UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Programme Name: B.Tech(Mechanical)	**Semester** : VII
Course Name : **Production and operations management**	**Time** : 03 hrs
Course Code : **MHEG 452**	**Max. Marks : 100**
Nos. of page(s) : 7	

SECTION A

S. No.		Marks	CO
Q 1	What are the objectives of operations management?	**5**	**CO1**
Q 2	Enumerate the stages of product development process in preliminary design.	**5**	**CO2**
Q 3	Detail the product failure curve with example.(Bath tub curve)	**5**	**CO2**
Q 4	Daily usage of drug follows a normal distribution with a mean of 500 gm and a standard deviation of 50 gm. If the lead-time for the procurement is 7 days and the drug store wants a risk of only 2%. Determine the Re-order point and safety stock when the Q system followed.	**5**	**CO4**

SECTION B

Q 5	Estimate the sales forecast for the year 2000, using exponential smoothening forecaster. Take $\alpha = 0.5$ and the forecast for the year 1995 as 160. Compare the forecast with least square method.	**10**	**CO3**

Year	1995	1996	1997	1998	1999
sales	180	168	159	170	188

Q 6	Solve by ABC analysis and categories the following:			10	CO3

Solve by ABC analysis and categories the following:

A firm has 7 items for production usage, classify them based on priority.

Item number	Annual quantity used	Unit value	Usage per year
1	75	80	6,000
2	150,000	0.9	135,000
3	500	3.0	1,500
4	18,000	0.20	3,600
5	3,000	0.30	900
6	20,000	0.10	2,000
7	10,000	2	20,000

10   CO4

Q 7   A company is setting an assembly line to produce 192 units/8 hour shift. The information regarding work elements in terms of times and immediate predecessors are below

Work element	Time in sec	Immediate predecessors
A	40	-
B	80	A
C	30	D E F
D	25	B

E	20	B
F	15	B
G	120	A
H	145	G
I	130	H
J	115	C I

1. What is the desired cycle time?

2. What is the theoretical no.of stations?

3. Use largest work element time rule to workout a solution on a precedence diagram.

4. What are the efficiency and balance delay of the solution obtained?

Q 8	Write short notes on: 1. Just in time 2. POKE-YOKE **OR** Write short note on: 1. Kaizen 2. Lean manufacturing.	**10**	CO5

SECTION-C

Q 9	(a) A company manufactures seasonal products. The information regarding the demand, capacities are below.**(15 marks)**	**20**	CO3

Period	1	2	3	4

Demand	700	1000	2000	1200
Regular Time	900	1000	1100	700
Over time	350	350	350	350
Sub contracting	600	600	600	600

Initial inventory = 200 units

Final inventory = 150 units

Regular time production cost/unit = Rs 125

over time production cost/unit = Rs 150

sub contracting cost/unit = Rs. 175

Inventory cost/unit/period = Rs 25

Formulate this problem as a **transportation model** to determine the optimum production cost.

(b) The processing times and the due dates of jobs for a single machine scheduling is given.**(5 marks)**

Determine the sequence in which will minimize the maximum lateness and determine the maximum lateness w.r.t the optimal sequence.

Q 10	**(a) Power's Ladder Manufacturing has an aggregate planning proposal (10 marks)** Backorder (shortage) cost per ladder -$10 per month Inventory carrying cost- $3 per month Present work force- 700 ladders/ month Cost is $ 70 per ladder at 700/mo. Cost is $75 for each ladder OVER 700/mo. If less than 700 ladders/mo. Cost is $82 per ladder	**20**	**CO5**

Find total cost - inventory cost, shortage cost, labor cost in both conditions.

