L-4/T-1/IPE **Date : 17/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

The text book titled "Shigley's Mechanical Engineering Design" is supplied.

Assume reasonable values for any missing data.

1. (a) A pressure-fed bearing has a journal diameter of 49.05 mm with a unilateral tolerance of +0.05. The bushing bore diameter is 50.085 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. The sump can dissipate 300 watts per bearing if necessary. For minimum radial clearances, using Trumpler's criteria find the allowable minimum film thickness, applicable load and average film temperature. **(15)**

   (b) The figure shows that a 16*T* 20° straight bevel pinion driving a 32*T* gear, and the location of the bearing centerlines. Pinion shaft 'a' receives 2.5 hp at 240 rev/min. Determine the bearing reactions at *A* and *B* if A is to take both radial and thrust loads. **(20)**

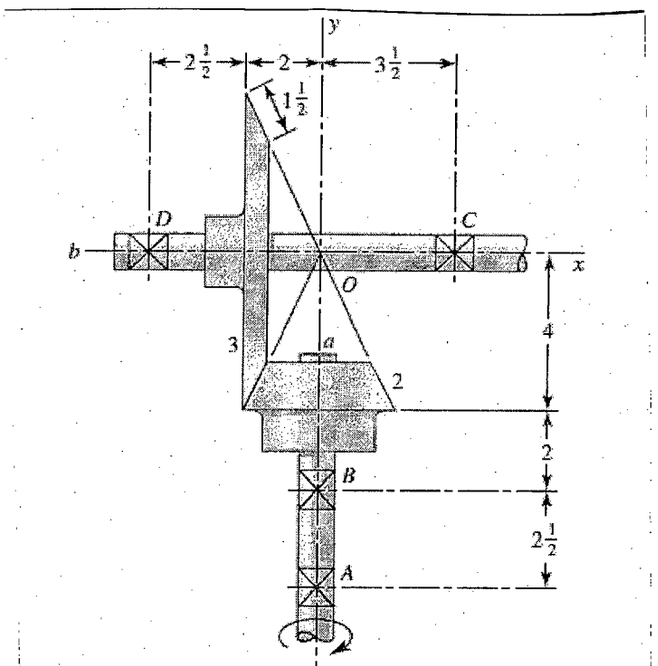

Fig.: 1 (b).

2. (a) A 20-tooth 20° pressure angle spur pinion rotates at 1500 rev/min and transmits 4.5 hp to a 50-tooth disk gear. The diametral pitch is 10 teeth/in, the face width 1.5 in, and the quality standard is No. 9. The gears are straddle-mounted with bearings immediately adjacent and have enclosure. The tooth profile is crowned and the compatibility is improved by lapping. Backup ratio of both gears are 1. The pinion is a grade 1 nitrided steel with a hardness of 300 Brinell tooth surface and through-hardened core. The gear is steel, through-hardened also, grade 1 nitrided steel.

Contd P/2

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Contd... Q. No. 2(a)

Poisson's ratio is 0.30, and Young's modulus is 30×106 psi. The power from the source is uniform but the driven machine faces moderate shock. Assume a pinion life of 10^8 cycles and a reliability of 0.90, and use $Y_N = 1.3558N^{-0.0178}$, $Z_N = 1.4488N^{-0.023}$. **(20+5)**

(i) Find the factor of safety of the pinion in wear.

(ii) To achieve the same amount of factor of safety of the gear in wear select appropriate hardness of gear material (consider the difference in K_s of pinion and gear).

(b) Consider a simply supported steel shaft as depicted in the figure below, with 1.5 in diameter and a 31-in span between bearings, carrying two gears weighing w_1 and w_2 lbf. If the intrinsic critical speed of the shaft is 600 rad/s and the first critical speed at loaded condition is 150 rad/s, using Dunkerley's equation, find the maximum allowable of w_2. **(10)**

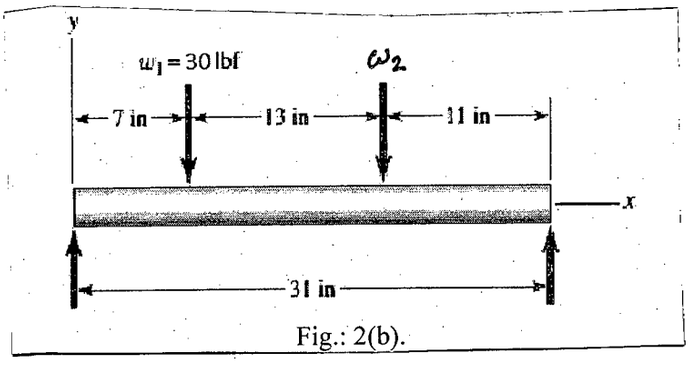

Fig.: 2(b).

