? (b) Explain the contributions of Taylor for scientific management and how it leads to the concept of scientific management. (L2)
- 22) (a) What is the concept of motivation? How does it affect behavior? (b) Bring out clearly the differences between hygiene factors and motivators. What are their implications to employee motivation at work place? (L5)

## **UNIT –II**

**{Relates to CO2.}**

### **Short Answer Questions-**

- 1) Define an “Organization”. What are its common characteristics? (L1)
- 2) Write brief notes on decentralization. (L2)
- 3) State the concept of organization chart. (L1)
- 4) Name the different types of organization structures. (L1)
- 5) What is the difference between lean and flat organization structure. (L4)
- 6) State the features of cellular organization structure. (L1)
- 7) Write short notes on inverted pyramid structure. (L4)
- 8) Differentiate between flat organization and tall organization. (L4)
- 9) What is boundary less organization and when is it suitable? (L2)
- 10) What is Virtual Organization and what are its merits and demerits? Discuss the reasons for its emergence. (L4)
- 11) Differentiate between organization and organizing. (L4)
- 12) Explain the terms ‘span of control’ and ‘unity of command’. (L2)
- 13) What are the factors which determine the appropriate span of management? (L1)

### **Long Answer Questions-**

- 1) Discuss the process of Organizing. Explain the principles to be observed while creating an organization structure. (L2)
- 2) What do you mean by departmentation? Evaluate the methods. (L5)
- 3) Discuss the importance of organization structure in an organization. (L2)
- 4) Explain in detail about committee organization along with an application. (L2)
- 5) (a) What are the steps involved for designing an organization structure? Explain. (b) Distinguish between the departmentalization and decentralization. (L4)
- 6) Draw an example of organization chart indicating more than three levels and explain. (L3)
- 7) (a) Describe various bases for departmentation and suggest a scheme of departmentation for a large marketing company with a field network all over the country. (b) What is free form organization? Give its chart and state its benefits and limitations compared to fixed and rigid structure. (L6)
- 8) How is informal organization relevant to managers? In what ways, can managers make most effective use of informal organization? (L5)
- 9) (a) Distinguish between a military organization and functional organization. (b) What is a network organization structure? Give the areas where it is best suitable for adopting. Give its strengths and weaknesses. (L5)
- 10) Which organization formal or informal, do you feel is the strengthener in executing industrial management? How? Give some exemplary situations in support of your answer. (L5)
- 11) (a) Explain the significance of informal organization. (b) Evaluate committee type of organization. (L5)

- 12) (a) Explain the method of departmentation by product. What are its advantages? (b) Evaluate matrix organization by comparing its strengths and weaknesses. (L5)
- 13) What are the aims of departmentation? List out the various methods of departmentation and explain any one in detail. (L2)
- 14) Explain about inverted pyramid structure with an example and also state its merits, demerits and suitability. (L2)
- 15) Draw organization chart of a line and staff organization and explain its characteristics. Give four merits & demerits. (L3)
- 16) (a) Discuss various forms of organization. (b) Explain any two in detail along with their merits and demerits. (L2)
- 17) Organization structure refers to the differentiation and interaction of activities and authorities and authority roles and relationship. Explain. (L5)
- 18) State the advantages of good organization. Differentiate between “Line Organization and Functional Organization”. (L4)
- 19) Explain about the inverted pyramid structure organization and write the advantages over other structures. (L2)
- 20) Most of the IT related and marketing oriented companies prefer to use Team or Project Organizations. Why? Discuss with reference to the features of these organizations. (L5)
- 21) Explain line and staff organization with a suitable example. What are its advantages and limitations? (L2)
- 22) (a) What is meant by decentralization. State the various factors of decentralization and its advantages. (b) Distinguish between delegation of authority and decentralization. (L4)
- 23) Explain about the matrix organization and write the advantages of it over other organizational structures. (L4)
- 24) Explain salient features of functional organization. What are its advantages and limitations? (L2)

### **UNIT –III**

**{Relates to CO3.}**

#### **Short Answer Questions-**

- 1) What are the objectives of operations management? (L1)
- 2) What are the factors to be considered for product design? (L1)
- 3) Specify the different types of plant layouts. (L4)
- 4) How to determine whether an organization has good product development process in place or not? (L5)
- 5) Is group technology layout any different from a product layout? Give reasons for your answers. (L4)
- 6) Differentiate between process layout and product layout. (L4)
- 7) State the characteristics of product layout. (L1)
- 8) Define ‘production system’. What are the methods of production? Elucidate. (L2)
- 9) State the symptoms of a bad plant layout. (L1)
- 10) What are the quantitative techniques for optimal design of layouts? (L1)
- 11) Describe standardization procedure along with its advantages. (L2)
- 12) Write briefly about mass production system. (L2)
- 13) What are the advantages of job and batch production? (L2)
- 14) What is plant location? (L1)
- 15) List out Muther’s principles of layout? (L1)

- 16) What are the factors to be considered for good plant Layout? (L1)
- 17) How to evaluate and decide among various alternative layout designs? (L4)
- 18) What are the factors affecting selection of Plant Location? (L1)
- 19) Differentiate between process layout and combination layout. (L4)
- 20) List the major factors that govern the plant location for an automotive and auto component manufacturing industry. (L1)
- 21) Define line balancing problem. (L1)
- 22) What are the objectives of line-balancing? (L1)
- 23) State the steps involved in RPW method for line balancing problem. (L1)
- 24) Write the concept governing plant location. (L2)
- 25) Define value? Specify how it can be increased. (L4)
- 26) Distinguish between cost and value. (L4)
- 27) Describe the various types of values with examples. (L2)
- 28) What is the need for value analysis of a product? (L4)
- 29) What are the objectives of value analysis? (L1)
- 30) List the phases of value analysis. (L1)
- 31) Write short notes on FAST Diagram. (L2)

#### **Long Answer Questions-**

- 1) Explain in detail the factors determining the location of an industrial plant. (L2)
- 2) Explain in detail about product design process. (L2)
- 3) (a) Give a comparative statement in the plant location study of an urban and a rural site by stating their advantages and disadvantages. (b) Explain the quantitative techniques for optimal design of layouts. (L4)
- 4) (a) Define continuous production and list out its characteristics. (b) Design the best suitable layout plan for a cool drink/beverage bottling factory. (Assume the data and required operations arbitrarily). (L6)
- 5) What facilities/factors would influence (both favorable and/or unfavorable) the location decisions in the case of the following: (i) city/urban sites, (ii) sub-urban sites, and (iii) rural/countryside sites. (L4)
- 6) (a) Describe the various factors to be considered in selecting the actual site in a particular locality. (b) Differentiate between process layout and product layout. (L4)
- 7) (a) State the advantages of suburban area as a site for industry. (b) Describe the product layout with a neat sketch and state its advantages and limitations. (L3)
- 8) (a) What do you mean by optimal design in plant layout? (b) Briefly discuss the factors to be considered for the selection of a location for a factory construction. (L2)
- 9) Explain various types of plant layouts with their relative advantages over other types. (L2)
- 10) (a) Discuss Product type of layout. State the advantage and disadvantage of product type of layout over process type of layout. (b) Explain the steps involved in designing a plant layout. (L4)
- 11) (a) Give an example of a fixed-position layout for product manufacture and for providing a service. (b) Classify the following as a job shop or as a flow shop stating your reasons. i) Executive health check-up in a hospital, ii) Automobile Mechanic repair shop, iii) Final assembly shop of computer manufacturer, iv) Tirupati temple laddu preparation. (L5)
- 12) How does a cellular layout combine a product and process layout? What are the advantages and disadvantages of a cellular layout? (L4)

- 13) Which is the best suitable layout plan for a flour mill (for example: to process wheat to flour)? Design a hypothetical layout and describe the features of the layout you have designed. (Assume the data such as sequence of operations, type and number of machines, facilities, etc, arbitrarily.) (L6)
- 14) Write the characteristics of job, batch and mass production systems. (L1)
- 15) Differentiate between job, batch and mass production systems. (L4)
- 16) Explain features, advantages, limitations and suitability of following layouts: i) Product, ii) Process and iii) Fixed position layout. (L2)
- 17) Identify an appropriate layout for each of the following situations. Justify your choice in a sentence or two: i) Manufacturing of garments for Van Heusen, ii) Multi cuisine restaurant in a posh residential area in Mumbai, iii) overhauling of helicopters, iv) an eye hospital, v) fabricator of custom made PCBs for a large number of electronic applications, vi) motor manufacturer producing 4 product groups for worldwide markets, vii) manufacturer of large turbines for power sector applications. (L5)
- 18) (a) Describe the objectives of plant layout. (b) State the principles of good plant layout. (L2)
- 19) Explain Ranked Positional Weight (RPW) method for solving line balancing problem. (L2)
- 20) What are the different steps in value analysis process? Explain the methodology. (L2)
- 21) (a) What is value engineering? What are its advantages? (b) Explain in detail the various phases in value analysis. (L2)
- 22) Solve the line balancing problem for the given network using the RPW method if 20 assemblies are required per day, having an eight hour per day effective work time. (L3)

