BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

Sub: **IPE 317** (Product Design II)

Full Marks: 210   Time: 3 Hours

Shigley's Mechanical Engineering Design 11th edition SI unit book will be provided.

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

There are **FOUR** questions in this section. Answer to Question no 1 is compulsory.
Answer any **TWO** questions form the Questions 2-4.

1. (a) A 20° spur pinion with 20 teeth and a module of 2.5 mm transmits 150 W to a 36-tooth gear. The pinion speed is 100 rpm, and the gears are grade 1, 18 mm face width, through hardened steel at 200 Brinell, uncrowned manufactured to a No. 6 quality standard with open gearing quality installation. Analyze the gear and estimate the AGMA bending and contact stresses and the corresponding factors of safety for a pinion life of 10^8 cycles and a reliability factor of 0.95. **(20)**

(CO4)

(b) Design a straight-bevel gear mesh for shaft centerlines that intersect perpendicularly. The uncrowded straight-bevel pinion has 22 teeth, a module of 4 mm, and a transmission accuracy number of 5. The pinion and the gear are made of through-hardened steel, both having a core and case hardness of 180 Brinell. The pinion drives the 24-tooth bevel gear. The pinion speed is 1800 rev/min, the face width is 25 mm, and the normal pressure angle is 20°. Both gears have an outboard mounting. Find the power rating based on AGMA pitting based on AGMA pitting resistance if the life goal is 109 revolutions of the pinion at 0.999 reliability. **(15)**

(CO1)

2. (a) A brake assembly has been tested and found to have a capacity that is normally distributed with a mean of 275 KN and a standard deviation of 25 KN. If a normally distributed force having a mean of 180 KN and a standard deviation of 3 KN is applied. What is the static reliability? **(10)**

(b) The minimum fatigue life of rivets in a compressor air-seal inlet of a gas turbine engine is modeled with lognormal distribution. During accelerated testing for the purpose of certification and approval, the mean value of minimum life is found to be 90 minutes, and the COV is 15%. The rivet design is unacceptable if the minimum life during accelerated testing is less than 50 minutes. What is the probability of nonacceptance of the rivet design? **(10)**

(c) Briefly discuss the causes of failure of a design for

i) Traditional point of view

ii) When the load is uncertain

iii) When the strength is uncertain

iv) When both load and natural strength are uncertain

v) Degradation with time **(15)**

3. (a) The figure shows a 400-mm diameter brake drum with four internally expanding shoes. Each of the hinge pins A and B supports a pair of shoes. The actuating mechanism is to be arranged to produce the same force F on each shoe. The face width of the shoes is 75 mm. The material used permits a coefficient of friction of 0.24 and a maximum pressure of 1000 kPa.

