

B.E. MECHANICAL ENGINEERING, THIRD YEAR, SECOND SEMESTER EXAM 2025
INDUSTRIAL MANAGEMENT

Time: 3 Hours

Full Marks: 100

Assume any relevant data, if necessary. Symbols in the Question Paper carry their usual meanings. Figures in the margin indicate full marks. All Parts of any one question must be answered together. Answer strictly to the point.

ANSWER ANY FIVE QUESTIONS OF THE FOLLOWING

1. (a) Times in minutes of different operations in the shipping department of a company are furnished below:

Work element	Cycle				Performance Rating
	1 st	2 nd	3 rd	4 th	
Obtain the case	0.15	0.25	0.20	0.17	90%
Place 3-dozzens bottle in the case	1.56	29.35	1.80	1.75	105%
Set case aside	0.20	0.10	0.10	0.15	95%

The operator takes 0.50 minute for personal requirement. Find out the standard time of the task.

- (b) What is 'THERBLIGS'? Discuss its importance in time study method.
- (c) Discuss about camera study methods.
- (d) Drawing an explanatory diagram discuss about a flow process chart considering at least ten different activities. 6+4+4+6 = 20
2. (a) A manufacturing company produces 10000 flow valves during a 10 day period. The quality policy of the company is to draw random samples of 50 flow valves twice a day. The number of defectives obtained from such sampling are as follows:

Sample no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. of defective:	9	6	13	3	9	2	11	9	14	5	8	9	13	20	15	7	12	8	3	4

Construct a fraction defective chart and conclude accordingly.

- (b) Defining Type I and Type II errors, discuss about an O.C. curve.

(c) With proper examples define the terms 'attributes' and 'variables'. What are the advantages of SQC over conventional and automated quality control? How it is done in the shop floor?
 $6+8+(3+2+1) = 20$

3. (a) Define the terms authority, responsibility and span of control in connection with industrial organization.

(b) Systematically deduce the number of minimum formal relationships that may be developed in an organization. What may be the consequences of such varied relationship?

(c) Drawing an explanatory figure discuss about a combined line-n-staff/functional organization structure. Mention the important advantages and limitations of this structure.
 $6+8+6 = 20$

4. (a) Define the terms reliability, availability and maintainability.

(b) Drawing an explanatory diagram discuss about the 'bath tub curve' and mention its importance in maintenance planning.

(c) Discuss, in brief, about total productive maintenance strategies followed in industry.

(d) Determine the operation availability and inherent availability of a system with mean time intervals between corrective maintenance of 900 hours and mean down time of 10 hours. Mean time between failures of the system is 100 hour whereas the mean time to repair of the failed items is 10 hours.
 $6+4+4+6 = 20$

5. (a) An engineering company planned to diversify its operations during the year 2005-06. The company allocated capital expenditure budget equal to Rs 5.15 crore in the year 2005 and Rs 6.50 crore in the year 2006. The company had to take five investment projects under consideration. The estimated net returns at that present value and the expected cash expenditures on each project in those two years are as follows.

Assume that the return from a particular project would be in direct proportion to the investment in it, so that, for example, if in a project, say A, 20% (of 120 in 2005 and of 320 in 2006) was invested, then the resulting net return in it would be 20% (of 240). This assumption also implies that individuality of the project should be ignored. Formulate this capital budgeting problem as an LP model to maximize the net return.

Project	Estimated Net Returns (in '000 Rs)	Cash Expenditure (in '000 Rs)	
		Year 2005	Year 2006
A	240	120	320
B	390	550	594
C	80	118	202
D	150	250	340
E	182	324	474

(b) What are the assumptions of a LP model?

(c) Use the graphical method to solve the following LP problem.

Minimize $Z = -x_1 + 2x_2$

Subject to the constraints, (i) $-x_1 + 3x_2 \leq 10$, (ii) $x_1 + x_2 \leq 6$, (iii) $x_1 - x_2 \leq 2$,
and $x_1, x_2 \geq 0$.