Element No.	1	2	3	4	5	6	7	8
Predecessor	–	–	1, 2	3	3	4, 5	5, 6	6, 7
Time in minutes	12	15	20	14	10	12	18	14

- 23) Find the number of workstations required for the given data of an assembly line using RPW method. Take cycle time = 25 minutes. (L3)

Element No.	1	2	3	4	5	6	7	8
Predecessor	–	–	1, 2	3	3	4, 5	5, 6	6, 7
Time in minutes	12	15	20	14	10	12	18	14

#### UNIT –IV

{Relates to CO4. & CO5.}

#### Short Answer Questions-

- 1) What is Work Study? (L2)
- 2) State the benefits of Work Study or basic aspects that work study takes care of. (L2)
- 3) What is allowance? What are the different types of allowances to be considered in establishing standard time? (L4)
- 4) What are the important factors affecting the allowances in work study? (L4)
- 5) Assuming that the total observed time for an operation of assembling an electric switch is 1 minute. If the rating is 120%, find normal time. If an allowance of 10% is allowed for the operation, determine the standard time. (L3)
- 6) What is Therblig? (L1)
- 7) What factors should be considered when selecting work elements for a time study? (L4)
- 8) What is micro motion study? Explain. (L2)
- 9) Explain the term: i) PMTS ii) MTM. (L2)
- 10) For what purposes might the results of a work measurement study be used? (L5)

- 11) Write short notes on procedure of method study. (L2)
- 12) Write a brief note on work measurement. (L2)
- 13) Write short notes on work sampling. (L2)
- 14) When should work sampling be used? (L5)
- 15) Define Quality. What are its types? (L1)
- 16) Define SQC. Explain its importance. (L2)
- 17) Explain the difference between inspection by attribute and inspection by variable. (L4)
- 18) Mention the different types of SQC charts for attributes. (L1)
- 19) What is difference between single sampling and double sampling plans? (L4)
- 20) Write about OC curves. (L2)
- 21) What is meant by producer risk and consumer risk with respect to OC curves? (L2)
- 22) Explain Ishikawa's Fishbone diagrams and state its application. (L2)

**Long Answer Questions-**

- a. (a) What are the techniques of work study and explain its significance. (b) What are the tools for recording information about method study? (L2)
- b. (a) State and explain in brief the steps involved in method study procedure. (b) "Critical examination is a motive force to develop a new method". Justify. (L5)
- c. (a) Name the various recording techniques used in method study. Give the various symbols used in recording techniques with their meaning. (b) Explain the objectives of time study. (L2)
- d. (a) Explain the utility of outline process chart in method study. Differentiate between outline process chart and flow process chart. (b) Explain the construction of a string diagram with a neat sketch. (L4)
- e. (a) What is a flow process chart? Discuss its utility for method study engineer. (b) Explain the objectives of micro-motion study. (L2)
- f. (a) What is time study? Describe the steps involved in time study. (b) Describe briefly the different technique of rating used in connection with work study of an operator's performance in a labor intensive industry. (L2)
- g. Compare the use of predetermined motion times for developing time standards with time study methods. What are the advantages and disadvantages of each? (L4)
- h. (a) Write stop watch procedure for collecting time study data. (b) Define SIMO charts and explain concept of it. (L2)
- i. (a) State the differences between method study and work measurement with their objectives. (b) Explain the need and procedure for conducting work sampling study. (L2)
- j. (a) Explain steps in stop watch time study for determining standard time. (b) State the advantages and limitations of stopwatch time over work sampling. (L4)
- k. (a) What do you understand by process control? Explain. (b) Define control chart and state the objectives of X-bar and R charts. (L2)
- l. (a) State the objective of X-bar and R chart. (b) Describe the method of constructing X-bar and R chart and explain how these charts help in determining lack of control. (L2)
- m. (a) What is meant by process capability? How will you determine the same? (b) Explain the theory underlying control charts for fraction defective. (L2)
- n. Explain single and double sampling plans using flow chart and state their applications. (L3)
- o. Explain about the working principle of double sampling plan with a flow chart. State its advantages over single sampling plan. (L3)

- p. If the limit of error required is to be  $\pm 5$  percent for 95 cases in 100, calculate the number of observations required if  $p=0.5$ . (L3)
- q. For a particular task (element), 40 observations were taken by a time study observer. Check whether this number of observations is sufficient for  $\pm 5\%$  accuracy with 95% confidence limit. Indicate the minimum number of observations required. (L3)

Time seconds (x)	4	5	6	7	8
Frequency / Occurrence (f)	10	5	10	10	5

- r. A job is broken into 3 elements and an initial time study of 5 cycles was undertaken:

Element	1	2	3	4	5	RF
1	1.10	1.20	0.80	1.10	0.80	1.20
2	2.20	2.30	1.50	2.10	1.90	0.90
3	1.50	1.55	1.45	1.60	1.40	1.10

Using an allowance factor of 12%, determine the standard time for this job. Also determine the number of cycles required if the company is to be 95% confident that the average time from the time study is within 4% of the true average cycle time. (L3)

- s. Calculate the limits of accuracy of given observations and check whether the number of observations is adequate for  $\pm 5\%$  accuracy and 0.95 confidence limit, if
- the number of observations of workers working = 4000
  - the number of observations of workers idle = 1000
  - total observations (n)= 5000 (L3)
- t. To determine the standard time of a particular work, 5 operators were kept under observation by a work sampling study group. The performance rating and the number of times the workers were found working each day were noted as given below:

Operator no.	Performance rating	Number of times found working				
		Jan 1	Jan 2	Jan 3	Jan 4	Jan 5
		X1	X2	X3	X4	X5
1.	120	5	6	4	5	4
2.	110	8	7	7	5	8
3.	130	10	11	9	10	10
4.	100	12	11	8	7	9
5.	120	6	8	12	11	9

The total number of observations each day was 100. The number of times workers were found idle in their respective work places:

Date	Jan 1	Jan 2	Jan 3	Jan 4	Jan 5
No. of times	5	7	6	8	7

The total production during 5 days = 3000 units, the working hours in a day = 8. Calculate the standard time for the job considering 30% as allowance. (L3)

- u. A taxi company has 20 taxis. The manager wants to establish, what proportion of time the taxis are sitting idle, which he estimates to be 25%. For a 95% level of confidence, what sample size should be used for the estimate to be within  $\pm 3\%$  of the actual proportion? How many rounds are necessary to complete the required number of observations? (L4)
- v. An operator was kept under observation for 5 days. He was found working on 400 occasions and abstaining idle 100 times. He produced 100 jobs during these days. The observation per day was 5 hours only and the total numbers of observations were 500. Take 130 as the performance rating for the operator and 30% allowance. Calculate the standard time if (i) the work is manual and (ii) if manual to machine work ratio is 3:1. (L3)

- w. (a) In a welding shop, a direct time study was done on a welding operation. One inexperienced industrial engineer and one experienced industrial engineer conducted the study simultaneously. They agreed precisely on cycle time but their opinion on rating the worker differed. The experienced engineer rated the worker 100 % while the other engineer rated the worker 120%. They used a 0.1 % allowance fraction.

Cycle time (minutes)	20	24	29	32
Number of times observed	2	1	1	1

From the above statement, determine the standard time using the experienced industrial engineer's worker rating and also using the inexperienced industrial engineer's worker rating. Comment on the reliability of time study engineers. (b) A manufacturer of garments wants to setup a quality control system using control charts for process control. The manufacturer has three options to choose from: i) Measure the critical dimensions of the garment for establishing its quality, ii) Segregate every batch of production into good quality and seconds quality, iii) Estimate the number of defects for bale of cloth issued for production. The manufacturer is not sure what it means to choose which of the above. Prepare a report explaining the pros and cons of each of the choices, the nature of efforts required to setup control charts and implications of their use. (L5)

- x. (a) A job consists of three work elements all performed by the same operator. An analyst conducted work sampling to determine the standard time for the job. The duration of the study is two shifts each with 400 minutes of effective time. The total number of acceptable units produced during the study period is 150 units. Determine the standard time by assuming allowance of 10%.

