LECTURE NOTES

ON

INDUSTRIAL ENGINEERING AND MANAGEMENT

6TH SEMESTER,

DEPT OF MECHANICAL ENGG.,

AUM SAI INSTITUTE OF TECHNICAL EDUCATION

NARAYANPUR, BERHAMPUR, GANJAM

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HOD

DEPARTMENT OF MECHANICAL ENGINEERING

INDUSTRIAL ENGINEERING & MANAGEMENT

Name of the Course: Diploma in MECHANICAL ENGINEERING			
Course code:	MET 601	Semester	6th
Total Period:	60	Examination	3 hrs
Theory periods:	4 P/W	Class Test:	20
Tutorial:	1 P/W	Teacher's Assessment:	10
Maximum marks:	100	End Semester Examination:	70

Rationale:

Main objective of Mechanical Engineering is to produce goods and services for benefit to mankind. Such productions are done utilizing various resources like Men, Materials, machines and Money. Industrial engineering and quality control is the subject which allows optimized use of such resources and hence very important for a mechanical engineering.

Course Objectives:

1. Identification of place for a new plant set up and systematic arrangement of machinery and shop for smooth production.
2. Understanding of stock management and maintenance to reduce plant ideal time.

1.0 Plant location and Layout **Periods**

- 1.1 Describe the features governing plant location. 8
- 1.2 Define plant layout.
- 1.3 Describe the objective and principles of plant layout.
- 1.4 Explain Process Layout, Product Layout and Combination Layout.

2.0 Operations Research:

- 2.1 Introduction to Operations Research and its applications
- 2.2 Define Linear Programming Problem, Solution of L.P.P. by graphical method
- 2.3 Evaluation of Project completion time by Critical Path Method and PERT (Simple problems)- Explain distinct features of PERT with respect to CPM

3.0 Inventory Control: 6

- 5.1 Classification of inventory.
- 5.2 Objective of inventory control.
- 5.3 Describe the functions of inventories.
- 5.4 Explain and Derive economic order quantity for Basic model. (Solve numerical)
- 5.5 Define and Explain ABC analysis.

6.0 Plant maintenance: 7

- 6.1 Describe the objectives of plant maintenance.
- 6.2 Describe the duties, functions and responsibilities of plant maintenance department.
- 6.3 Describe the types of maintenance: Preventive, Breakdown, Scheduled and Predictive maintenance.

7.0 Inspection and Quality Control: 12

7.1 Define Inspection and Quality control.
7.2 Describe planning of inspection.
7.3 Describe types of inspection.
7.4 Study of factors influencing the quality of manufacture.
7.5 Explain the Concept of statistical quality control, Control charts (X, R, P and C - charts). Solve related problems.

8.0 Contemporary Quality Management concepts 6

8.1 Concept of total quality management (TQM)
8.2 ISO-9000/14000, concept & its evolution & implications.
JIT, Six Sigma, 7S, Lean manufacturing

Learning Resources:

Sl. No.	*Name of Authors*	*Title of the Book*	*Name of the Publisher*
1	O.P.Khanna	Industrial Engineering & Management	Dhanpat Rai & Sons
2	Telsang	Industrial Engg & Production Management	S. Chand
3	M.Mahajan	Statistical Quality Control	Dhanpat Rai & Sons

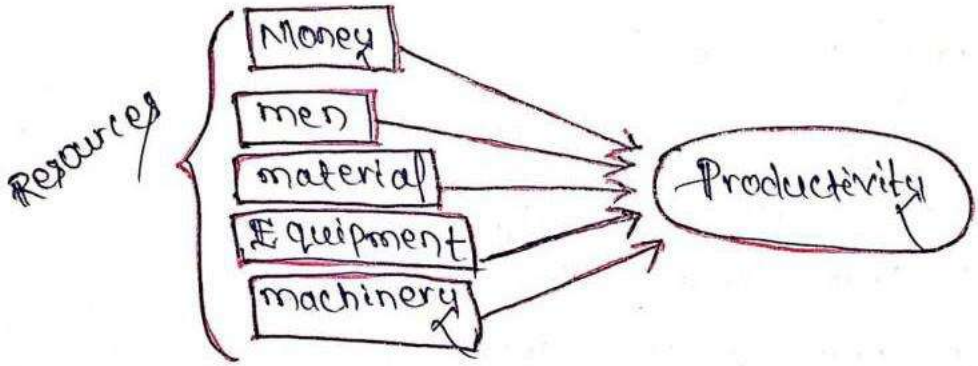
Industrial Engg :-

→ Introduction

→ The americal institute of industrial engineers (AIIE) has defind the theoritical consept of industrial engg. as, concerned with design, improvement & installation of integrated system of peoples, materials, equipment & energy.