i) Determine the maximum actuating force

ii) Estimate the brake capacity

iii) Estimate the hinge-pin reactions **(20)**

Here a = 150mm, c = 165 mm, R = 200 mm, and d = 50 mm
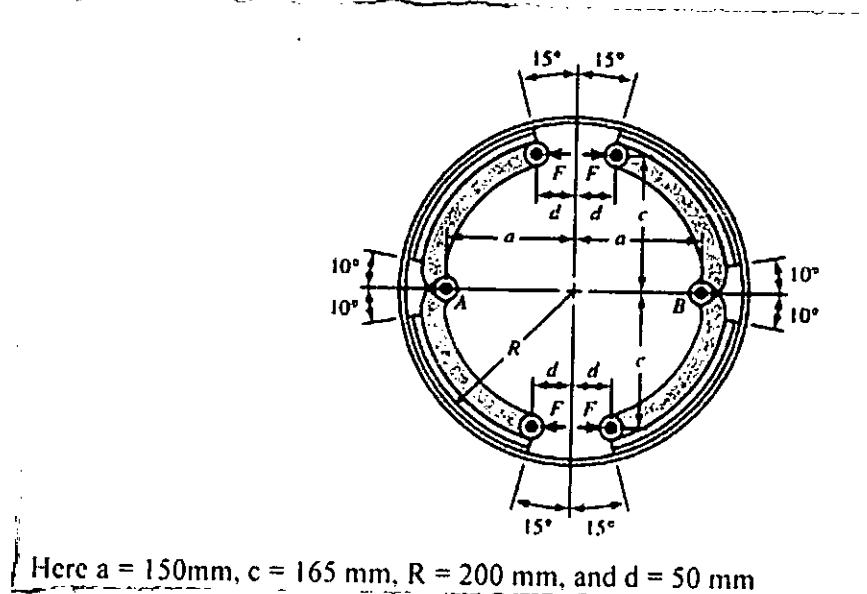
(b) Design a friction metal flat-belt drive to connect a 1 kW, four-pole squirrel-cage motor turning at 1750 rev/min to a shaft 381 mm away, running at half speed. The circumstances are such that a service factor of 1.2 and a design factor of 1.05 are appropriate. The life goal is 10^6 belt passes, f = 0.35, and the environmental considerations require a stainless steel belt. **(15)**

4. (a) A pair of straight bevel gears has a velocity ratio of 2:1. The pitch circle diameter of the pinion is 80 mm at the large end of the tooth. A 5 KW power is supplied to the pinion, which rotates at 800 rpm. The face width is 400 mm, and the pressure angle is 20°. Calculate the tangential, radial, and axial components of the resultant tooth force acting on the pinion. **(10)**

(b) A parallel helical gear set consists of a 19-tooth pinion driving a 57-tooth gear. The pinion has a left-hand helix angle of 30°, a normal pressure angle of 20°, and a normal module of 2.5 mm. Find

    i) The normal, transverse, and axial circular pitches

    ii) The transverse diametral pitch and the transverse pressure angle

    iii) The addendum, dedendum, and pitch diameter of each gear. **(10)**

(c) A 21-tooth spur pinion mates with a 28-tooth gear. The diamteral pitch is 3 mm and the pressure angle is 20°. Make a drawing of the gears showing one tooth on each gear. Find and tabulate the following results: the addendum, dedendum, clearance, circular pitch, tooth thickness, and base-circle diameters; the lengths of the arc of approach, recess, and action; and the base pitch and contact ratio. **(15)**

SECTION – B

There are **FOUR** questions in this section. Answer to Question no 5 is compulsory.

Answer any **TWO** questions form the Questions 6-8.

Assume any missing data.

5.   (a) Explain the elements of the cost of goods concerning your product developed for the corresponding sessional course. **(15)**

(CO2)

(b) A 02-series single-row deep-groove ball bearing is to be selected which is expected to carry a 2-kN axial load and 8-kN radial load with a 99 percent reliability for 10 kh. The ineer ring rotates at 400 rev/min. Use the Weibull parameters for Manufacturer 2 in Table 11-6. **(20)**

(CO3)

6.   (a) How break-even analysis can be used as a product screening tool? **(05)**

(b) Discuss the relationship between the "guidelines of DFE for Life Cycle Stages" and the "Reduction of the Cost of Logistics" which is one of the steps of DFM. **(15)**

(c) Prototyping is the process of developing an approximation of a product. You all have already completed creating your prototype in the product design II sessional. Now share your insights on the following- **(15)**

    (i) Purpose of the prototype

    (ii) Use of CAD Modelling and Analysis

    (iii) Creating a schedule with three dates

7. (a) "The use of comprehensive prototypes depends on the relative level of technical or market risk and the cost of building a comprehensive prototype." - Illustrate with the help of a diagram. **(10)**

(b) What are the benefits of using a structured concept selection process? **(10)**