Work Element No.	1	2	3
Frequency of performance	70	80	50
Performance Rating (%)	80	120	110

(b) A time study was made of a punch press operator. The average observed time after discounting non normal occurrences was 0.52 minutes per unit. The operator performance was judged to be 90 and the allowances for this type of work totals 12 percent. What is the normal and standard time for this job? (L3)

- y. (a) What are the desirable characteristics of a sample taken for sampling plan? Explain. (b) A job has been subdivided into 4 elements. The time for each element and respective ratings are given below. Calculate the normal time and standard time for each element and for the job if allowance is 5%. (L3)

Element No.	1	2	3	4
Observed time	0.6	1	1.2	1.5
Rating factor (%)	100	80	130	90

- z. The following data represents the number of defectives found while inspecting a lot of 1000 items, the sample size being 25. Plot a p chart. Also interpret the chart. (L3)

Lot Number	1	2	3	4	5	6	7	8	9
Number of defectives	7	10	8	5	9	11	3	7	6

- aa. The following table gives the number of defects in a casting used for making crank case of a diesel engine. Construct a C chart with 3 sigma limits and comment on the casting process. (L3)

Sample Number	1	2	3	4	5	6	7	8	9	10
Number of defects	15	11	25	10	12	20	15	10	17	13

bb. The following data represents the number of defects found on each cabinet inspected. Plot a control chart with control limits. Also interpret the chart. (L3)

Sample Number	1	2	3	4	5	6	7	8
Number of defects	7	10	8	31	20	14	28	25

cc. The following data represents the mean diameter and range found on each cabinet inspected with sample size 4. Plot X-bar and R chart and state whether the process is in control. Take,  $A_2=0.729$ ,  $D_3=0$  and  $D_4=2.282$ . (L3)

Sample No.	1	2	3	4	5	6	7	8	9	10
X-bar	102	105	96	114	91	99	108	103	100	111
R	2	5	13	28	17	4	8	17	9	7

dd. The following table gives the coded measurement obtained from 10 subgroups of 5 each:

Subgroups No.	Statistics	Subgroups No.	Statistics
1	-1,2,1,0,1	6	-1,2,1,1,2
2	2,0,1,0,1	7	0,1,-3,2,1
3	1,1,0,0,1	8	0,0,-1,0,1
4	2,1,0,-1,0	9	2,1,-1,0,0
5	1,-1,0,0,-1	10	3,-3,1,1,1

i. Construct the variable controls charts with 3 sigma limits and investigate the process is in control.

ii. What will be the control limits on X-bar and R charts for immediate future?

iii. Estimate the value of standard deviation. (L4)

ee. (a) With reference to method study, describe the effect of the following factors: i) economic factors, ii) Technical factors, iii) Human factors. (b) Construct X and R charts and state whether the process is in control. X has been computed from a sample of 5 units drawn at an interval of 2 hours from an ongoing manufacturing process. Given,  $A_2=0.577$ ,  $D_3=0$  and  $D_4=2.114$ . (L3)

Sample No.	1	2	3	4	5	6	7	8	9	10
Mean X	23	37	34	13	29	26	39	45	34	20
Range R	10	30	11	21	17	20	5	14	38	34

ff. From the following readings, draw X-bar and R charts and comment on the results. (L3)

Sample #	1	2	3	4
X1	1.05	1.09	0.99	0.95
X2	1.03	1.00	1.04	1.01
X3	0.98	1.04	0.96	1.13
X4	1.01	0.93	0.99	0.99
X5	0.97	1.08	1.04	0.94

Control Chart Factors for X-bar and R Charts			
Sample size, n	Mean Factor, $A_2$	Upper Range, $D_4$	Lower Range, $D_3$
2	1.88	3.268	0
3	1.023	2.574	0
4	0.729	2.282	0
5	0.577	2.115	0

## UNIT -V

{Relates to CO6.}

### Short Answer Questions-

- 1) Define the term job evaluation and list various methods of job evaluation. (L1)
- 2) Write short notes on job description. (L2)
- 3) State and explain the advantages of job evaluation. (L2)
- 4) What are the main benefits and limitations of job evaluation? (L1)

- 5) How a merit rating is given for job evaluation? (L2)
- 6) Explain about point method of job evaluation. (L2)
- 7) What do you understand by a Project Network? (L2)
- 8) Define: i) Activity on node (AON) ii) Activity on arrow (AOA). (L1)
- 9) State Fulkerson's rule for numbering the nodes in a network. (L1)
- 10) Explain the rules of network construction. (L2)
- 11) What is project management and what are its objectives? (L1)
- 12) Provide an example of precedence relationships from your personal life. (L3)
- 13) What is project cost analysis? Narrate its importance. (L2)
- 14) What is critical path in the network diagram? How to identify it? (L2)
- 15) Differentiate between CPM and PERT. (L4)
- 16) Explain the meaning and concept of crashing in network technique and state its significance and how it is done. (L2)
- 17) Critically examine and explain the trade-off in network crashing. (L5)

### **Long Answer Questions-**

- 1) (a) What is meant by 'Job Evaluation'? (b) What objectives can be served from scientific job evaluation studies? (L2)
- 2) (a) Enumerate various steps involved in job evaluation procedure. (b) Briefly explain the job evaluation methods with merits and demerits. (L2)
- 3) Explain about classification method and factor comparison method of Job Evaluation. (L2)
- 4) Explain Network Analysis. Discuss the techniques used in network analysis in Project Management. (L2)
- 5) (a) Explain the terms related to network planning method. (b) Write applications of network techniques to simple engineering problems. (L2)
- 6) Explain Fulkerson's rule for numbering the nodes in a network using an example. (L3)
- 7) (a) How are 'Activities' classified? Explain their relationship. (b) Explain the concepts 'EST, EFT, LST, LFT', 'Free float' and 'Independent float'. (L2)
- 8) (a) What is PERT? (b) Define optimistic time, pessimistic time and most likely time and explain how to estimate the expected time to complete the activity in PERT technique. (L2)
- 9) (a) What are the steps involved in preparation of PERT diagram. (b) Write short notes on: i) CPM ii) Project crashing. (L2)
- 10) With the help of an example, explain the Critical Path Method in Project Management. (L3)
- 11) (a) Write the steps in CPM for accomplishing a project planning. (b) Explain about earliest and latest times and floats for an activity. (L2)
- 12) (a) Explain methodology in CPM analysis for determining the critical path of a network. (b) What is meant by crashing of an activity? (L2)
- 13) Define the following: i) Crash time ii) Normal cost iii) Crash cost iv) Normal time v) Cost slope. (L2)
- 14) Elucidate the procedure for network crashing. (L2)
- 15) Write Short note on: i) Project Cost Analysis and ii) Project Crashing. (L2)
- 16) Draw an A-O-A network of the project with following situation and do node labeling as per Fulkerson's rule: P, Q, R, S, T and U are activities such that P is prerequisite of S; Q is prerequisite of S and T; R is prerequisite of T; S and T are prerequisites of U. (L3)
- 17) In a construction project, events have been identified as A, B, C, D, E, F, G, H and J. A is the start event. J is the end event and it is a successor event to F. B occurs after A. C succeeds B and restrains the occurrence of G. D occurs after B but before G. E and F occur

after C. E precedes F. G is predecessor to H. H precedes J and follows F. Draw a network. (L3)

- 18) (a) Describe briefly the factor comparison method of job evaluation. (b) A project PERT network has only three possible paths, P-R, P-S-U, and Q-T-U. The activities along with their expected time and standard deviations are represented in ordered pairs as P (8, 2), Q (16, 4), R (15, 3), S (14, 2), T (5, 2) and U (5, 1). Develop the network and find the probability of completing the project in 25 days. (L3)

- 19) Time taken by different activities of P.E.R.T project is as given below: (L3)

Activity		Activities Times		
Tail Event (i)	Head event(j)	Optimistic time	Pessimistic time	Most likely time
1	2	1	3	2
2	3	1	7	4
2	7	2	4	3
3	4	1	5	3
3	5	0	0	0
4	6	0	0	0
5	6	3	13	5
7	8	4	12	8
6	9	4	14	6
8	9	1	2	2

- a) Draw the network and determine the expected duration and variance of each activity.  
 b) What is the probability of completing the project within scheduled completion time of 25 days?  
 c) What should be project duration (due date) for the probability of completion of 95%?  
 d) Calculate approximate probability that jobs on next most critical path be completed by 25<sup>th</sup> day?  
 e) Estimate the probability that entire project will be completed by due date of 25 days?
- 20) The following represents a project that should be scheduled using PERT: (L3)

Task	Immediate Predecessors	Times (days)
		$t_o-t_m-t_p$
A	-	10-22-28
B	A	4-4-10
C	A	4-6-14
D	B	1-2-3
E	C	1-5-9
F	C, D	7-8-9
G	E, F	2-2-2

- a) Draw the network if  $t_o$ ,  $t_m$ ,  $t_p$  represents least, most likely and great time respectively.  
 b) Calculate the earliest expected time and the latest allowable occurrence time for each event taking due date as 40 days.  
 c) Determine the critical path and the expected project completion time?