→ Industrial engginering is going to play a pivotal role in increasing the productivity. In other words it is that engineering approach to the detailed analysis of the use & cost of the resources of an organisation.

→ The main resources are men, money, materials, equipment & machinery.



CH-1 → PLANT LOCATION & LAYOUT ←

Introduction

→ A plant is a space where all the resources like men, money, material, equipment, machinary etc are brought together for manufacturing products.

→ Plant location means deciding a suitable location area, place etc where the plant or factory will start ~~functning~~. functoning.

→ Plant location involves two measure activities –

(i) to select a proper geographical region.

(ii) to choose a suitable sites within region.

Plant Location Problem :-

1 → Selection Region.

2 → Selection of a particular site.

3 → conditions that demand city location.

4 → conditions demanding rural location.

5 → conditions that demand sub urban location.

Factors affecting Plant Location :-

① Nearness to raw materials :- It will reduce the cost of transporting raw material from the vendors end to the plant like sugar, cement, Jute & cotton textiles.

② Transport Facilities :- A lot of money is spent both in transporting the raw material & the finished goods. speedy transport facilities, that ensure timely supply of raw materials to the company & finished goods to the customers, There are time basic modes of physical transportation, air, road, rail, water & Pipe line.

③ Availability of Labour :- suitable labour force of right time of adiquate size & at resonable rates with its proper attitude towards work are a few factors which govern plant location to measure extent.

④ Nearness to market :- It also reduces the cost of transpotation as well as the changes of the finish products.

⑤ Availability of fuel & power :- Steel industries or steel plants are located near source of fuel (coal, diesel) to cut down fuel transpotation costs. Electric power should remain available contineously in proper quantity & at resonable rates.

⑥ Availablity of water :- Depending on the nature of the plant water should be available in adiquative quantity & should be proper quantity in essential paper & chemical plant.

⑦ Climatic cond' :- Climate greatly influence human efficiency & behaviour. Textile mills require humidity with the developments in the field of heating, ventilating & air conditioning, Climate of the region doesn't present much problem occurs control of Climates needs money.

(8) Financial & other aids :- Certain states give aids as loans, feed money, funding, built of sheds to attracked industrialies.

(9) Land :- Area, the shape of site, topography, cost drainage & other facilities, the probability of floods, earthquakes etc. influence the selection of plant location.

(10) Supporting industries :- All industries will not make all the components & parts by it self & it subcontracts the work to venders.

(11) Social infrafactures :- Availability of community facilities like (a) Housing facilities
(b) Educational facilities
(c) Medical facilities
(d) Internate facilities & so on are tobe consider.

(12) Law & taxation :- The policies of the state & local bodies concerning labour laws, safety its arethe factors that demand attentation.

* PLANT LAYOUT :-

→ Plant Layout means the disposition of the various facilities like equipments, materials, manpowers etc & services of the plant within the area of the site selected previously.

→ Plant layout is a plan of an optimum arrangement of facilities including personal, operating equipment, storage space, material handling equipment & all other supporting services along with the design of best structure to contain all these facilities.

*) objectives of plant layout :-

1 → Materials handling & transpotation is minimize.
2 → Work stations are designed suitabely & properly.
3 → Suitable places are alocated to production centers & service centers.
4 → Movements made by the workers are minimized.
5 → Delay time of semifinished products is minimized.
6 → Working conditions are safer, better & improved
7 → Increased flexibility of changes in product design & for future expansion.
8 → Plant maintanance is simpler.
9 → Increased productivity & better product quality with reduced capital cost.
10 → A good plant layout permits materials to move through the plant at the desired speed with the lower cost.

Principle of plant layout :-

*) Principle of integration :-

→ A good plant lay out is one that integrates men, materials machines & supporting services. In order to get the optimum utilization of resources & max^m effectiveness.

*) Principle of smooth & continuous flow :-

→ A good layout makes the materials to move in forward direction towards the completion stage.

*) Principle of Minimum movements & material handling :-

→ The facilities should be arranged such that the total distances travelled by the men & the materials should be minimum.

It is better to transport materials in bulk rather than small amounts.

*) Principle of cubic space utilization :-

→ The good layout utilizes both horizontal & vertical space. Besides using the floor space of a room. The ceiling height is also utilized. Boxes & bags containing raw materials or goods can be stacked are above the other to store more items in the same room.