(c) An Oiles SP 500 alloy brass bushing is 25 mm long with a 25 mm dia bore and operates in a clean environment at 21°C. The allowable wear without loss of function is 0.125 mm. The radial load is 2250 N. The shaft speed is 200 rev/min. Estimate the number of revolutions of radial wear to be 0.125 mm. Use Table 12-11 for reference. **(15)**

8. (a) Explain the factors that influence the selection of sample size. **(10)**

(b) Scooters are currently sold in this market at a rate of 150,000 units per year. The company sells the product through a single distributor which accounts for 25 percent of the sales in this category. Assume that results from a concept test with factory managers responsible for purchasing transportation devices indicate a definitely-would-buy fraction of 0.30 and a probably-would-buy fraction of 0.20. Determine: **(10)**

(i) Probability that the product is purchased if the customer is aware of it and it is available

(ii) Quantity of the expected sales

(c) A pressure-fed bearing has a journal diameter of 50.00 mm with a unilateral tolerance of -0.05 mm. The bushing bore diameter is 50.084 mm with a unilateral tolerance of +0.10 mm. The length of the bushing is 55 mm. Its central annular groove is 5 mm wide and is fed by SAE 30 oil is 55°C at 200 kPa supply gauge pressure. The journal speed is 2880 rev/min carrying a load of 10 kN. The sump can dissipate 300W per bearing if necessary. For minimum radial clearances, perform a design assessment using Trumpler's criteria. **(15)**
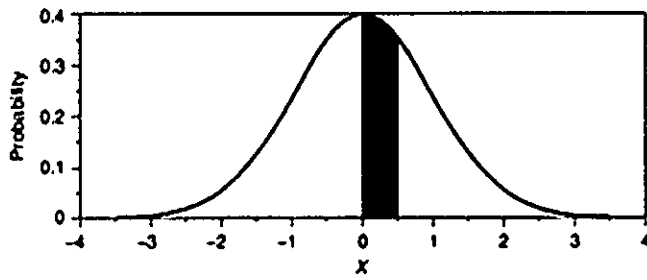
Area under the Normal Curve from 0 to X