- d) Determine the probability of completing the project no more than 5 days later than expected project completion time?
- e) Calculate the probability of not completing the project at least 3 days earlier than expected time.

21) A manufacturing company is planning to introduce a new product commercially. The list of activities to be carried out with the corresponding duration of time in weeks is listed below: (L5)

Activity	Description	Duration	Immediate Predecessor
A	Initial discussions	3	-
B	Product design	11	A
C	Market survey	9	A
D	Market evaluation	2	C
E	Product costing	5	B
F	Sales plan	6	C
G	Product pricing	2	D, E
H	Prototype construction	11	F, G
I	Market information preparation	8	B
J	Prototype testing	9	H, I

- a) Draw the network to represent various activities of the project and find the minimum duration of the project?
- b) Answer the following (each is an independent issue by itself):
- What is the effect on critical path if job F is delayed and it takes 10 days for its completion?
  - Does the project duration get affected if job I is delayed by 8 more days?
  - What difference does it make if jobs B and E are completed 2 days ahead of schedule?

22) For the characteristics of a project schedule as given below: (L3)

Activity	1-2	1-3	2-4	3-4	3-5	4-9	5-6	5-7	6-8	7-8	8-10	9-10
Time(days)	4	1	1	1	6	5	4	8	1	2	5	7

- a) Construct the CPM network.
- b) Calculate total float, free float and independent float for all the activities (critical and non-critical)
- c) Calculate earliest and latest, start and finish time for all the activities
- d) Calculate project duration and identify critical path.
- 23) A maintenance project consists of jobs as shown in the table. Determine the minimum crashing cost of schedules ranging from normal length down to and including the minimum length schedule. (L3)

Job	Normal time in days	Crash time in days	Cost Slope (Rs./day)
1-2	9	6	200
1-3	8	5	250
1-4	15	10	300

2-4	5	3	100
3-4	10	6	150
4-5	2	1	400

24) The table below shows the related activities of a project normal and crash duration in number of days and cost in Rs. The indirect cost of the project is Rs. 150 per day. (L5)

Activity	Normal		Crash	
	Duration	Cost	Duration	Cost
1-2	3	360	2	400
2-3	6	1400	4	1600
2-4	9	2000	5	2600
2-5	7	1000	5	1500
3-4	8	400	4	600
4-5	5	1600	3	2000
5-6	3	500	2	750

- Draw the network and find the normal duration and cost of completing the project?
- Crash the project systematically and plot the project time-cost curve.
- Based on project time-cost curve, answer the following:
  - What is the optimum duration and optimum cost of the project?
  - What is the minimum possible duration and corresponding cost of the project?
  - If it is mandated to complete the project within 18 days, what is the optimum duration to do so?
  - What should be the strategy if the firm would have to pay a penalty of Rs. 75 per day for delay in project completion beyond 14 days?
  - If bonus of Rs. 5000 is available for completing the project by 10<sup>th</sup> day, should the proposal be accepted?

25) A project is composed of five jobs namely P, Q, R, S and T. Activity P must precede all others while activity T must follow all others while other jobs can run concurrently. The normal and crash cost in thousands of rupees per day for the activities are given in the form  $X(N_c/N_t, C_c/C_t)$  where ( $N_c$  is Normal cost,  $N_t$  is Normal time,  $C_c$  is Crash cost and  $C_t$  is Crash time) as P(60/10, 80/8), Q(24/12, 40/4), R(20/8, 36/6), S(24/10, 40/6) and T(32/6, 32/6). Draw the network and AON diagrams and identify the critical path. Also crash the network fully to find out the minimum duration and optimum cost. Indirect costs are Rs. 6000/day. (L3)

26) The given table reveals the information about various activities of a project network. There is a possibility to crash any activity for maximum of 2 days at the rate of Rs. 1000 per day for the activity starting at event-1, Rs. 800 per day at event-2 and Rs. 500 at event-3. The overhead costs are Rs. 1300 per day.

- Construct the project network and identify the critical path. What is the normal duration and corresponding total cost of the project?
- Crash the project systematically and plot the project time-cost curve. Find out minimum cost and optimal time and also find out the additional cost required to reach the optimal time. (L3)

Activity	Duration (Days)	Cost (Rs.)
1-2	9	8000
1-3	5	5000
1-4	10	7000
2-4	8	6000
3-4	6	9000

## XI. OBJECTIVE QUESTIONS: JNTUH

### UNIT-I

- Management is the art of \_\_\_\_\_ through formally organized groups.
- Management is both \_\_\_\_\_ and \_\_\_\_\_.
- Management is an \_\_\_\_\_ science.
- The functions of management as given by Henry Fayol include to forecast and plan, to organize, \_\_\_\_\_, to coordinate and to control.
- The 4M's of management may be identified as: (a) \_\_\_\_\_ (b) \_\_\_\_\_ (c) \_\_\_\_\_ (d) \_\_\_\_\_.
- Planning ends with \_\_\_\_\_.
- Management is necessary to ensure \_\_\_\_\_ in organization.
- The approach that says technology alone cannot make organizations successful is known as \_\_\_\_\_.
- Elton Mayo is well known for \_\_\_\_\_ experiments.
- \_\_\_\_\_ coined the term 'POSDCORB'.
- \_\_\_\_\_ is attributed with the development of the two-factor theory of motivation.
- The father of modern management is \_\_\_\_\_.
- Gilbreth divided all human movements into elements according to their properties and are termed as \_\_\_\_\_.
- One of the principles of Management as developed by Henry fayol with the meaning 'In Union there is Strength' is originally referred as \_\_\_\_\_.
- In Maslow's Needs theory, \_\_\_\_\_ level represents the peak point of all needs.
- Authority can be delegated but \_\_\_\_\_ cannot be delegated.
- One of the earliest and most enduring descriptions of managerial roles comes from \_\_\_\_\_.
- The process of determining the course of action to achieve the goals is called \_\_\_\_\_.
- \_\_\_\_\_ function aims at selecting the right person for right job.
- Name two non-financial factors that motivate the employees (i) \_\_\_\_\_ (ii) \_\_\_\_\_.
- The leaders who involve their subordinates in decision making are said to adopt \_\_\_\_\_ style of leadership.
- Force = valence x \_\_\_\_\_. (A) experience (B) experiment (C) expectancy (D) equality
- Which of the following management concepts does not refers to: (A) social process (B) exact science (C) omnipresent and universal (D) situational in nature.
- The process which includes selection, recruitment, training, etc. is: (A) organizing (B) staffing (C) forecasting (D) planning.

25. The process of transmitting ideas to the concerned persons or agencies is called as: (A) organizing (B) communicating (C) controlling (D) coordinating.
26. One of the principles of Management that refers to respect for agreements that are directed to achieving obedience, application and onward marks of respect is termed as: (A) discipline (B) authority (C) responsibility (D) order.
27. The managerial function with a set of processes used to get people work together by influencing, motivating and directing together for achieving organizational goals is termed as: (A) controlling (B) organizing (C) leading (D) planning.
28. An Autocratic leader is one who: (A) invites suggestions from followers before taking the final decision (B) gives lot of freedom to the followers to act as they prefer (C) takes decisions but leaves the remaining to subordinates (D) dislikes to receive either suggestions or options from the subordinates.
29. In 'POSDCORB' the letter 'R' stands for: (A) Reasoning (B) Reviewing (C) Reporting (D) Redrafting.
30. Continuous food and shelter comes under \_\_\_\_\_ needs: (A) affiliation (B) esteemed (C) physiological (D) safety.
31. Which of the following is not a financial factor in the motivation process: (A) allowances (B) bonus (C) flexible working hours (D) salary packages.
32. Which feature does not form as one of Fayol's 14 principles of management? (A) order (B) esprit de corps (C) initiative (D) individualism.
33. What do you call a style of leadership that takes account of other's views, opinions and ideas? (A) Autocratic (B) Democratic (C) Laissez-faire (D) People-oriented.
34. Unity of command means \_\_\_\_\_.