*) principle of safety, security & satisfaction :-

→ Working places should be safe, well ventilated & free from dust, noise, fumes, odours & other hazardous cond'ns.

*) Principle of mgm flexibility :-

→ The good layout is one that can be altered without much cost & time. The machinery is arranged in such a way that the changes of the production process can be achieved at the least cost.

* Process Layout :- (Functional Layout)

→ The layout is recomended for batch production. All machines performing similar type of operation are grouped at one location in the process layout.

→ for ex :- All lathes, milling m/c, shaping m/c, grinding m/c kept at one place.

Adv :- Better utilization of equipments.

→ Wide flexibility exists during alotment of work to equipment & workers.

→ Better product quality because to attained one time of m/c

→ Varieties of Jobs coming as different Job orders make the work more challenging & intresting.

Disadv :- For same amount of production more space is required.

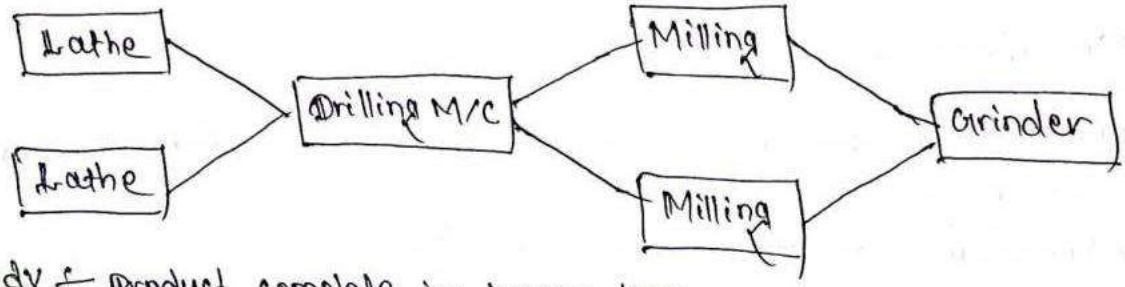
→ More materials in process remain in queue for further operation

→ Work in process inventory is large.

→ Production planing & control is difficult.

Product Layout :-

→ The various operations on raw material are performed in a sequence & the machines are arranged in the sequence in which the raw material will be operated upon.



Adv :- Product complete in lesser time.

→ Smooth & contineous work flow.

→ Simplified production, planning & control.

→ Automatic material handling, less movements, so cost is reduced.

Dis adv :- Lack of flexibility.

→ One inspector has to attained a number of m/c in a production line.

→ More m/c to be purchased & kept which require high capital investment.

Combination Layout :-

→ This is called the mixed type of layout usually a process layout is combined with the product layout.

→ For ex :- refrigerator manufacturing uses a combination layout.
Manufacturing various components → process layout

for assembling of components → product layout.

CH 02 operations & research :-

→ Introduction :-

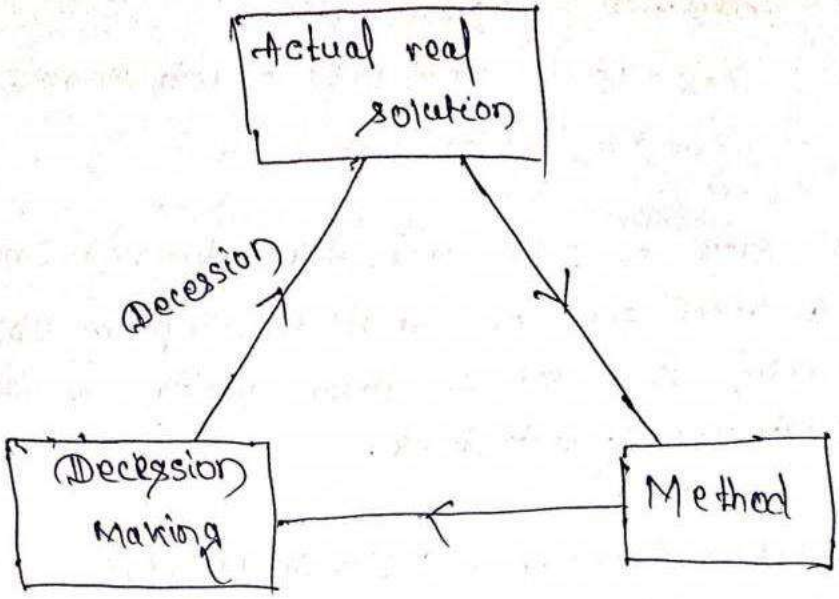
→ Operation research signifies research on operations. It is the organised application of modern science, mathmatics & computer technics, to Govt, business & industrial problems arising in the dirc to complex & the management of the large system of men, materials, money & machines.