3. (a) A pair of straight-tooth bevel gears with gear ratio 3:1, has a diametral pitch of 5 at the large end, a 1.10-in face width, and a 20° normal pressure angle; the gears are grade 1 steel through-hardened with a core and case hardness of 200 Brinell. The pinion has 20 teeth. The gears are properly crowned and have a quality number of Qv = 8. Both the motor and driven machine produce light shock. Only the pinion is straddle mounted. It is likely that the application intended will require outboard mounting of the gears. The gears are operated at a speed of 700 rpm to transfer 7hp. The intended safety factor is 2, cycle life is 10^7 at general condition and operating temperature is 260° F. Find the reliability of the gear set for bending. **(25)**

(b) In the figure below, the shaft has two steep angle tapered roller bearings A & B. The bearings are desired to have a life two times the rated life. If the reliability goal is 85% and application factor is 1.5, find the catalog load rating for bearing A & B. **(10)**

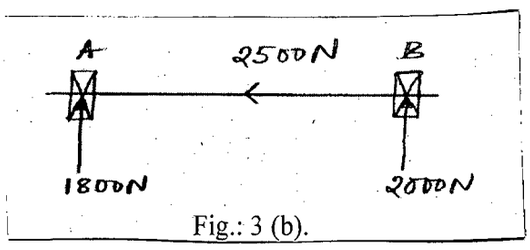

Fig.: 3 (b).

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4. (a) A steel worm rotates at 2000 rev/min transmitting 1 hp to the output shaft with a gear ratio 15:1. The pitch diameter of the worm is 1.50. The tangential diametral pitch of the gear is 8 teeth per inch and the normal pressure angle is 22.5°. The ambient temperature is 70°F, the application factor is 1.25, the design factor is 1, the gear face is 0.5 in, the lateral case clearance is 5in, and the gear is sand-cast bronze. For minimum number of threads in the worm- **(27)**

(i) Determine the transmitted gear forces and the mesh efficiency.

(ii) Is the mesh sufficient to handle the loading?

(iii) Estimate the lubricant sump temperature, assuming fan-stirred air.

(b) A self-aligning ball bearing carries an axial load of 1500 N and a radial load of 2500N, having the inner ring stationary. Basic static load rating is 20,000N. If the bearing is intended to have a life of 150,000hr at 750 rpm, find the catalog load rating. **(8)**

SECTION-B

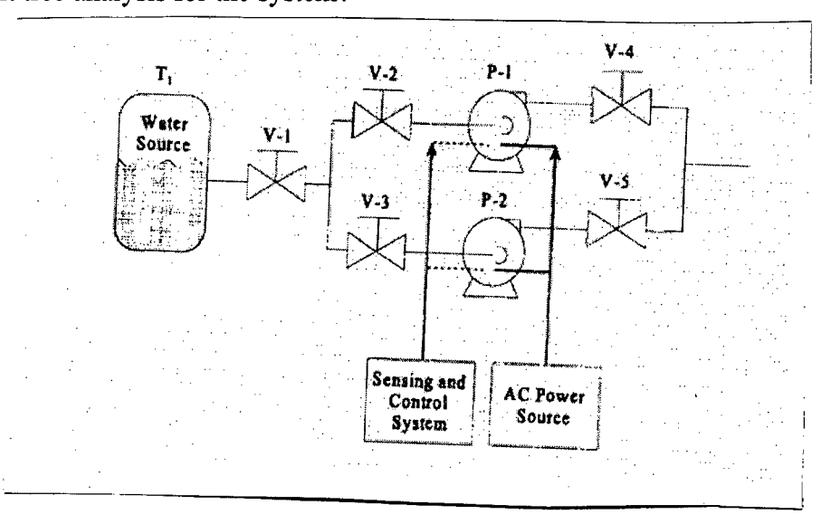
There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Elon Musk's revolutionary transit system, the hyperloop is proving to be the future of travel. When built, hyperloop service will be world's faster over ground service, with hyperloop pods whisking passengers from Montreal via Ottawa to Toronto faster than passenger planes; that is 640 km in only 39 minutes. However, it is beyond expectation for ticket prices to be anywhere near affordable. But, if you can afford world's first hyperloop service, in less than an hour you could be fine dining in Montreal after long day at work in Toronto, 640 km away. **(10)**