(b)

Month	Expected	Production days	Month	Expected	Production days
January	500	22	July	900	21
February	600	18	August	900	21
March	600	21	September	800	20
April	700	21	October	700	22
May	700	22	November	600	20
June	800	20	December	600	18

Lenova Computer, Ltd has a aggregate planning proposal.(10 marks)

Beginning inventory 100 units, Stock out cost $50 per unit, Inventory Holding Cost $10 per unit based on count at month's end, Sub-contracting $40 extra per unit Maximum of 1500 extra units per month, Overtime Maximum of 200 units per month $10 extra per unit. Calculate the total cost in following plans

Month	Jan	Feb	Mar	Apr	May	June
Demand	1000	1200	1400	1200	1500	1300

Plan 1- Produce at 1200/month and subcontract to meet demand
Plan 2- produce at 1100 / month and use only overtime to meet demand.
    Plan 3- Produce at 1100/month and use overtime with stock out cost.
    Plan 4- Produce at 1300/month to meet the demand.

OR

The forecasted demand for a product for 6 months cycle is given. Each unit requires 10 man-hours and labor cost is Rs. 6/Regular time and Rs. 9/over time. The total cost /unit is Rs. 200 and as sub-contracted is Rs. 208/unit. Currently there are 20 workers, hiring cost is Rs. 300.person, and layoff cost is Rs. 400/person. Company wants to maintain 20% of the stock for next month. There are 50 units in stock for beginning which carried forward at Rs. 2/month/unit. The stock our cost is Rs. 20/unit/month. Every worker has 8 hours regular time of work.

Month	Jan	Feb	Mar	Apr	May	June
Demand	300	500	400	100	200	300
Work days	22	19	21	21	22	20

Three aggregate plans are proposed:

Plan 1: vary the work force
Plan 2: Maintain the work force and use overtime.
Plan 3: Maintain the work force and build the inventory or incur stock out cost.
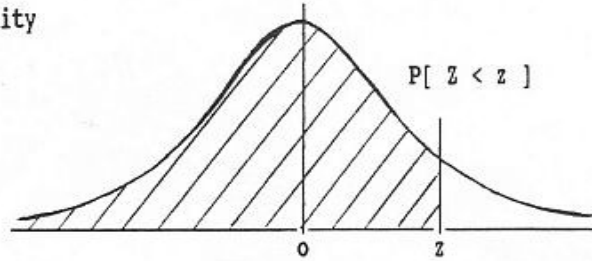
Compare all three plans, find the optimized solution.

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability
up to the standardised normal value z
i.e.

$$P[\ Z < z\ ] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}Z^2)\ dZ$$

P[Z < z]

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Programme Name: B.Tech(Mechanical) Semester : VII
Course Name   : Production and operations management Time   : 03 hrs
Course Code   : MHEG 452 Max. Marks : 100
Nos. of page(s) : 5

SECTION A

S. No.		Marks	CO
Q 1	What are the objectives of Production management?	5	CO1
Q 2	Explain the relationship between product and process in final design.	5	CO2
Q 3	Describe the stages in product life cycle.	5	CO2
Q 4	Annual demand of an item is 48000. The average lead-time is 4 weeks. The standard deviation of demand during the average lead-time is 75 units/week. The cost of reordering is Rs. 400/order. The price/unit is Rs. 10. The carrying cost /unit/year is 15% of the purchase price. The maximum delay in lead-time is 2 weeks and the probability of this delay is 0.25. Consider the service level of 0.95. Find the re-order level when Q system is used.	5	CO4

SECTION B

Q 5	Estimate the sales forecast for the year 1990, using exponential smoothening forecaster. Take $\alpha = 0.5$ and the forecast for the year 1986 as 15. Compare the forecast with least square method.		

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989
sales	13	20	20	28	30	32	33	38	43

Marks: 10 — CO3

Q 6   Solve by ABC analysis and categories the following:

A firm has 10 items for production usage, classify them based on priority.

Item number	101	102	103	104	105	106	107	108	109	110
Unit cost	5	11	15	8	7	16	20	4	9	12
Annual demand	48000	2000	300	800	4800	1200	18000	300	5000	500

Marks: 10 — CO3

Q 7	The company is engaged in the assembly of a wagon on a conveyor. 500 wagons are required/day. Production time available/day is 420 mins. The other information is below.	10	CO4

Work element	Time in sec	Immediate predecessors
A	45	-
B	11	A
C	09	B
D	50	-
E	15	D
F	12	C
G	12	C
H	12	E
I	12	E
J	08	F G H I
K	09	-

Find the minimum no. of work stations, balance delay and line efficiency.