→ Methoddogy :-

1→ Understand the actual real situation, capture the same & define the problem.
2→ Formulate in mathmatical model.
3→ Develop a mathmatical solution.
4→ Implement the ~~dicision~~ decision to the real situation.
5→ Verify the results.

Methods of operation research :-

1→ Linear programming
- → Graphical linear programming.
- → Transportation method.
- → Simplex method.



*) Linear programming :-

*) Linear programming is a powerful mathmatical technique for finding the best use of limited resources of a concern. It may be defind as a technique which alocates scarce available resources under cond"s of certainity in a optimum manner to achieve the company objectives which may be max" overall profit or minimum overall cost.

Linear programming problem :-

→ A linear form is meant a mathmatical expression of the type $a_1x_1 + a_2x_2 + \ldots\ldots + a_nx_n$, where $a_1, a_2 \ldots\ldots a_n$ are the constants & $x_1, x_2 \ldots\ldots x_n$ are the variables. The form programming refers to the process of determining a particular plan of action.

Linear programming deals with the optimisation (Maximize or minimize) of a func of variables known as objective func, subjected to a set of linear equations or inequalites known as constraints or restrictions.

for eg :- Max $z = 8x + 3y$ (Objective function)

$x+y = 12$ } Linear eq^n
$x-y = 10$ } constraints or restrictions.

General form of linear programming problem $\frac{0}{5}$

→ The general from of LPP calls for optimising (maximize or minimize) a linear func of variables called the objective function subjected to a set of linear equations & inequalities called the constraints & restrictions.

→ General form $\frac{0}{5}$

* objective function (max or min) $Z = c_1x_1 + c_2x_2 + \cdots + c_nx_n$

→ subjected to the constaints $= a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n$ ($\leq$ or $\geq$) b_1

$a_{12}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n$ ($\leq$ or $\geq$) b_2

$\vdots$

$a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n$ ($\leq$ or $\geq$) b_n

& $x_1, x_2 \cdots x_n \geq 0$.

→ A firm manufactures two type of products A & B Sales them at a profit of rupees 2 on time A & rupees 3 on thime B. Each product is processed in 2 machines G & H. Type A requir 1 min. processing time on 'G' & 2 mins on each. Type B requires 1 min processing time on m/c G & 1 min on M/c 'H'. The M/C 'G' is available for not more than 8 hours & 40 Minits while M/C H is available for 10 hours. During any working day. Formulate the problem as LPP.

suppose :-

x_1 no of products A are Manufacturing.

x_2 no of products B are manufacturing.

Machines	Types of products in (minutes)		
	product A (x_1 unit)	product B (x_2 unit)	Available time in (min)
G	1	2	400 m
H	2	1	600 m
profit	Rs 2.	Rs 3	

Max $Z = 2x_1 + 3x_2$ (objective fun^n)

linear eq^n = $x_1 + x_2 \leq 400$ m
$2x_1 + x_2 \leq 600$
} constraints

Problem :- A furniture Manufacturer Makes two products chairs & tables. Each chair contributes a profit of Rs. 20 & each table of Rs. 40. chairs & tables, from raw materials to finished products are processed in 3 sections S_1 & S_2 & S_3 in section S_1 Each chair requires one hour & each table requires 4 hours of processing time. In sec^t S_2 Each chair requires 3 hours & each table one hours & in sec^t S_3 the times are 1 hour & 1 hour for chair & table respectively. The Manufacturer wants to optimize his profits if sec^t S_1, S_2 & S_3 can be avail for not more than 24, 21, 8 hours respectively.

suppose :-

Here x_1 No of chairs are manufactured.

x_2 No of tables are manufactured.

Process	Types products in mints.		
	Product of chairs x_1	Product of tables x_2	Available time in min.
S_1	1	4	1440 min
S_2	3	1	1260 min
S_3	1	1	480 min
Profit	Rs 20	Rs 40	

Max^{m} $Z = 20x_1 + 40x_2$ (objective fun^{c})

linear eq^{n} $= x_1 + 4x_2 \leq 1440$

$3x_1 + x_2 \leq 1260$

$x_1 + x_2 \leq 480$

} linear eq^{n} or constraints.

$x_1 \geq 0$, $x_2 \geq 0$ Non negative constraints.