(i) At what level of redesigning for sustainability does it lie and why?

(ii) What are the other levels of redesigning for sustainability? Differentiate all with proper examples.

(b) Consider the pumping system in the following figure. Sufficient water is delivered from water source T_1 when only one of the two pumps, P-1 or P-2 works. All the levels V-1 through V-5 are normally open. The sensing and control system use the same ac power AC. Assume the water content in T_1 is sufficient and available, there are no human errors, and no failure in the pipe connections is considered important. Does the fault tree analysis for the system? **(10)**



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Contd... Q. No. 5

(c) A disk brake have two annular pads with inner and outer radius respectively, r_i = 4 inch and r_0 = 6 inch, subtend an angle of 120°, have a coefficient of friction of 0.45, and are actuated by a pair of hydraulic cylinders 2.0 inch in diameter. The maximum hydraulic pressure that can be applied is 2500 psi. For uniform pressure, **(15)**

(i) Estimate the actuating force F.

(ii) Find the average pressure P_a.

(iii) Find the equivalent radius r_e and force location $\bar{r}$.

6. (a) According to project M, a compact bubble car concept gets 107 miles per gallon; thus it uses 34% less energy over its lifecycle than a typical car. The chassis – the base frame of a car – is made of recycled carbon fiber and has room for three passengers. Different views of its main body frame are shown below. **(13)**

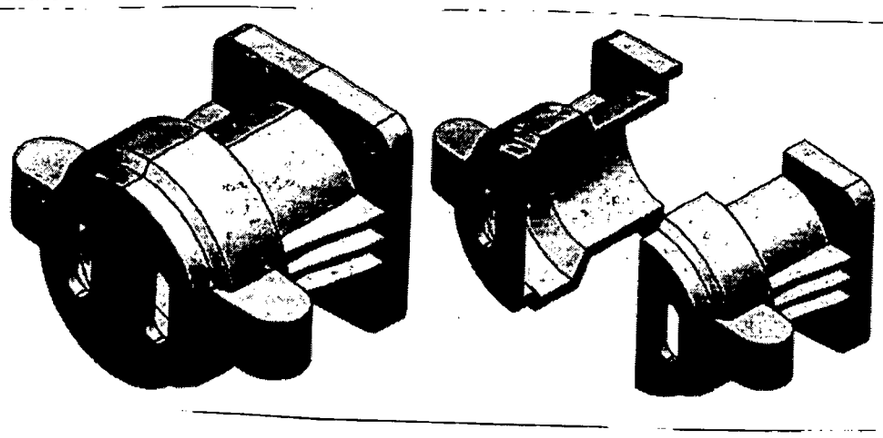
(i) What manufacturing process is used for its body frame production?

(ii) What specific design considerations you should make for its manufacturability? Elucidate with necessary schematics.

(b) "DFE has a major influence in 'trade-in' concept" – Do you agree? Explain showing reverse logistic process of smart phones in developed countries. **(7)**

(c) What is stochastic point process? Differentiate between renewal process and non-homogenous Poisson process with necessary equations. **(9)**

(d) Consider, the following two figures. First one is the actual object to be manufactured while the second one is splitted along the parting line of the mold required to manufacture it. Do you think that undercut analysis is required here? Elucidate. **(6)**



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7. (a) A clutch is a mechanical device which engage and disengages power transmission especially from driving shaft to driven shaft. As a reliability engineer, you want to design a dry friction clutch of automobile system for reliability. **(23)**

(i) Do system identification and reliability identification of this clutch system.

(ii) How do you test reliability by ALTA method?

(iii) Define Fisher matrix and Bogey testing method. How would you apply this two in designing a clutch system for its reliability?