8+4+8=20

6. A manufacturer of leather belts makes three types of belts A, B and C which are processed on three machines M_1 , M_2 and M_3 . Belt A requires 2 hours on machine M_1 and 3 hours on machine M_2 and 2 hours on machine M_3 . Belt B requires 3 hours on machine M_1 , 2 hours on machine M_2 and 2 hours on machine M_3 and Belt C requires 5 hours on machine M_2 and 4 hours on machine M_3 . There are 8 hours of time per day available on machine M_1 , 10 hours of time per day available on machine M_2 and 15 hours of time per day available on machine M_3 . The profit gained from belt A is Rs 3.00 per unit, from Belt B is Rs 5.00 per unit, from belt C is Rs 4.00 per unit. What should be the daily production of each type of belt so that the products yield the maximum profit.

20

7. (a) Determine an initial basic feasible solution to the following transportation problem by using (a) NWCM, (b) LCM, and (c) VAM.

	D ₁	D ₂	D ₃	D ₄	Supply
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

(b) *S Dutta* runs a high-end jewelry shop. He advertises weekly in reputed newspapers and is thinking of increasing his ad budget. Before doing so, he decides to evaluate the past effectiveness of these ads. Five weeks are sampled, and the data are shown in the table below:

Sales (in Lakhs Rs.)	Ad Budget that week (in Thousand Rs.)
11	5
6	3
10	7
6	2
12	8

Develop a regression model to help *S Dutta* evaluate his advertising. Using the data, find the coefficient of determination, r^2 , for the model.

10+10=20

8. (a) In Border Roads Organization, the vehicles and equipment are being overhauled in base workshop. The overhauling of vehicles involves a number of jobs. These are given in the following table

<i>Job</i>	<i>Description</i>	<i>Immediate Predecessors</i>	<i>Expected Time (days)</i>
A	Dismantling of vehicle	—	3
B	Inspection and preparation of visual inspection on report	A	2
C	Stripping minor assys	B	2
D	Stripping major assys	B	3
E	Overhauling engine	C	40
F	Cleaning chassis	C, D	2
G	Cleaning body and cabin	C, D	2
H	Repairing gear box	C	2
I	Repairing break system	D	1
J	Repairing axle and propeller shaft	D	6
K	Repairing road spring	D	2
L	Repairing chassis	F	2
M	Repairing body and cabin	G	5
N	Placing chassis and fitment of engine	E, L	2
O	Fitting major assys	N, H	1
P	Fitting minor assys and cabin	N, I, J, K, M	2
Q	Checking and rectification	O, P	1
R	Mechanical inspection for passing	Q	1
S	Painting	R	1
T	Checking and rectification before final inspection	S	1
U	Final inspection and passing	T	1
V	Closing the job card	U	1

- Draw a network diagram for the overhauling project.
- Identify the critical path. What is its length?
- Find the total float and free float for each task.

b) What is project crashing? Explain with a suitable example.

14+6=20

9.(a) A chemical company is trying to find the optimal batch size for the reorder of concentrated sulphuric acid. The management accountant has supplied the following information:

- The purchase price of H_2SO_4 is Rs 150 per gallon.
- The clerical and data processing costs are Rs 500 per order.

All the goods are transported by rail. Each time the special line to the factory is opened the company is charged Rs 2,000. A charge of Rs 20 gallon is also made. The company uses 40,000 gallons per year. Maintenance costs of stock are Rs 400 per gallon per year.

Each gallon requires 0.5 sq ft of storage space. If warehouse space is not used, it can be rented out to another company at Rs 200 per sq ft per annum. The available warehouse space is 1,000 sq ft, the overhead costs being Rs 5,000 per annum. Assume that all free warehouse space can be rented out.

(i) Calculate the economic reorder size.

(ii) Calculate the minimum total annual cost of holding and reordering stock.

(b) Six jobs go over machine I first and then over II. The order of the completion of jobs has no significance. The following table gives the machine times in hours for six jobs and the two machines:

Job	:	1	2	3	4	5	6
Machine I	:	5	9	4	7	8	6
Machine II	:	7	4	8	3	9	5

Find the sequence of the jobs that minimizes the total elapsed time for completing the jobs. Find the minimum time by using Gantt Chart or by any other method.

12+8=20