→ A firm can produce 3 type of clothes says A, B & C. three kinds of wool are required for it says red, green & blue wool. one unit lenght of type A cloth needs two yards of red wool & 3 yards of blue wool. One unit lenght of type B cloth needs 3 yards of red wool, 2 yards of green wool & 2 yards of blue wool. One unit length of type C cloth needs 5 yards of green & 4 yards of blue wool. The profit from sale of 1 unit length of

Type A is Rs. 10, type B is Rs. 8 & type C is Rs 5. Determine how the firm should use the available material so as to maximize the profit. formulat this as LPP.
(N- the company has a stock of only 8 yards of red wool, 10 yeard of green wool, & 15- blue.

	Types of products.			
	red (x_1)	green (x_2)	blue (x_3)	Available yeared
A	2	0	3	8
B	3	2	2	
C	0	5	1	
Profit	Rs. 10	Rs. 8	Rs. 5	

Suppose x_1 units of A cloths are manufactured.

x_2 units of B Cloths are manufactured.

x_3 units of C Cloths are manufactured.

required of tool.	Types of products			
	A (x_1)	B (x_2)	C (x_3)	Available yeard.
red	2	3	0	8
green	0	2	5	10
blue	3	2	1	15
profit	Rs. 10	Rs. 8	Rs. 5.	

$$\text{Max}^m Z = 10x_1 + 8x_2 + 5x_3 \text{ (objective fun}^c\text{)}.$$

suppose $2x_1 + 3x_2 \leq 8$

$2x_2 + 5x_3 \leq 10$

$3x_1 + 2x_2 + 4x_3 \leq 15.$

} linear eq?

$x_1 \geq 0$, $x_2 \geq 0$, $x_3 \geq 0$ Non negative constraints.

→ A farm manufactures two types of products A & B sales them at a profit of Rs-2 on the type A on ~~cost~~ Rs 3 on type B. Each product is process on two m/c's g & h. Type A requir 1 minute of processing time on g & 2 minute on h. Type B requires 1 min on g & 1 min on h. The M/C G is available for not more than 6 hours & 40 minutes while M/C 'h' is available for 10 hours during any working day. formulate the problem as LPP in graphical method.

M/C's	Product's		
	type A	type B	time required in (min)
g	1	1	400 min
h	2	1	600 min
profit	Rs-2	Rs-3	

$$\text{Max } z = 2x_1 + 3x_2 \quad \text{(objective fun}^{n}\text{)}$$

suppose

$$x_1 + x_2 \leq 400$$

$$2x_1 + x_2 \leq 600$$

In constraint C_1 : $x_1 + x_2 = 400$

Let $x_1 = 0$: $0 + x_2 = 400 \Rightarrow x_2 = 400$

Let $x_2 = 0$ $x_1 = 400$

x_1	x_2
0	400
400	0

In constrain C_2 : $2x_1 + x_2 = 600$

Let $x_1 = 0$; $2 \times 0 + x_2 = 600$

$\Rightarrow x_2 = 600$

Let $x_2 = 0$; $2x_1 + x_2 = 600$

$\Rightarrow 2x_1 = 600$

$\Rightarrow x_1 = 600/2 = 300$

x_1	x_2
0	600
300	0

Max $Z = 2x_1 + 3x_2$

Point O = (0,0) = 0

A = (300, 0) = 600

B = (200, 200) = 1000

C = (0, 100) = 1200

Max Z = 1200

the max^m objective fun^c is 1200 at point C

In constrain

$x_1 + x_2 = 400$

$2x_1 + x_2 = 600$

$-x_1 = -200$

put the value in eq^n (1)

$200 + x_2 = 400$

$\Rightarrow x_2 = 400 - 200$

$= 200$

PROJECT Evaluation & completion by CPM & PERT :-

Project Management :- A project consist of interrelated activities which are to be executed in a certain order before the entire test is completed.

→ The activities are interconnected in a logical sequence which is known as precedence relationship.

→ Project is represented in the form of a network for the purpose of analytical treatment to get solutions for scheduling & controlling its activities.

Techniques :- There are two techniques are involved for managing & completing & evaluating the project.

(1) CPM :- (Critical Path Method)
(2) PERT (Project Evaluation & Review technique).

Phases of project Management :-

→ Planning :- Preventing Dividing the project into distintict activities.
→ Estimating time requirement for each activity.
→ Establising residence relationships among the activities,
→ construction of the arrow / network diagram,
→ scheduling :- Determines the start & end time of each & every activity.
→ Controlling :- Uses the arrow diagram or network diagram & time chart for continuous monitoring & progress reporting.