(b) Write down the simple cost model that captures the effect of MTBF and MTTR on cost and reflects minimum repair philosophy. **(6)**

(c) Sequentially show all possible sources that contribute to maintenance downtime. Differentiate between MTR and MTTR. **(6)**

8. (a) With the help of Cummins tool, do a complete DFA analysis for a traditional stapler remover. Also, give proper reasoning behind the logical statement, presented in Cummins tool, taking one from each aspect. **(18)**

(b) Suppose, you want to apply reverse engineering on lock mechanism available in market. For this purpose, once you broke a 'Kiko' lock and explore its working mechanism. With necessary schematics, share your exploration on the way this lock works to keep the key unmoved unless locking is done. **(7)**

(c) An on-board computer has, through the use of built-in test equipment, the capability of being restored when a failure occurs. Two standby computers are available for use whenever the primary fails. Assume failure rate and repair rate of the main one 0.0005 and 0.1 respectively. Failure rate for both of the standby units are 0.002. Show the rate diagram for the system and determine system reliability at 1000-hr intervals. All rates are expressed in units per hour. Assume arbitrary values and cases if necessary. **(10)**

L-4/T-1/IPE **Date: 22/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2016-2017

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**.

1. (a) What is an industrial robot? Briefly explain the commercial and technological importance of industrial robots. **(10)**

   (b) Distinguish joints from links used in industrial robots. Discuss common joints used in industrial robots with neat sketches. **(10)**

   (c) Define work volume for an industrial robot. Explain different body-and-arm configurations available in commercial industrial robots. Also draw the work volume for each of these configurations. **(15)**

2. (a) Discrete process control systems dealing with parameters and variables that change in discrete moments in time — Explain with examples. **(8)**

   (b) What are the basic elements of logic control? Draw the truth tables for the logic network diagrams shown in Fig. Q. No. 2(b). **(12)**

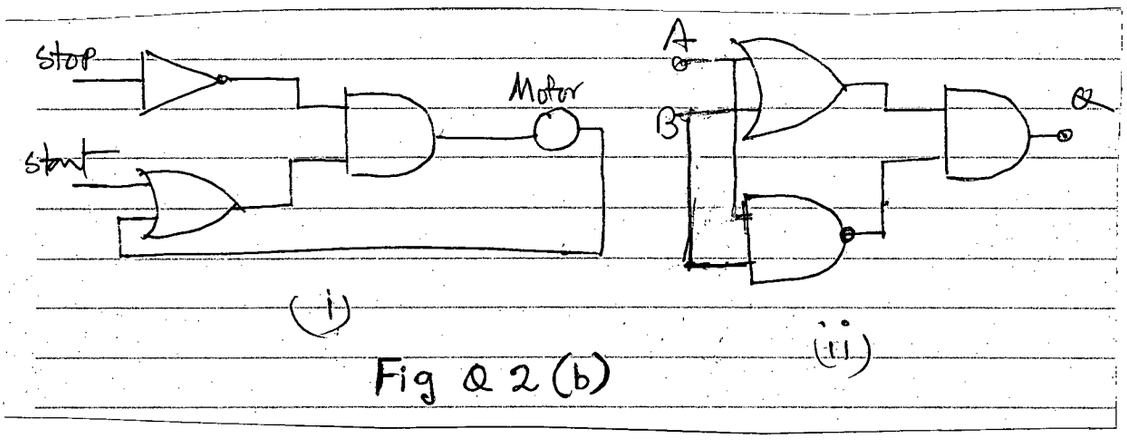

Fig Q 2 (b)

   (c) What is an FMS? To qualify as being flexible, a manufacturing system should satisfy several criteria — Do you agree? Explain why. **(15)**

3. (a) Classify the common layout configurations found in today's FMSs. Explain each of them with sketches. **(20)**

   (b) Briefly discuss how CIM integrates all engineering functions and business functions of a manufacturing industry. **(15)**

Contd P/2

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4. (a) Define CAPP. How can a CAPP system help a manufacturing engineer in his decision making? **(10)**

(b) What is the basic difference between a retrieval CAPP system and a generative CAPP system? Explain the general procedure of the retrieval CAPP systems. **(25)**

SECTION – B

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

5. (a) Suppose a company wants to install AGV in its factory for three different purposes: **(15)**

(i) To transfer raw materials from the raw material receiving zone to the warehouse following a fixed path

(ii) To transfer raw materials and WIPs in a process layout to produce different type of products in batches

(iii) To transfer finished products to the Finished goods inventory

Suggest the types and guidance technologies of AGVs for the mentioned purposes and justify your answer with details of operating techniques of these vehicles.