X	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00000	0.00399	0.00798	0.01197	0.01595	0.01994	0.02392	0.02790	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	0.05962	0.06356	0.06749	0.07142	0.07535
0.2	0.07926	0.08317	0.08706	0.09095	0.09483	0.09871	0.10257	0.10642	0.11026	0.11409
0.3	0.11791	0.12172	0.12552	0.12930	0.13307	0.13683	0.14058	0.14431	0.14803	0.15173
0.4	0.15542	0.15910	0.16276	0.16640	0.17003	0.17364	0.17724	0.18082	0.18439	0.18793
0.5	0.19146	0.19497	0.19847	0.20194	0.20540	0.20884	0.21226	0.21566	0.21904	0.22240
0.6	0.22575	0.22907	0.23237	0.23565	0.23891	0.24215	0.24537	0.24857	0.25175	0.25490
0.7	0.25804	0.26115	0.26424	0.26730	0.27035	0.27337	0.27637	0.27935	0.28230	0.28524
0.8	0.28814	0.29103	0.29389	0.29673	0.29955	0.30234	0.30511	0.30785	0.31057	0.31327
0.9	0.31594	0.31859	0.32121	0.32381	0.32639	0.32894	0.33147	0.33398	0.33646	0.33891
1.0	0.34134	0.34375	0.34614	0.34849	0.35083	0.35314	0.35543	0.35769	0.35993	0.36214
1.1	0.36433	0.36650	0.36864	0.37076	0.37286	0.37493	0.37698	0.37900	0.38100	0.38298
1.2	0.38493	0.38686	0.38877	0.39065	0.39251	0.39435	0.39617	0.39796	0.39973	0.40147
1.3	0.40320	0.40490	0.40658	0.40824	0.40988	0.41149	0.41308	0.41466	0.41621	0.41774
1.4	0.41924	0.42073	0.42220	0.42364	0.42507	0.42647	0.42785	0.42922	0.43056	0.43189
1.5	0.43319	0.43448	0.43574	0.43699	0.43822	0.43943	0.44062	0.44179	0.44295	0.44408
1.6	0.44520	0.44630	0.44738	0.44845	0.44950	0.45053	0.45154	0.45254	0.45352	0.45449
1.7	0.45543	0.45637	0.45728	0.45818	0.45907	0.45994	0.46080	0.46164	0.46246	0.46327
1.8	0.46407	0.46485	0.46562	0.46638	0.46712	0.46784	0.46856	0.46926	0.46995	0.47062
1.9	0.47128	0.47193	0.47257	0.47320	0.47381	0.47441	0.47500	0.47558	0.47615	0.47670
2.0	0.47725	0.47778	0.47831	0.47882	0.47932	0.47982	0.48030	0.48077	0.48124	0.48169
2.1	0.48214	0.48257	0.48300	0.48341	0.48382	0.48422	0.48461	0.48500	0.48537	0.48574
2.2	0.48610	0.48645	0.48679	0.48713	0.48745	0.48778	0.48809	0.48840	0.48870	0.48899
2.3	0.48928	0.48956	0.48983	0.49010	0.49036	0.49061	0.49086	0.49111	0.49134	0.49158
2.4	0.49180	0.49202	0.49224	0.49245	0.49266	0.49286	0.49305	0.49324	0.49343	0.49361
2.5	0.49379	0.49396	0.49413	0.49430	0.49446	0.49461	0.49477	0.49492	0.49506	0.49520
2.6	0.49534	0.49547	0.49560	0.49573	0.49585	0.49598	0.49609	0.49621	0.49632	0.49643
2.7	0.49653	0.49664	0.49674	0.49683	0.49693	0.49702	0.49711	0.49720	0.49728	0.49736
2.8	0.49744	0.49752	0.49760	0.49767	0.49774	0.49781	0.49788	0.49795	0.49801	0.49807
2.9	0.49813	0.49819	0.49825	0.49831	0.49836	0.49841	0.49846	0.49851	0.49856	0.49861
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49896	0.49900
3.1	0.49903	0.49906	0.49910	0.49913	0.49916	0.49918	0.49921	0.49924	0.49926	0.49929
3.2	0.49931	0.49934	0.49936	0.49938	0.49940	0.49942	0.49944	0.49946	0.49948	0.49950
3.3	0.49952	0.49953	0.49955	0.49957	0.49958	0.49960	0.49961	0.49962	0.49964	0.49965
3.4	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983
3.6	0.49984	0.49985	0.49985	0.49986	0.49986	0.49987	0.49987	0.49988	0.49988	0.49989
3.7	0.49989	0.49990	0.49990	0.49990	0.49991	0.49991	0.49992	0.49992	0.49992	0.49992
3.8	0.49993	0.49993	0.49993	0.49994	0.49994	0.49994	0.49994	0.49995	0.49995	0.49995
3.9	0.49995	0.49995	0.49996	0.49996	0.49996	0.49996	0.49996	0.49996	0.49997	0.49997
4.0	0.49997	0.49997	0.49997	0.49997	0.49997	0.49997	0.49998	0.49998	0.49998	0.49998

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B.Sc. Engineering Examinations 2022-2023

Sub: IPE 407 (Ergonomics and Safety 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. Answer any **THREE** questions.