Q 8	Write short notes on:
	    1. World class manufacturing
	    2. SCM(Supply Chain Management)
	
	    OR
	
	Write short note on:
	    1. ERP(Enterprise resource planning)
	    2. FMS(Flexible manufacturing system)
		10	**CO5**

<div align="center">SECTION-C</div>

Q 9	(a) The supply, demand, cost and inventory data for a company, which has a constant work force, is given. The company wants to meet all the demand, allocate the production capacity and find the optimal solution through **Transportation Model.(15 marks)**	**20**	**CO3**

Period	1	2	3	4
Demand	100	50	70	80
Regular time	60	50	60	65
Over time	18	15	18	20
Sub contracting	1000	1000	1000	1000

Initial inventory = 20 units
Final inventory = 25 units
Regular time production cost/unit = Rs 100
over time production cost/unit = Rs 125
sub contracting cost/unit = Rs. 130
Inventory cost/unit/period = Rs 2.

(b) The processing times and the due dates of jobs for a single machine scheduling is given.**(5 marks)**

JOB	1	2	3	4	5
Processing time	9	7	5	11	6
Due date	16	20	25	15	40

Determine the sequence in which will minimize the maximum lateness and determine the maximum lateness w.r.t the optimal sequence.

Q 10 A company manufactures the consumer durable products and the company intends to develop an aggregate plan for six months.
Material cost – Rs.100/unit
Inventory cost – Rs. 10/unit/month
Stock out cost – Rs. 20/unit/month
Subcontracting cost – Rs. 200/unit
Hiring cost – Rs 50/worker
Layoff cost – Rs. 100/worker
Regular time cost – Rs. 12.50/hour
Over time cost - Rs 18.75/hour
Beginning inventory – 200 units
Safety stock – nil

20 **CO5**

Month	Jan	Feb	Mar	Apr	May	June
Demand	500	600	650	800	900	800
Work days	22	19	21	21	22	20

Work out the cost of the following strategies:
1. Vary the work force
2. Constant work force- vary the inventory or allow shortage cost
3. Constant work force – use subcontracting.

OR

Wetski currently maintains a steady production level at the average demand all year around and does not hire or fire workers. Fill all blank spaces in the following table so that it represents an aggregate production plan based on Wetski's current production and hiring policy. What is the total cost of this plan?

Regular production cost = $55 per unit

Production rate = 750 units/worker/quarter

Overtime production cost = $82 per unit

Holding cost = $4 per unit per quarter

Subcontracting cost = $77 per unit

Backorder cost = $80 per unit per quarter

Opening workforce level = 11

Hiring cost = $140 per worker

Overtime capacity = 2500 units per quarter

Firing cost = $550 per worker

Subcontracting capacity = 1000 units per quarter

Opening inventory = 0

Quarter	Demand
1	3700
2	4600
3	14500
4	21000

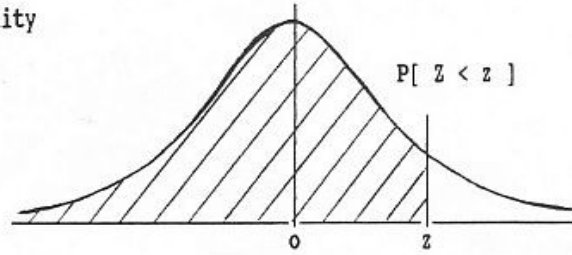Work out the cost of the following strategies:
1. Vary the work force

| | 2. Constant work force- vary the inventory or allow shortage cost
3. Constant work force – use subcontracting. | | |

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability
up to the standardised normal value z
i.e.

$$P[\ Z < z\ ] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}Z^2)\ dZ$$

P[Z < z]

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000