L-4/T-I/IPE Date: 31/08/2025

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-I B. Sc. Engineering Examinations 2023-2024

Sub: **IPE 451** (Supply Chain Management)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. **Question No. 1 is compulsory.**

Answer any **TWO** questions from the rest.

1. (a) Interpret "Implied Uncertainty (Demand and Supply) Spectrum". Draw necessary diagram and explain with example. **(15) (CO1)**

   (b) "This curve shows the lowest possible cost for a given level of responsiveness". Which curve is mentioned here? Explain the statement with necessary diagram. **(15) (CO1)**

   (c) Which main organization does Sam's Club belong to? What is their supply chain strategy? Explain and justify. **(5) (CO1, CO2)**

2. (a) Describe the impact of online sales of grocery items with respect to Peapod. What was the total impact value of performance at Peapod? **(15)**

   (b) Explain "supply chain decision making framework" with respect to Wal-Mart. Use appropriate diagram. Wall-Mart pioneered a system. What is that system? **(15+5)**

3. (a) "Forward buying results in large orders during the promotion period followed by very small orders after that, as has been proven and demonstrated by chicken noodle soup example". What obstacle is this? Explain with right diagram. **(15)**

   (b) What are the key sourcing related processes? What data or information leads to the idea – "It is crucial that suppliers be actively involved at design stage"? Explain the idea. **(15+5)**

4. (a) What is the cheapest mode of transport for carrying bulk loads? Explain. **(15)**

   (b) Zeta Ltd. supplies batteries to Alpha Mobile company. Weekly demand of battery at Alpha is 1200 units, which they buy at a price of 70 $/unit. Safety stock of battery at Alpha is 40% of the average demand during delivery lead time. Holding cost is 30% of the value of stock. Purchase lot size is 2000 units per order. Air shipment cost of one lot from Zeta to Alpha is 200$. While shipment time is 1 week, order processing time at Zeta is another 1 week. Determine the followings: **(20)**

   (i) Annual material cost

   (ii) Annual holding cost

   (iii) Annual ordering (shipment) cost

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SECTION – B

There are **FOUR** questions in this section. Answer **Question No. 5** is **Mandatory**. Answer the rest of the **TWO** questions from questions 6-8.

5. (a) PharmaMed produces over-the-counter pain relievers and requires acetaminophen powder for its production line. The company consumes 10,000 kg of acetaminophen powder per month. Its supplier charges $500 per shipment, regardless of size. A chemical supplier offers an all-unit quantity discount: $12/kg for orders less than 12,000 kg $11.80/kg for orders between 12,000 and 25,000 kg, and $11.50/kg for orders over 25,000 kg. PharmaMed has a holding cost rate of 25% per year. **(20)** **(CO3, CO4)**

   (i) What is the optimal order quantity for PharmaMed?

   (ii) What is the total annual cost under this policy?

   (iii) What is the average inventory held (cycle inventory)?

   (iv) How would this compare with the policy if the supplier simply offered a flat rate of $11.50/kg?

   (b) Champion manufactures winter fleece jackets for sale in the United States. Demand for jackets during the season is normally distributed, with a mean of 20,000 and a standard deviation of 10,000. Each jacket sells for $60 and costs $30 to produce. Any leftover jackets at the end of the season are sold for $25 at the year-end clearance sale. Holding jackets until the year-end sale adds another $5 to their cost. A recent recruit has suggested shipping leftover jackets to South America for sale in the winter there rather than running a clearance. Each jacket will fetch a price of $35 in South America, and all jackets sent there are likely to sell. Shipping costs add $5 to the cost of any jacket sold in South America. Would you recommend the South American option? How will this decision affect production decisions at Champion? How will it affect profitability? **(15)** **(CO5)**

6. (a) A global electronics retailer is deciding whether to serve the European market through three regional distribution centers or one centralized distribution center. Weekly demand in each region is normally distributed, with a mean of 800 units and a standard deviation of 200. Demand experienced in each region is independent, and the supply lead time is three weeks. The retailer incurs a holding cost of 20% per year, and the cost of each product is $2,000. With three regional distribution centers, the retailer can ensure next-day deliver using local transportation at a cost of $15 per unit. With a single centralized distribution center, the retailer will need to use a premium air freight service costing $20 per unit for next-day delivery. Operating three regional distribution centers costs $120,000 per year more than operating one centralized distribution center. What distribution network do you recommend? Assume a desired Cycle Service Level (CSL) of 0.90. **(20)**

   (b) Weekly demand for HP printers at a Sam's Club store is normally distributed, with a mean of 250 and a standard deviation of 150. The store manager continuously monitors inventory and currently order 1,000 printers each time the inventory drops to 600 printers. HP currently takes two weeks to fill an order. How much safety inventory does the store carry? What CSL does Sam's Club achieve as a result of this policy? What fill rate does the store achieve? **(15)**

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7. (a) NovaTech, a tech startup, has launched a new wearable device called the PulseBand. The PulseBand is sold through ElectroHub, a nationwide electronics retail chain. ElectroHub has estimated that demand for the PulseBand will depend on the final retail price p according to the demand curve: **(25)**

$$Demand\ D = 2{,}000{,}000 - 2000p$$

The production cost for NovaTech is $100 per PulseBand.

(i) What wholesale price should NovaTech charge for the PulseBand? At this wholesale price, what retail price should ElectroHub set? What are the profits for NovaTech and ElectroHub at equilibrium?

(ii) If both NovaTech and ElectroHub coordinate their pricing, what should be the retail price of ElectroHub to maximize the supply chain profit?

(iii) If NovaTech decides to discount the wholesale price by $40, how much of a discount should ElectroHub offer to customers if it wants to maximize its own profits? What fraction of the discount offered by NovaTech does ElectroHub pass along to the customer?

(b) GreenLeaf Organics, a retailer specializing in organic skincare products, sells EcoGlow moisturizer with an annual demand of 150,000 units. The manufacturer currently charges $5 per unit, and GreenLeaf incurs a holding cost of 25% per year. GreenLeaf currently orders in lots of 7,500 units. The manufacturer has offered a trade promotion discount of $0.20 for all units purchased by retailers over the next two months only. This promotion will be invalid after two months. How many units of EcoGlow should GreenLeaf order given the promotion? Also determine the amount of forward buy in this scenario. **(10)**

8. (a) Differentiate between order fill rate and cycle service level with appropriate examples. **(10)**

(b) "Supply chain management is nothing without proper logistics and distribution network" – do you agree? Reflect your thoughts on this matter. **(10)**

(c) Explain the cycle view of supply chain processes with a necessary diagram. **(15)**

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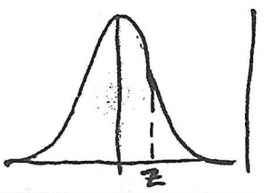
(4)

Standard Normal Cumulative Probability Table

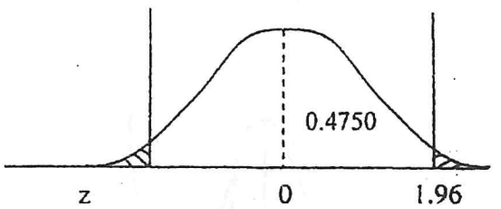


Cumulative probabilities for POSITIVE z-values are shown in the following table:

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	0.5160	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	0.7852
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	0.8810	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	0.9772	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	0.9864	0.9868	0.9871	0.9875	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	0.9925	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	0.9979	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
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

(5)

Table A. Standard Normal Distribution Values (Areas under the normal curve).



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0/09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990