1. (a) Explain human respiratory and cardiovascular responses to physical activity with necessary diagrams. **(15)**

   (b) "On size does not fit all" - elaborate on this statement about using gloves to operate vibrating hand tools. **(15)**

   (c) Differentiate between the Noise-Induced Hearing Loss and Temporary Threshold Shift. **(5)**

2. (a) Write in detail about the consequences of not avoiding tissue compression stresses while using hand tools. **(15)**

   (b) Why is uniform lighting crucial for the visual comfort of workers in a workplace? Mention different guidelines for avoiding glare and improving uniform lighting. **(15)**

   (c) What is the significance of heat acclimatization on a production floor? **(5)**

3. (a) Describe the NIOSH lifting equation. How can you utilize this equation to prevent lifting injuries? Explain with an example. **(15)**

   (b) Explain different health issues arising from unhealthy exposure to the high-temperature work environment. **(15)**

   (c) What do you understand by design for safe operations? **(5)**

4. (a) Describe different classes of fire. Differentiate between Dry and Wet Barrel Hydrant. **(10+10)**

   (b) Mention the following for each type of fire extinguisher- **(15)**

      i) Working Principle

      ii) Band Color

      iii) Relationship with classes of fire

IPE 407

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Distinguish between Preliminary and Detailed Assessments concerning RMG factory building. **(10)**

    (b) What are the types of construction based on fire resistance? Discuss the relationship between common structural elements with fire resistance rating. **(10)**

    (c) If you were safety manager, what would be your recommendations for means of escape and fire detectors for RMG factory buildings in Bangladesh? **(15)**

6. (a) What ergonomic considerations should you make for designing hand-basin? **(10)**

    (b) Discuss the relationship between sitting posture and intervertebral disc pressure. **(10)**

    (c) With neat sketches differentiate between different types of spinal disc conditions. **(15)**

7. (a) Discuss the relationship between bicycle saddle design with contouring and cushioning. **(10)**

    (b) How is pelvic tilt related to pregnancy? What would be your suggestions for fixing pelvic tilt after pregnancy period? **(10)**

    (c) Explain with necessary sketches, the effects of the presence of restraints, the effect of manual activity, the effect of working surface conditions, and the effects of apparel on the workspace envelope. **(15)**

8. (a) Write a short note on the following- **(10)**

    i) Flash Evaporation

    ii) Flammability of liquids

    (b) Explain the Figure 8(b) by defining the associated terms. **(10)**
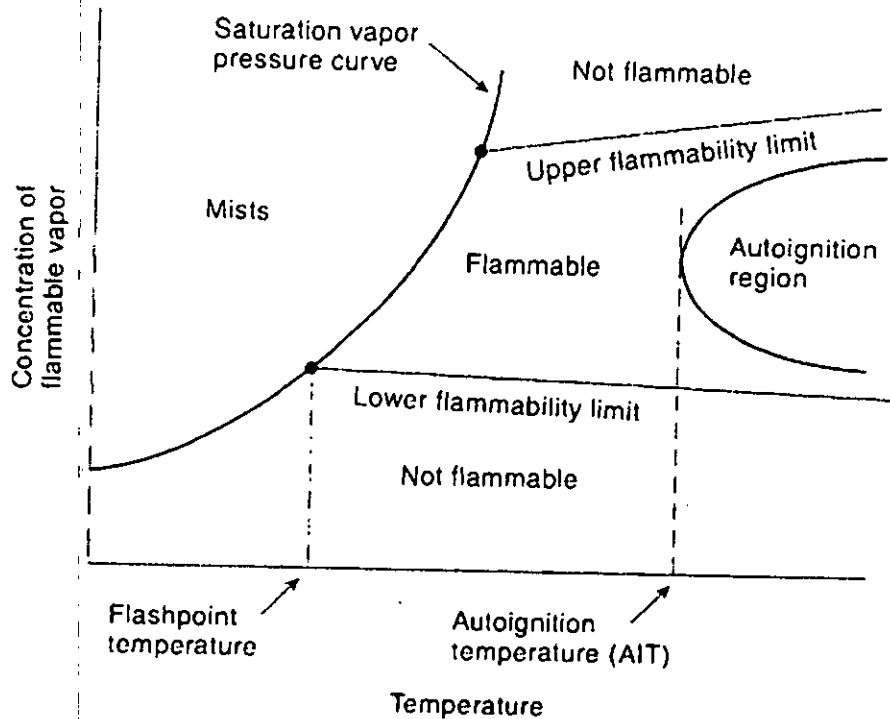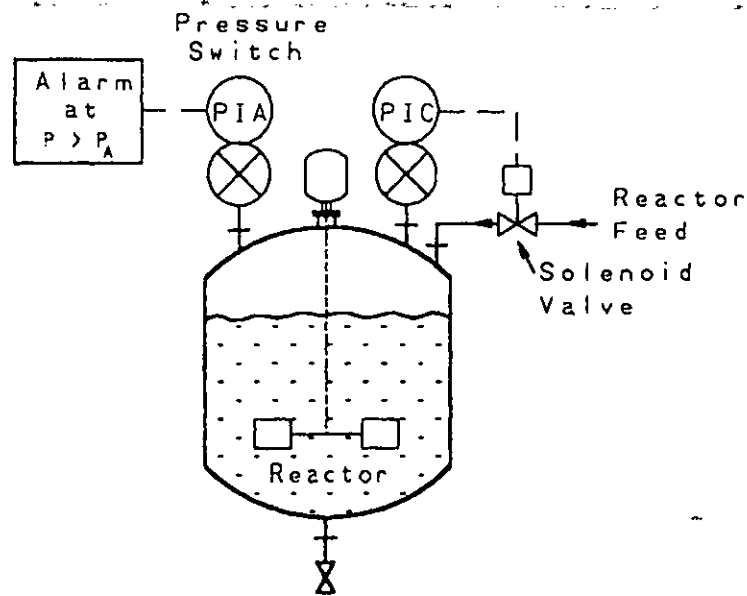