(b) What are the benefits of using AS/RS? **(5)**

(c) An analysis of 50 parts processed in 5 machines are shown in the following task flow table. Additional information is that, 40 parts enter the machine grouping at machine C, 10 parts enter the machine grouping at machine D, 40 parts leave after processing at machine E and 10 parts leave after processing at machine A. Arrange the machines in the cell showing in a part flow diagram. **(15)**

	A	B	C	D	E
A	0	10	0	0	25
B	25	0	0	0	20
C	5	10	0	40	0
D	10	25	15	0	0
E	10	0	0	0	0

6. (a) Classify barcode readers and briefly explain the mechanism of these readers. **(5)**

(b) Identify part families and corresponding machine grouping for the following part machine incidence matrix using rank order clustering technique: **(15)**

		Parts						
		A	B	C	D	E	F	G
Machine	1	1		1	1	1	1	
	2	1			1			
	3		1					1
	4			1		1	1	
	5		1					1
	6			1			1	
	7		1			1		1
	8	1			1			

Contd P/3

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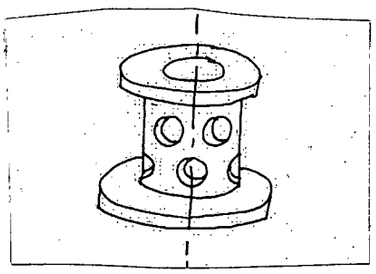
(c) What is Open Systems Interconnection model (OSI model)? Describe the stages involved in this model and mention the name of the protocols used in each of these stages. **(15)**

7. (a) Suppose, you want to convert your current process layout into a cellular layout. What factors would you need to consider for the design of the machine cells? Describe with necessary figures. **(20)**

(b) What are the benefits of using composite part concept? Draw diagram of six (06) different parts of the part family from the following composite part. **(6)**



(c) What is a dual ring network? What is the advantage of using this type of network? **(4)**

(d) Differentiate broadband from baseband signaling methods. **(5)**

8. (a) What do you understand by the 'Factory of the Future' (FOF)? Explain in brief. **(5)**

(b) How would you describe the four initiatives currently underway in different regions? Discuss the relationship between Human and Industry in the past and future. **(15)**

(c) Write short notes on: **(15)**

(i) IOT

(ii) Data Analytics

(iii) Smart robotics

L-4/T-1/IPE **Date: 27/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2016-2017

Sub: **IPE 403** (Project and Environmental 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) Name any five types of project based on need with appropriate example for each. **(10)**

(b) Monitoring is important to control project activities. You need to collect data for this purpose — why? How frequent should you collect data that would be appropriate for a project? **(8)**

(c) Negotiation is one of the special demands to be a project manager — discuss. **(5)**

(d) For the following task table, draw the network diagram, calculate project duration, find all possible critical paths and calculate free slack for each task: **(12)**

Task	Successor	Duration (day)
h	k, l	4
j	—	7
f	j	5
d	f, g, i	7
i	l	7
b	d, e	4
l	—	6
g	j, k	4
a	d	5
e	g, h, i	8
c	e	6
k	—	7

2. (a) How can you distinguish three different types of Matrix organization structures in terms of authority of PM and FM? **(8)**

(b) Multicultural communication affects the performance of project — elaborate with example. **(6)**

(c) Chartering can be related to communication and negotiation — how? **(6)**

Contd P/2

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Contd... Q. No. 2

(d) For the following table, prepare a work schedule by having an available 30 manpower resource: **(15)**

Task	Predecessor	Duration (day)	Manpower
a	—	8	30
b	—	10	12
c	a	16	15
d	a	16	6
e	b, c	8	21

3. (a) Bottom-up budget is better than Top-down budget — do you agree with this statement? Justify your answer. **(8)**