## UNIT-II

1. An organization bounded by defined rules and regulations is called \_\_\_\_\_.
2. An organization governed by likes and dislikes of its members is called \_\_\_\_\_.
3. A diagrammatic representation in a miniature form of the structure of the organization is known as \_\_\_\_\_.
4. In line and staff form of organization structure, planning of work will be carried out by \_\_\_\_\_ personnel.
5. If a large variety of projects ranging from large to small, \_\_\_\_\_ type of organization structure is suitable.
6. Lean organization structure facilitates effective supervision on account of \_\_\_\_\_ number of subordinates under one's jurisdiction.
7. The line of authority is identified in \_\_\_\_\_.
8. Unity of command means \_\_\_\_\_.
9. Different layers of management in an organization are called \_\_\_\_\_.
10. A flat organization is always associated with \_\_\_\_\_ span.
11. The authority and responsibility should always be \_\_\_\_\_ and \_\_\_\_\_.
12. The principle of one subordinate- one supervisor is called \_\_\_\_\_.
13. That type of organization structure wherein no member owns responsibility for decision is called \_\_\_\_\_.
14. The line of flow of authority from the management to every subordinate in the organization is called \_\_\_\_\_.
15. The project organization is also called \_\_\_\_\_.

16. The type of organization structure wherein one member owns the responsibility for decision is called \_\_\_\_\_.
17. Line organization is suitable for a \_\_\_\_\_ organization.
18. Line organization is favored because of \_\_\_\_\_.
19. \_\_\_\_\_ refers to the effective control of a number of subordinates by supervisor at a given point of time.
20. 'Span of control' implies: (A) imposing controls on managers (B) the relationship between one department and another (C) proportion between boss and subordinates under his jurisdiction (D) empowering subordinates to discharge the duties of their boss.
21. The type of organization structure preferred for conducting an industrial tour is: (A) line (B) line and staff (C) functional (D) committee.
22. The role of gang boss in functional organization is: (A) preparation of all work up to the time that the work piece is set in the machine (B) to issue specifications and instructions related to jobs to the workers (C) to look after the maintenance of tools and accessories as per specifications (D) to maintain good relations with subordinates.
23. Decentralization of authority facilitates the management to: (A) restrict the powers of top management (B) derive quickness in decision making (C) minimize the number of decision makers in the hierarchy (D) maintain effective industrial relations.
24. The type of organization preferred for an automobile industry is \_\_\_\_\_. (A) line organization (B) functional organization (C) line and staff organization (D) line, staff and functional organization.
25. Military type of organization is known as \_\_\_\_\_. (A) line organization (B) functional organization (C) line and staff organization (D) line, staff and functional organization.
26. In a line organization \_\_\_\_\_. (A) responsibility of each individual is fixed (B) discipline is strong (C) quick decisions are taken (D) all of these.
27. In a functional organization \_\_\_\_\_. (A) quality of work is better (B) wastage of material is minimum (C) specialized knowledge and guidance to individual worker is provided (D) all of these.
28. F. W. Taylor introduced a system of organization known as \_\_\_\_\_.: (A) line organization (B) functional organization (C) line and staff organization (D) line, staff and functional organization.

### UNIT-III

1. \_\_\_\_\_ production method and \_\_\_\_\_ layout is suitable for ship building.
2. In job production, the design of production depends on the \_\_\_\_\_.
3. \_\_\_\_\_ layout is characterized by lower degree of flexibility.
4. In \_\_\_\_\_ layout, the degree of flexibility is relatively high.
5. The voluntary group of employees from given section or department meet on a regular basis to identify, analyze and develop solutions to a variety of work related problems is called \_\_\_\_\_.
6. Plant location is a \_\_\_\_\_ decision.
7. The type of production where design varies from product to product is \_\_\_\_\_.
8. Aircraft building is an example of \_\_\_\_\_ layout.
9. The type of production system followed in sugar mills is \_\_\_\_\_.
10. If all the processing equipment and machines are arranged according to the sequence of operations of a product the layout is known as \_\_\_\_\_.

11. Plant layout is a determinant of \_\_\_\_\_ and profitability.
12. Distributing the tasks evenly over work stations, so as to minimize idle time of men and machines is called as \_\_\_\_\_.
13. The relationship between inputs and outputs is called \_\_\_\_\_.
14. RPW method of Line Balancing was given by \_\_\_\_\_.
15. In line balancing problem for the given network, if 25 assemblies are required per day, having an eight hour per day effective work time then the cycle time is \_\_\_\_\_ minutes.
16. In fixed position layout, the material movement cost is \_\_\_\_\_.
17. Job order production is preferred if: (A) standardized products are to be maintained in large quantities (B) customers preferences vary from time to time (C) the Management has chosen the policy of 'Make to Stock' (D) automation in production is needed.
18. The subsystem responsible for the conversion of a design data to work instruction is termed as: (A) product planning (B) project planning (C) process planning (D) none of the above.
19. The type of production used for cars and scooters, is: (A) job production (B) batch production (C) flow production (D) just in time.
20. What is advantage for product layout? (A) huge capital layout (B) little flexibility (C) lower cost of material handling (D) discontinuity in produces.
21. Operations management is a \_\_\_\_\_ process. (A) Translation (B) transformation (C) transition (D) transaction.
22. Which of these layout types is most associated with a mass process? (A) Product (B) process (C) fixed position (D) cellular.
23. The following type of layout is preferred for low volume production of non standard products: (A) Product layout (B) Process layout (C) Fixed position layout (D) Combination layout.
24. This chart is a graphic representation of all the production activities occurring on the shop floor: (A) Operation process chart (B) Flow process chart (C) Templates (D) All of the above.
25. If a line is balanced with 90 percent efficiency, the balance delay would be \_\_\_\_\_. (A) 10 percent (B) 90 percent (C) 100 percent (D) None of the above.
26. For a small scale industry, the fixed cost per month is Rs. 5000. The variable cost per product is Rs. 20 and sales price is Rs. 30 per piece. The break even production per month will be: (A) 300 (B) 460 (C) 500 (D) 1000.
27. In jobbing production: (A) highly skilled workers are needed (B) unit costs are high (C) operations are labor-intensive (D) all of these.
28. Which of the following charts are used for plant layout design? (A) Operation process chart (B) Man machine chart (C) Travel chart (D) all of these.
29. The main object of scientific layout is: (A) to produce better quality of product (B) to utilize maximum floor area (C) to minimize production delays (D) all of these.
30. The type of layout used for manufacturing steam turbines, is: (A) product layout (B) process layout (C) fixed position layout (D) any one of these.
31. Product layout is best suited where: (A) one type of product is produced (B) product is standardized (C) product is manufactured in large quantities (D) all of the above.
32. The product layout: (A) lowers overall manufacturing time (B) requires less space for placing machines (C) utilizes machine and labor better (D) all of these.
33. The unit cost in case of batch production is \_\_\_\_\_ as compared to jobbing production. (A) same (B) low (C) high (D) None of these.