Figure 8(b)

8. (c) A diagram of the safety systems in a certain chemical reactor is shown in the following Figure 8(c). This reactor contains a high-pressure alarm to alert the operator in the event of dangerous reactor pressures. It consists of a pressure switch within the reactor connected to an alarm light indicator. For additional safety, an automatic high-pressure reactor shutdown system is installed. This system is activated at a pressure somewhat higher than the alarm system and consists of pressure switch connected to a solenoid valve in the reactor feed line. The automatic system stoops the flow of reactant in the event of dangerous pressures. Compute the overall failure rate, the failure probability, the reliability, and the MTBF for a high-pressure condition. Assume a 1-year period of operation. Also, develop an expression for the overall failure probability based on the component failure probabilities. **(15)**

A chemical reactor with an alarm and an inlet feed solenoid. The alarm and feed shutdown systems are linked in parallel.

Figure 8(c)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-4/T-1   B. Sc. Engineering Examinations 2022-2023
Sub: **IPE 419** (Computer Integrated Manufacturing)
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. Answer any **THREE** questions.

1. (a) Discuss general characteristics of industrial work situations that tend to promote the substitution of robot for human labor. **(10)**

(b) Discuss common joints used in industrial robots? Explain with necessary sketches. Describe delta robot configuration. **(10)**

(c) What does the notation TLR:RT mean? Draw hierarchical control structure of a robot microcomputer controller. Briefly discuss different control systems used in industrial robot. **(15)**

2. (a) What are the advantages of PLCs for industrial control applications? What conditions will make PCs suitable for industrial control applications? Briefly explain. **(15)**

(b) An automatic pump system is to be designed for a designed for a residential building with one overhead tank and one underground tank. When overhead tank gets empty and there is minimum level of water in the underground tank, pump will turn ON automatically. Again when overhead tank gets full or underground tank gets empty, pump will turn OFF. Draw a schematic diagram of the system with required sensors and actuators. Also provide the following items for this system: **(10)**
(i) Logic network diagram
(ii) Truth table
(iii) Ladder logic diagram

(c) Discus three different parts of scan briefly. What are the factors that influence scan time? Does scan time affect the output of a PLC? Explain. **(10)**