(b) What are the items need to be included in Milestone schedule? State the importance of these items for a project. **(7)**

(c) For the following activity table, find all possible crash times and corresponding costs: **(20)**

		Duration (day)		Cost (BDT)	
Activity	Predecessor	Normal	Crash	Normal	Crash
A	—	3	2	1100	1400
B	—	2	1	800	1000
C	A	4	2	1200	2000
D	B	5	3	1400	2000
E	C, D	4	3	1800	2300
F	C	6	4	1600	2200
G	D	3	1	1700	2500
H	G	2	2	1500	1500

4. (a) Piecemeal system prevents the success of a project — how? Mention the steps to be taken to remove this system. **(6)**

(b) Briefly describe three different types of cybernatic control mechanism in controlling a project. Provide appropriate example as well. **(8)**

(c) Project manager is often termed as "conflict manager" — justify. **(5)**

(d) Investment and return for two different projects A and B are as follows: **(10)**

Year	Project A	Project B
0	–1,00,000	–1,00,000
1	25,000	35,000
2	30,000	35,000
3	30,000	30,000
4	35,000	25,000
5	35,000	25,000

Contd P/3

IPE 403

Contd... Q. No. 4

(e) Consider a project requiring 30 units of products to be produced. An expert worker takes 15 hrs to complete a single part. However 23 parts need to be produced to be an expert at 70% learning rate. If the wage rate is Tk. 150/hr, by how much amount will be the budget underestimated without considering the learning effect? **(6)**

SECTION – B

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

5. (a) Differentiate between ecosystem and habitat. **(10)**

(b) What are the four categories of industries? Give three examples under each category. **(10)**

(c) Write short note on Delhi smog pollution including mentioning its causes. **(15)**

6. (a) What are the greenhouse gases? List ten greenhouse gases and write short note on any one of them. **(2+4+10)**

(b) Differentiate between wet deposition and dry deposition with appropriate examples. **(10)**

(c) "Issue of Environmental pollution can be analyzed on five level" — what are they? Describe. **(9)**

7. (a) Write short note on any two layers of atmosphere. **(18)**

(b) Describe operation of ETP plants of the industry you visited during your industrial attachment or any other industry known to you. **(17)**