34. Fixed position layout is also known as: (A) analytical layout (B) synthetic layout (C) static product layout (D) none of these.
35. In order to avoid excessive multiplication of facilities, the layout preferred is: (A) product layout (B) process layout (C) group layout (D) static layout.
36. Which of the following type of layout is suitable for automation and automobile manufacturing concern? (A) product layout (B) process layout (C) fixed position layout (D) combination layout.
37. In product layout: (A) specialized and strict supervision is required (B) machines may not be used to their maximum capacity (C) manufacturing cost rises with a fall in the volume of production (D) all of the above.
38. In process layout: (A) handling and back-tracking of materials is too much (B) production control is more difficult and costly (C) routing and scheduling is more difficult (D) all of the above.
39. According to Muther, the basic principle of best layout is: (A) principle of over-all integration (B) principle of flow (C) principle of flexibility (D) all of these.
40. Product layout is also known as: (A) analytical layout (B) synthetic layout (C) static product layout (D) none of these.
41. Product layout is used for: (A) job production (B) batch production (C) mass production (D) any one of these.
42. Process layout is also known as: (A) analytical layout (B) synthetic layout (C) static product layout (D) none of these.
43. Process layout is employed: (A) where low volume of production is required (B) where similar jobs are manufactured on similar machines (C) where machines are arranged on functional basis (D) all of the above.
44. In value engineering, the term value refers to: (A) manufacturing cost of the product (B) selling price of the product (C) total cost of the product (D) utility of the product.
45. In value engineering, important consideration is given to: (A) customer satisfaction (B) function concept (C) profit maximization (D) cost reduction.
46. The aim of value engineering is to: (A) find the depreciation value of a machine (B) determine the selling price of a product (C) minimize the cost without change in quality of the product (D) all of the above.
47. Value analysis is particularly of interest when: (A) jobbing work economics are involved (B) production is on large scale (C) only few components are involved (D) costly equipment is used.
48. The value engineering technique in which experts of the same rank assemble for product development is called: (A) Delphi (B) brain storming (C) morphological analysis (D) direct expert comparison.
49. The correct sequence of phases in value engineering is: (A) creative phase, information phase, investigation phase, evaluation phase (B) information phase, creative phase, investigation phase, evaluation phase (C) investigation phase, information phase, creative phase, evaluation phase (D) creative phase, investigation phase, evaluation phase, information phase.

#### **UNIT-IV**

1. The technique which aims at avoiding unnecessary movements in carrying out a given job is called \_\_\_\_\_.
2. The term Therblig was coined by \_\_\_\_\_.

3. Two components of work study are \_\_\_\_\_ and \_\_\_\_\_.
4. The basic unit of work activity in micro motion studies is called \_\_\_\_\_.
5. SIMO charts are used in micro motion studies which are \_\_\_\_\_.
6. Any measurable characteristic is called \_\_\_\_\_.
7. The control chart for sample means is called \_\_\_\_\_.
8. The product quality characteristics which can be measured only in terms of go or no go basis is called \_\_\_\_\_.
9. Quality may be of two types: quality of design and \_\_\_\_\_.
10. \_\_\_\_\_ is defined as customer satisfaction in general and fitness for use in particular.
11. The process of measuring the output and comparing it to check whether it meets the given specified requirements or not, is called \_\_\_\_\_.
12. Where the data given is about the number of defects per unit, \_\_\_\_\_ chart can be used.
13. If the data given is about the number of defectives, \_\_\_\_\_ chart can be used.
14. In time study, normal time is \_\_\_\_\_ than the standard time.
15. \_\_\_\_\_ is used where the management wants to know the percentage of idle time for workers.
16. The difference between maximum and minimum values of measurement of units in a given sample is called \_\_\_\_\_.
17. Work study is done with the help of \_\_\_\_\_.
18. We use control charts to monitor \_\_\_\_\_.
19. In acceptance sampling, when there is a finite probability that the lot may be accepted even if the quality is not really good, is called \_\_\_\_\_.
20. The mean of sampling distribution is equal to mean of \_\_\_\_\_.
21. The chart used to monitor variable is \_\_\_\_\_.
22. An analyst who wanted to estimate the percentage of time a machine is idle would probably use \_\_\_\_\_ method.
23. Therbligs are most closely related to \_\_\_\_\_.
24. \_\_\_\_\_ study is a relatively low cost way of designing work for high productivity.
25. \_\_\_\_\_ method of determining standard time is profitable for long cycle operation.
26. Work study examines: (A) Method (B) Duration of work (C) Both A and B (D) None of the above.
27. In process charts, the symbol used for storage is: (A) Circle (B) Square (C) Arrow (D) Triangle
28. Which among the following is a type of control chart for variables? (A) C Chart (B) P Chart (C)  $\bar{x}$  chart (D) U Chart
29. Work study involves: (A) only method study (B) only work measurement (C) method study and work measurement (D) only motion study.
30. Work study is mainly aimed at: (A) determining the most efficient method of performing a job (B) establishing the minimum time of completion of a job (C) developing the standard method and standard time of a job (D) economizing the motions involved on the part of the worker while performing a job.
31. The main objective of work measurement is to: (A) plan and schedule of production (B) formulate a proper incentive scheme (C) estimate the selling prices and delivery dates (D) all of the above.
32. The average time recorded by work study man for an operation is called: (A) standard time (B) normal time (C) observed time (D) none of these.

33. Which one of the following techniques is used for determining allowances in time study?  
(A) Acceptance sampling (B) Linear regression (C) Work sampling (D) Job Evaluation.
34. P.M.T.S. (Predetermined Motion Time Systems) include: (A) M.T.M. (Method Time Measurement) (B) W.F.S. (Work Factor Systems) (C) B.M.T.S. (Basic Motion Time Study) (D) all of these.
35. The time taken by a trained worker to perform an operation, while working at a steady pace, is known as: (A) standard time (B) normal time (C) representative time (D) none of these.
36. Time study is carried out to determine the time required to complete job by: (A) a slow worker (B) a fast worker (C) an average worker (D) an apprentice.
37. Time study is used to: (A) determine standard costs (B) determine the number of machines a person may run (C) provide a basis for setting piece price or incentive wages (D) all of the above.
38. In time study, the rating factor is applied to determine: (A) standard time of a job (B) merit rating of the worker (C) fixation of incentive rate (D) normal time of a worker.
39. The determination of standard time in a complex job system is best done through: (A) stop watch time study (B) analysis of micro motions (C) grouping timing technique (D) analysis of standard data system.
40. The purpose of micro motion study is to: (A) assist in finding out the most efficient way of doing work (B) train the individual operator regarding the motion economy principles (C) help in collecting the motion time data for synthetic time standards (D) all of the above.
41. Micro motion study is: (A) analysis of one stage of motion chart (B) motion study, when seen on a time chart (C) subdivision of an operation into Therbligs and their analysis (D) enlarged view of motion study.
42. M.T.M. is used to: (A) improve existing methods (B) establish time standards (C) develop effective methods in advance of the beginning of production (D) all of the above.
43. Standard time is equal to: (A) normal time minus allowances (B) normal time plus allowances (C) representative time multiplied by rating factor (D) normal time taken by an operation.
44. Time study is carried out: (A) by finding all the significant information's regarding the job, work place and machine tool etc. (B) by breaking up each operation into small elements which are measurable with the help of the measuring device accurately (C) by observing and recording the time taken by the operator for an operation (D) all of the above.
45. Acceptance sampling is used in: (A) job production (B) batch production (C) mass production (D) all of the above.
46. Work sampling is applied for: (A) estimation of the percentage utilization of machine tools (B) estimating the percentage of the time consumed by various job activities (C) finding out time standards, especially where the job is not repetitive and where time study by stop watch method is not possible (D) all of the above.
47. A diagram showing the path followed by men and materials while performing a task is known as: (A) string diagram (B) travel chart (C) flow process chart (D) flow diagram.
48. The symbol  refers \_\_\_\_\_ and \_\_\_\_\_. (A) operation (B) operation and inspection (C) operation and transport (D) transport and inspection.

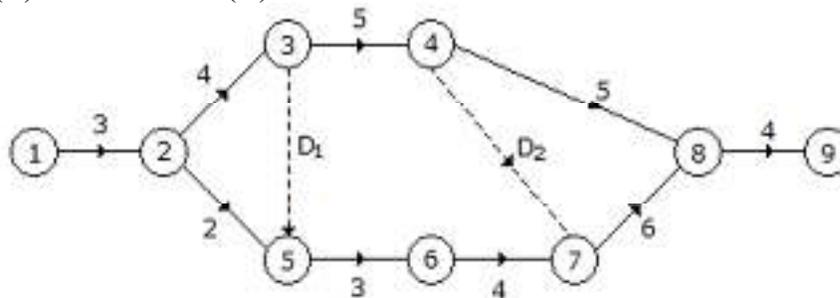
#### UNIT-V

1. The allowance delay for an event without causing delay of the project completion is called \_\_\_\_\_.
2. An activity with a specific goal occupying a specific period of time is called \_\_\_\_\_.