3. (a) What is a Flexible Manufacturing System (FMS)? Describe the capabilities that a manufacturing system must possess to be flexible. **(10)**

(b) Classify FMSs based on (i) type of operations, (ii) number of machines and (iii) level of flexibility. Discuss each of them. **(10)**

(c) Explain the components and functions of primary handling systems and secondary handling systems used in FMS with necessary drawings. Draw an open field layout and label different part/components of the system. How does an open field layout differ from other types of layouts. **(15)**

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4. (a) Compare rapid prototyping and virtual prototyping. What does augmented reality mean? **(10)**

   (b) Discuss retrieval CAPP system and generative CAPP systems briefly. **(10)**

   (c) "Full implementation of CIM results in automation of the information flow through every aspect of the company's organization."- Do you agree? Explain why. **(15)**

SECTION – B
There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Five machines will constitute a GT cell. The from-to data for the machines are shown in the table below. **(20)**

		To			
From	1	2	3	4	5
1	0	10	80	0	0
2	0	0	0	85	0
3	0	0	0	0	0
4	70	0	20	0	0
5	0	75	0	20	0

   (i) Determine the most logical sequence of machines for this data, and construct the network diagram, showing where and how many parts enter and exit the system.

   (ii) Compute the percentages of in-sequence moves, bypassing moves, and backtracking moves in the solution.

   (iii) Develop a feasible layout plan for the cell based on the solution.

   (b) What do you understand by the concept 'Key Machine'? **(5)**

   (c) What are the typical objectives in cellular manufacturing? **(10)**

6. (a) What are the different types of vehicle navigation technology used in AGV? Explain. **(20)**

   (b) Discuss the various measures used to assess the performance of a storage system. **(15)**

7. (a) What do you understand by Open Systems Interconnection model (OSI model)? Elaborate. **(20)**

   (b) What is the meaning of ATM with respect to Network Communications? Discuss. **(15)**

8. (a) Define the term "Factory of the Future" and outline the key characteristics that distinguish it from traditional manufacturing facilities. Provide examples of technologies that contribute to the transformation of a factory into a future-ready facility. **(20)**

   (b) Explain the role of Internet of Things (IoT) in the Factory of the Future. Discuss how IoT technologies enhance connectivity, data collection, and overall efficiency in a modern manufacturing setting. **(15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2022-2023

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. Answer any **THREE**.

1. (a) Managers must take two key decision when designing a distribution network. What are those two key decisions? With respect to these two key decisions, in case of Bangladesh Drug (medicine) distribution, what will be your decisions? Justify your answer.   **(15)**

    (b) Grocery chains Webvan, Peapod, and Albertsons have used this distribution network in their business. Probably, the same distribution network will be useful for a grocery company in Dhaka city. What distribution network is this? Explain its operation with right diagram.   **(20)**

2. (a) What are the three basic steps to achieving (supply chain) strategic fit?   **(10)**

    (b) What is EDLP? Is it a logical driver?   **(5)**

    (c) What is Bullwhip effect? Explain with appropriate diagram. Give at least 3 examples who (companies) found this effect in their chains.   **(17+3)**

3. (a) Napaolitano and Jue described that as "just-in-time for distribution system". What is that? Explain.   **(15)**

    (b) Which transportation network is used by Seven-Eleven supermarket chain? Why is it justified? Explain with necessary diagram.   **(20)**

4. (a) Describe the role of PayPal in relation with supply chain.   **(15)**

    (b) Tetra Ltd. supplies compressors to Aircon Ltd. for production of air coolers. Weekly demand of compressor at Aircon is 1200 units, what they buy at a price of 200 \$/unit. Safety stock of compressor at Aircon is 40% of the average demand during delivery lead time. Holding cost is 30% of the value of stock. Purchase lot size is 1500 units per order. Shipment cost of one lot from Tetra to Aircon is 300 \$. While shipment time is 1 week, order processing time at Tetra is another 1 week. Determine the followings: **(4×5=20)**

      (i) Annual material cost

      (ii) Annual holding cost

      (iii) Annual ordering (shipment) cost

      (iv) Is the purchase lot size an EOQ for Aircon? Justify your answer with right logic.