8. (a) What principles Kyoto establishes at its heart? **(17)**

(b) What do you mean by integrated system of ISO? **(8)**

(c) Write short note on "Ramsar Convention on wetlands". **(10)**

Learning Rate Coefficients

Unit	70%		75%		80%		85%		90%	
Number	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	0.700	1.700	0.750	1.750	0.800	1.800	0.850	1.850	0.900	1.900
3	0.568	2.268	0.634	2.384	0.702	2.502	0.773	2.623	0.846	2.746
4	0.490	2.758	0.563	2.946	0.640	3.142	0.723	3.345	0.810	3.556
5	0.437	3.195	0.513	3.459	0.596	3.738	0.686	4.031	0.783	4.339
6	0.398	3.593	0.475	3.934	0.562	4.299	0.657	4.688	0.762	5.101
7	0.367	3.960	0.446	4.380	0.534	4.834	0.634	5.322	0.744	5.845
8	0.343	4.303	0.422	4.802	0.512	5.346	0.614	5.936	0.729	6.574
9	0.323	4.626	0.402	5.204	0.493	5.839	0.597	6.533	0.716	7.290
10	0.306	4.932	0.385	5.589	0.477	6.315	0.583	7.116	0.705	7.994
11	0.291	5.223	0.370	5.958	0.462	6.777	0.570	7.686	0.695	8.689
12	0.278	5.501	0.357	6.315	0.449	7.227	0.558	8.244	0.685	9.374
13	0.267	5.769	0.345	6.660	0.438	7.665	0.548	8.792	0.677	10.052
14	0.257	6.026	0.334	6.994	0.428	8.092	0.539	9.331	0.670	10.721
15	0.248	6.274	0.325	7.319	0.418	8.511	0.530	9.861	0.663	11.384
16	0.240	6.514	0.316	7.635	0.410	8.920	0.522	10.383	0.656	12.040
17	0.233	6.747	0.309	7.944	0.402	9.322	0.515	10.898	0.650	12.690
18	0.226	6.973	0.301	8.245	0.394	9.716	0.508	11.405	0.644	13.334
19	0.220	7.192	0.295	8.540	0.388	10.104	0.501	11.907	0.639	13.974
20	0.214	7.407	0.288	8.828	0.381	10.485	0.495	12.402	0.634	14.608
21	0.209	7.615	0.283	9.111	0.375	10.860	0.490	12.892	0.630	15.237
22	0.204	7.819	0.277	9.388	0.370	11.230	0.484	13.376	0.625	15.862
23	0.199	8.018	0.272	9.660	0.364	11.594	0.479	13.856	0.621	16.483
24	0.195	8.213	0.267	9.928	0.359	11.954	0.475	14.331	0.617	17.100
25	0.191	8.404	0.263	10.191	0.355	12.309	0.470	14.801	0.613	17.713
26	0.187	8.591	0.259	10.449	0.350	12.659	0.466	15.267	0.609	18.323
27	0.183	8.774	0.255	10.704	0.346	13.005	0.462	15.728	0.606	18.929
28	0.180	8.954	0.251	10.955	0.342	13.347	0.458	16.186	0.603	19.531
29	0.177	9.131	0.247	11.202	0.338	13.685	0.454	16.640	0.599	20.131
30	0.174	9.305	0.244	11.446	0.335	14.020	0.450	17.091	0.596	20.727
31	0.171	9.476	0.240	11.686	0.331	14.351	0.447	17.538	0.593	21.320
32	0.168	9.644	0.237	11.924	0.328	14.679	0.444	17.981	0.590	21.911
33	0.165	9.809	0.234	12.158	0.324	15.003	0.441	18.422	0.588	22.498
34	0.163	9.972	0.231	12.389	0.321	15.324	0.437	18.859	0.585	23.084
35	0.160	10.133	0.229	12.618	0.318	15.643	0.434	19.294	0.583	23.666
36	0.158	10.291	0.226	12.844	0.315	15.958	0.432	19.725	0.580	24.246
37	0.156	10.447	0.223	13.067	0.313	16.271	0.429	20.154	0.578	24.824
38	0.154	10.601	0.221	13.288	0.310	16.581	0.426	20.580	0.575	25.399
39	0.152	10.753	0.219	13.507	0.307	16.888	0.424	21.004	0.573	25.972
40	0.150	10.902	0.216	13.723	0.305	17.193	0.421	21.425	0.571	26.543
41	0.148	11.050	0.214	13.937	0.303	17.496	0.419	21.844	0.569	27.111
42	0.146	11.196	0.212	14.149	0.300	17.796	0.416	22.260	0.567	27.678
43	0.144	11.341	0.210	14.359	0.298	18.094	0.414	22.674	0.565	28.243
44	0.143	11.484	0.208	14.567	0.296	18.390	0.412	23.086	0.563	28.805
45	0.141	11.625	0.206	14.773	0.294	18.684	0.410	23.496	0.561	29.366
46	0.139	11.764	0.204	14.977	0.292	18.975	0.408	23.903	0.559	29.925
47	0.138	11.902	0.202	15.180	0.290	19.265	0.405	24.309	0.557	30.482
48	0.136	12.038	0.201	15.380	0.288	19.552	0.403	24.712	0.555	31.037
49	0.135	12.173	0.199	15.579	0.286	19.838	0.402	25.113	0.553	31.590
50	0.134	12.307	0.197	15.776	0.284	20.122	0.400	25.513	0.552	32.142
51	0.132	12.439	0.196	15.972	0.282	20.404	0.398	25.911	0.550	32.692
52	0.131	12.570	0.194	16.166	0.280	20.684	0.396	26.307	0.548	33.241
53	0.130	12.700	0.192	16.358	0.279	20.963	0.394	26.701	0.547	33.787
54	0.128	12.828	0.191	16.549	0.277	21.239	0.392	27.094	0.545	34.333
55	0.127	12.955	0.190	16.739	0.275	21.515	0.391	27.484	0.544	34.877
56	0.126	13.081	0.188	16.927	0.274	21.788	0.389	27.873	0.542	35.419
57	0.125	13.206	0.187	17.114	0.272	22.060	0.388	28.261	0.541	35.960
58	0.124	13.330	0.185	17.299	0.271	22.331	0.386	28.647	0.539	36.499
59	0.123	13.453	0.184	17.483	0.269	22.600	0.384	29.031	0.538	37.037
60	0.122	13.574	0.183	17.666	0.268	22.868	0.383	29.414	0.537	37.574

L-4/T-1/IPE **Date: 05/03/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2016-2017

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**.