3. \_\_\_\_\_ is event oriented technique.
4. \_\_\_\_\_ decides the relative values of different jobs in an organization.
5. A job \_\_\_\_\_ is a written statement of the job's activities, the equipment required for it, and the working conditions in which it exists.
6. The various commonly used methods or systems of job evaluation are: i) \_\_\_\_\_, ii) \_\_\_\_\_, iii) \_\_\_\_\_.
7. Job factors in point method are: i) \_\_\_\_\_ ii) \_\_\_\_\_ iii) \_\_\_\_\_ iv) \_\_\_\_\_.
8. A programme is also called a \_\_\_\_\_.
9. The task or an activity which does not consume resources yet is shown to indicate a logical sequence in a network is called \_\_\_\_\_.
10. The event which is not tied into the network is called \_\_\_\_\_.
11. To deal with large and complex projects or works management use \_\_\_\_\_.
12. The link between Gantt chart PERT/CPM network is \_\_\_\_\_.
13. The absolute minimum time associated with the crash cost is \_\_\_\_\_.
14. The time estimate which assumes no hindrances in its completion is called \_\_\_\_\_.
15. Float represents \_\_\_\_\_ utilized resources.
16. The formula for cost slope in project crashing is \_\_\_\_\_.
17. In beta distribution standard deviation is equal to \_\_\_\_\_.
18. Which of the following is not content of job description: (A) job title (B) personnel manager (C) main objective (D) what authority one has.
19. Time taken to delay a particular event without affecting the project completion time is (A) deviation (B) succession (C) slack (D) critical path.
20. What does crash cost means? (A) cost incurred due to crash (B) cost incurred due to errors (C) cost incurred to reduce activity duration to minimum (D) None of these.
21. The performance of a specific task in CPM is known as \_\_\_\_\_. (A) Dummy (B) Event (C) Activity (D) Contract.
22. Job Evaluation tries to make a systematic comparison between: (A) Workers (B) Jobs (C) Machines (D) Departments.
23. Which of the following statement is not correct: (A) PERT is probabilistic in nature (B) CPM is probabilistic in nature (C) CPM and PERT use similar terminology but were developed independently (D) All of the above.
24. Arcs in a project network indicate: (A) Completion times (B) Precedence relationships (C) Activities (D) The critical path.
25. A dummy activity becomes a critical activity when its earliest start time (EST) is \_\_\_\_\_ as its latest finishing time (LFT).
26. \_\_\_\_\_ is a project planning and control technique.
27. Job evaluation is the method of determining the: (A) relative values of a job (B) worker's performance on a job (C) worth of the machine (D) value of overall production.
28. Bar chart is suitable for: (A) large project (B) major work (C) minor work (D) all of these.
29. Which of the following increases with the number of days in the project: (A) optimal costs (B) direct costs (C) indirect costs (D) all of these.
30. Which of the following statement is wrong? (A) An activity consume time and resources whereas an event do not consume time or resources (B) The performance of a specific task is called an activity (C) An event is an instantaneous point in time at which an activity begins or ends (D) The turning of a job on lathe is an event whereas job turned is an activity.

31. Which of the following are the guidelines for the construction of a network diagram? (A) Each activity is represented by one and only one arrow in the network (B) Dangling must be avoided in a network diagram (C) Dummy activity consumes no time or resource (D) all of the above.
32. Which of the following statement is correct about the network diagram? (A) The head of the arrow represents the end of an activity (B) The events are represented graphically by circles or nodes at the beginning and the end of activity by arrows (C) The tail end of the arrow represents the start of an activity (D) all of the above.
33. The start or completion of task is called: (A) an event (B) an activity (C) a duration (D) none of these.
34. Actual performance of a task is called: (A) an event (B) an activity (C) a duration (D) none of these.
35. An activity of the project is graphically represented by \_\_\_\_\_ on the network diagram. (A) a circle (B) a straight line (C) an arrow (D) none of these.
36. A dummy activity in a network diagram: (A) is represented by a dotted line (B) is an artificial activity (C) does not consume time or resources (D) all of the above.
37. Dummy activities are used to: (A) determine the critical path (B) determine the project completion time (C) maintain the required network (D) none of these.
38. Earliest finish time can be regarded as: (A) earliest start time + duration of activity (B) earliest start time - duration of activity (C) latest finish time + duration of activity (D) latest finish time - duration of activity.
39. Slack represents the difference between the: (A) earliest completion time and latest allowable time (B) latest allowable time and earliest completion time (C) earliest completion time and normal expected time (D) latest allowable time and normal allowable time.
40. When slack of an activity is positive: (A) it represents a situation where extra resources are available and the completion of project is not delayed (B) it represents that a programme falls behind schedule and additional resources are required to complete the project in time (C) the activity is critical and any delay in its performance will delay the completion of whole project (D) none of the above.
41. When slack of an activity is negative: (A) it represents a situation where extra resources are available and the completion of project is not delayed (B) it represents that a programme falls behind schedule and additional resources are required to complete the project in time (C) the activity is critical and any delay in its performance will delay the completion of whole project (D) none of the above.
42. Slack may be: (A) positive (B) zero (C) negative (D) all of the above.
43. A critical activity has: (A) maximum slack (B) minimum slack (C) zero slack (D) average slack.
44. A PERT network has three activities on critical path with mean time 3, 8 and 6 and standard deviations 1, 2 and 2 respectively. The probability that the project will be completed in 18 days is: (A) 0.50 (B) 0.63 (C) 0.90 (D) 0.99.
45. PERT stands for: (A) Programme Estimation and Reporting Technique (B) Process Estimation and Review Technique (C) Programme Evaluation and Review Technique (D) Planning Estimation and Resulting Technique.
46. PERT requires: (A) single time estimate (B) double time estimate (C) triple time estimate (D) none of these.

47. PERT analysis is based upon: (A) optimistic time (B) pessimistic time (C) most likely time (D) all of the above.
48. PERT is applied for: (A) marketing programmes and advertising programmes (B) installation of machinery (C) research and development of products (D) all of the above.
49. PERT: (A) provides an approach for keeping planning up-to-date (B) provides a way for management to require that planning be done on a uniform and logical basis (C) permits management to foresee quickly the impact of variations from the plan (D) all of the above.
50. CPM stands for: (A) Combined Process Method (B) Critical Path Method (C) Common Planning Method (D) Critical Process Method.
51. Which of the following statement is correct? (A) When slack of an activity is zero, it falls only on critical path (B) CPM technique is useful to minimize the direct and indirect expenses (C) Critical path of a network represents the minimum time required for completion of project (D) all of the above.
52. Critical path method: (A) helps in ascertaining time schedules (B) makes better and detailed planning possible (C) provides a standard method for communicating project plans schedules and to time and cost performance (D) all of the above.
53. CPM requires: (A) single time estimate (B) double time estimate (C) triple time estimate (D) none of these.
54. The essential condition for the decompression of an activity is that: (A) the project time should change due to decompression (B) after decompression the time of an activity invariably exceeds its normal time (C) an activity could be decompressed to the maximum extent of its normal time (D) none of the above.
55. The probabilistic time is given by: (where  $t_o$  = Optimistic time,  $t_p$  = Pessimistic time, and  $t_m$  = Most likely time): (A)  $(t_o + t_p + t_m)/3$  (B)  $(t_o + 2t_p + t_m)/4$  (C)  $(t_o + 4t_p + t_m)/6$  (D)  $(t_o + t_p + 4t_m)/6$ .
56. In CPM, the cost slope is determined by (where  $C_c$  = Crash Cost,  $N_c$  = Normal Cost,  $C_t$  = Crash Time and  $N_t$  = Normal Time): (A)  $C_c/N_c$  (B)  $(C_c - N_c)/(N_t - C_t)$  (C)  $N_c/C_c$  (D)  $(N_c - C_c)/(N_t - C_t)$ .
57. In a network shown in the figure below, the critical path is along: (A) 1-2-3-4-8-9 (B) 1-2-3-5-6-7-8-9 (C) 1-2-3-4-7-8-9 (D) 1-2-5-6-7-8-9.