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) AbL Corp. sources from hundreds of suppliers and is considering the aggregation of indound shipments to lower costs. Truckload shipping costs $500 per truck along with $100 per pickup. Average annual demand from each supplier is 10,000 units. Each unit costs $50 and AbL incurs a holding cost of 20 percent. **(20)**

    (i) What is the optimal order frequency and order size if AbL decides to aggregate four suppliers per truck?

    (ii) What is the optimal order size and frequency if each truck has a capacity of 2,500 units?

(b) Demand for smart phones at G&G store is 1,000 units per month. G&G incurs a fixed order placement, transportation, and receiving cost of $4,000 each time an order is placed. Each smart phones costs G&G $500 and the retailer has a holding cost of 20 percent. Evaluate the number of smart phones that the store manager should order in each replenishment lot and determine the followings – **(15)**

    (i) Cycle inventory

    (ii) Number of orders per year

    (iii) Annual ordering and holding cost

    (iv) Average flow time

6. (a) Drugs Online (DO) is an online retailer of prescription drugs and health supplements. Vitamins represent a significant percentage of its sales. Demand for vitamins is 10,000 bottles per month. DO incurs a fixed order placement, transportation, and receiving cost of $100 each time an order for vitamins is placed with the manufacturer. DO incurs a holding cost of 20 percent. Assume that the manufacturer uses the following marginal unit discount pricing schedule. **(20)**

Order Quantity	marginal Unit Price
0 – 5,000	$3.00
5,000 – 10,000	$2.96
Over 10,000	$2.92

Evaluate the number of bottles that DO should order in each lot.

(b) Weekly demand for keyboards at A&T is normally distributed, with a mean of 2,500 and a standard deviation of 500. The replenishment lead time is two weeks. Assume that the demand is independent from one week to the next. Evaluate the CSL resulting from a policy of ordering 10,000 keyboards when there are 6,000 keyboards in inventory. **(10)**

(c) Explain different types of Replenishment Policies with examples. **(5)**

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7. (a) Best Buy sells three models of computers, The Litepro, The Medpro, and the Heavypro. Annual demands for the three products are D_L = 12,000 for the Litepro, D_M = 1,200 units for the Medpro, and D_H = 120 units for the Heavypro. Each model costs Best Buy $500. A fixed transportation cost of $4,000 is incurred each time an order is delivered. For each model ordered and delivered on the same truck, and additional fixed cost of $1,000 per model is incurred for receiving and storage. Best Buy incurs a holding cost of 20 percent. Product managers have decided to order jointly, but to be selective about which models they include in each order. Evaluate the ordering policy and cost using a suitable algorithm. **(20)**

(b) The processor in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of the supply chain. Explain those cycles with necessary diagram. **(15)**

8. (a) Supply chain processes fall into one of two categories depending on the timing of their execution to end customer. With necessary diagrams and examples, explain the two supply chain processes. **(20)**

(b) The objective of every supply chain should be to maximize the overall value generated which is known as Supply Chain Surplus. Explain the correlation amongst Supply Chain Surplus, Consumer Surplus, and Supply Chain Profitability. **(15)**

Table A. Standard Normal Distribution Values (Areas under the normal curve).
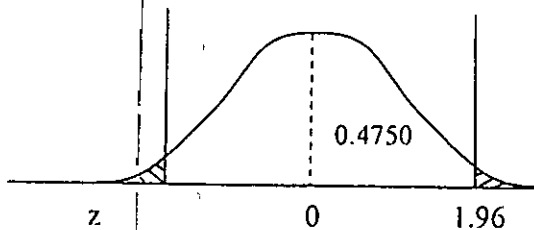
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0/09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	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