## XII. GATE QUESTIONS:

- The principles of motion economy are mostly used while conducting
  - a method study on an operation
  - a time study on an operation
  - a financial appraisal of an operation
  - a feasibility study of the proposed manufacturing plant
- The standard time of an operation while conducting a time study is

- (A) Mean observed time + allowances  
 (B) Normal time + allowances  
 (C) Mean observed time + rating factor + allowances  
 (D) Normal time + rating factor + allowances
3. In PERT analysis a critical activity has  
 (A) Maximum Float (B) zero Float (C) Maximum Cost (D) minimum Cost
4. An assembly activity is represented on an Operation Process Chart by the symbol  
 (A) □ (B) A (C) D (D) O
5. A project has six activities (A to F) with respective activity durations 7, 5, 6, 6, 8, 4 days. The network has three paths A-B, C-D and E-F. All the activities can be crashed with the same crash cost per day. The number of activities that need to be crashed to reduce the project duration by 1 day is:  
 (A) 1 (B) 2 (C) 3 (D) 6
6. The expected time ( $t_e$ ) of a PERT activity in terms of optimistic time ( $t_0$ ), Pessimistic time ( $t_p$ ) and most likely time ( $t_m$ ) is given by \_\_\_\_\_.
7. For an assembly line, total task time at the workstation I, II, III, IV, V and VI in minutes are 7, 9, 7, 10, 9 and 6 minutes respectively. What is the line efficiency of the assembly line?  
 (A) 70% (B) 75% (C) 80% (D) 85%
8. An electronic equipment manufacturer has decided to add a component subassembly operation that can produce 80 units during a regular 8-hrs shift. The operation consist of three activities namely M-Mechanical assembly, E- Electric wiring and T-Test taking Standard time in minutes 12, 16 and 3 respectively. For line balancing, the number of work stations required for the activities M, E and T would respectively be (A) 2, 3, 1 (B) 3, 2, 1 (C) 2, 4, 2 (D) 2, 1, 3
9. A firm produces 120 units of product in every 8 hour shift. Four operations (P, Q, R and S) having processing time in minutes 1, 2, 4 and 3 respectively are needed to manufacture each unit of product. Operations Q and R cannot be performed before completing operation P. Operation S can be performed only after completing operations Q and R. These operations are to be assigned to workstations, such that one or more operations are performed in each workstation. Only one unit of product will be processed in each workstation at a time. The minimum number of workstations that will achieve the production target, without violating the precedence constraints, is (A) 1 (B) 2 (C) 3 (D) 4
10. For a particular project, eight activities are to be carried out. Their relationships with other activities and expected duration are mentioned in the table below:

Activity	a	b	c	d	e	f	g	h
Predecessors	-	a	a	a	b	d	c, e	f, g
Duration (days)	3	4	5	4	2	9	6	2

The critical path for the project is:

- (A) a – b – e – g – h (B) a – c – g – h (C) a – d – f – h (D) a – b – c – f – h

### XIII. IES QUESTIONS:

1. A company wants to expand the solid propellant manufacturing plant by the addition of more than 1 ton capacity curing furnace. Each ton of propellant must undergo 30 minutes of furnace time including loading and unloading operations. Furnace is used only 80 percent of the time due to power restrictions. The required output for the new layout is to be 16 tons

- per shift (8 hours). Plant (system) efficiency is estimated at 50 percent of system capacity. The number of furnaces required will be (A) 3 (B) 2 (C) 1 (D) 4
2. To construct an operating characteristic curve, an agreement has to be reached between producer and consumer through which of the following points?
    - (1) Maximum proportion of defectives that will make the lot definitely unacceptable
    - (2) The producer is willing to accept that some of satisfying the quality level (AQL) will be rejected ( $\alpha = 5\%$ )
    - (3) Maximum level of percentage defectives that will make the lot definitely unacceptable
    - (4) The consumer is willing to take lots of quality level (LTPD) even though they are unacceptable ( $\beta = 10\%$ )
 (A) 1, 2 and 3 only (B) 1, 2, 3 and 4 (C) 1, 2 and 4 only (D) 2, 3 and 4 only
  3. An organization has decided to produce a new product. Fixed cost for producing the product is estimated as Rs. 1, 00, 000. Variable cost for producing the product is Rs. 100. Market survey indicated that the product selling price could be Rs. 200. The break even quantity is (A) 1000 (B) 2000 (C) 500 (D) 900.
  4. The time for which a piece of equipment operates is called: (A) Seek time (B) effective time (C) access time (D) real time
  5. Travel chart mainly helps: (A) Improving the existing plant layout (B) while selecting plant location (C) While introducing new products (D) none of the above
  6. A dummy activity is used in PERT network for: (A) Precedence relationship (B) Necessary time delay (C) Resource restriction (D) Resource idleness
  7. The objective of work measurement is to: (A) Plan and schedule the production (B) Estimate the selling price and delivery date (C) Formulate a proper incentive scheme (D) All of the above
  8. In value engineering 'worth' is value of: (A) Product (B) Service (C) System (D) Function
  9. In CPM, the project duration can be reduced by crashing: (A) One or more non-critical activities (B) One or more critical activities only (C) One or more dummy activities only (D) Activities having independent float.
  10. Value engineering is necessary to be used when following symptoms are indicated: (1) New product designs are to be introduced (2) The firm is unable to meet delivery date (3) Rate of return on investment goes down. Which of the above statements is/are correct? (A) 1, 2 and 3 (B) 2 only (C) 1 and 3 only (D) 2 and 3 only
  11. During the time study on a job, the representative time, the rating and allowances are observed to be 0.4 minutes, 120% and 10% of standard time respectively. The normal time and standard time, in minutes, are respectively: (A) 0.48 and 0.533 (B) 0.533 and 0.48 (C) 0.6 and 0.66 (D) 0.7 and 0.8.
  12. If the probability of an acceptance of a 1% defective lot is 0.95, then AOQ is (A) 0.01 (B) 0.10 (C) 0.0095 (D) 0.095.
  13. Which one of the following statements is not correct? (A) PERT is probabilistic whereas CPM is deterministic (B) In PERT slack on various events is calculated whereas in CPM floats are calculated (C) Critical path in a network is the path on which events have no slack (D) More than four dummy activities cannot be used in a PERT network.
  14. Which of the following is true with respect to a PERT network? (A) Activity duration is beta-distributed and project duration is normally distributed (B) Activity duration is normally distributed and project duration is beta distributed (C)

Activity duration is deterministic and hence project durations are also deterministic (D)  
Four time estimates are used for determining average duration of an activity

15. Consider the following terms used to study the functions of the material:

(1) Use value (2) Esteem value (3) Exchange value (4) Scrap value

Which of these are used to identify in the value engineering approach?

(A) 1, 2, 3 and 4 (B) 1, 3 and 4 only (C) 1, 2 and 3 only (D) 2, 3 and 4 only

#### **XIV. WEBSITES:**

1. [www.iiie-india.com](http://www.iiie-india.com)
2. <http://doer.col.org/handle/123456789/3742>
3. <https://www.edx.org/course/international-project-management-ritx-pm9003x-1>
4. <https://www.edx.org/course/practices-in-engineering-management>
5. <https://www.edx.org/micromasters/iimbx-entrepreneurship#instructors>
6. <https://www.openlearning.com/courses/mem575-mooc-ild>
7. <https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/>
8. <https://www.nitie.edu/>
9. <https://pubsonline.informs.org/journal/msom>
10. [www.isye.gatech.edu/](http://www.isye.gatech.edu/)
11. <https://krannert.purdue.edu/undergraduate/majors/industrial-management/>

#### **XV. EXPERT DETAILS:**

1. Dr. Sarang Deo, Associate Professor, ISB, Hyderabad
2. Prof. A. R. Aryasri, former Professor, JNTU, Hyderabad
3. Dr. P. Bhattacharya, Scientist-G, DRDL, Hyderabad
4. Prof. Ashok K Pundir, NITIE, Mumbai
5. Prof. S. G. Deshmukh, Director, IIIT, Gwalior
6. Dr. Ravi Shankar, Professor, IIT, Delhi
7. Dr J.M.Mahajan, Professor, IIT, Delhi
8. Prof. Pradeep Kumar, IIT, Roorkee
9. Prof. P.K.Jain, IIT, Roorkee
10. Dr. Christopher S. Tang, Professor, UCLA

#### **XVI. JOURNALS (National & International):**

1. Journal of Industrial Engineering and Management
2. Decision Sciences
3. Engineering Management
4. European Journal of Industrial Engineering
5. Asia Pacific Journal of Management
6. International Journal of Operations & Production Management
7. International Journal of Productivity and Quality Management
8. Journal of Advances in Management Research
9. Manufacturing & Service Operations Management
10. Management Science
11. Computers & Industrial Engineering

#### **XVII. LIST OF TOPICS FOR STUDENT SEMINARS:**

- 1) Social responsibilities of management
- 2) Theories of motivation
- 3) Types of organization structures
- 4) Statistical quality control
- 5) Job evaluation
- 6) PERT and CPM analysis

**XVIII. CASE STUDIES / SMALL PROJECTS:**

- 1) Performing case study on current management practices in industries.
  - 2) Designing organizational structure for any small organization.
  - 3) Designing product layout for any small organization.
  - 4) Case study involving value analysis in an industry.
  - 5) Work study and standard time calculations in an industry.
- Statistical quality control in industries