One Normal distribution table attached.

1. (a) In relation with Outsourcing, describe how W.W. Grainger and Dell changed their strategies . **(15)**

   (b) Bellfort Refrigerator Company buys compressors from Comptech Company Ltd. at unit price of 100$. Annual demand of compressor is 730,000 units. Total purchasing lead time includes 2 days order processing time at supplier Comptech's office. Safety stock of Bellfort is 50% of the average demand during the purchasing lead time, whereas holding cost is 15% of the value of stock. They computed and found the safety stock to be 8000 units. Because of packaging and transportation constraints, Bellfort is forced buy with a lot of 36,500 units of compressors in one order. Ordering cost/order is 500$/order. **(4+8+8)**

   (i) Compute the in-transit time.

   (ii) What is the total annual inventory bolding cost?

   (iii) What is the annual ordering cost?

2. (a) What are the three basic questions, which need to be considered when designing a transportation network of a supply chain? **(15)**

   (b) What do you understand by 4PL service providers? Define and explain. **(15)**

   (c) What role does Schneider play? **(5)**

3. (a) What do you understand by an "Efficient Frontier" in a supply chain. Explain with example. **(15)**

   (b) From historical perspective, today's supply chain management represents a confluence (a fusion) of at least three main streams of knowledge and experience. What are those? **(20)**

4. (a) What is PayPal? Explain its role in supply chain. **(15)**

   (b) Which design option for distribution network generally takes place in fast-moving grocery business, such as, Webvan, Peapod, and Albertson's have used in their delivery? Explain with appropriate diagram. **(20)**

Contd P/2

SECTION – B

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

Assume reasonable values for any missing data.

Standard Normal Table is attached.

5. (a) Illustrate obstacles to coordination in a supply chain. **(20)**

(b) What is the bullwhip effect? Discuss it with suitable examples and necessary figures. **(15)**

6. (a) Suppose some students of your class have established a T-shirt selling shop at Palashi Bazar Dhaka in January 2018. The shop is named BUET Fashions. Your class captain will work as a purchasing manager for the shop. He purchases T-shirts from a vendor in China. The vendor sells T-shirts to BUET Fashions for $34.99 a piece. Shipping from China to Dhaka costs $110 per order. When an order arrives, it has been estimated that receiving and inspection tasks cost the shop $25. The annual holding cost for a T-shirt is calculated as 11$ of the purchase cost. The manager estimates that 3100 T-shirts will be sold during the year 2018. **(20)**

   (i) Determine the optimal order quantity.

   (ii) The vendor has recently offered a 3% discount on the purchase price if the BUET Fashions orders 500 or more but less than 2000 at a time, and a 5% discount if the Shop orders 2000 or more at a time. Would you take up one of these offers? If so, what is the new optimal order quantity, and if not, why not? Use the same holding cost from part 6 (a)-(i) throughout this question.

(b) Link five Sustainable Development Goals (SDGs) as applicable to the readymade garment industry supply chain of Bangladesh. Justify your linkage with proper explanation. **(15)**

7. (a) Motorola obtain cell phones from its contract manufacturer located in China to serve the U.S. market. The U.S. market is served from a warehouse located in Memphis, Tennessee. Daily demand at the Memphis warehouse is normally distributed, with a mean of 5,000 and a standard deviation of 4,000. The warehouse aims for a CSL of 99%. The company is debating whether to use sea or air transportation from China. Sea transportation results in a lead time of 36 days and costs $0.50 per phone. Air transportation results in a lead time of 4 days and cost $1.50 per phone. Each phone costs $100, and Motorola uses a holding cost of 20 percent.

Contd P/3

IPE 451

Contd... Q. No. 7(a)

Given the minimum lot sizes, Motorola would order 100,000 phones at a time (on average, once every 20 days) if using sea transport and 5,000 phones at a time (on average, daily) if using air transport. To begin with, assume that Motorola takes ownership of the inventory on delivery. **(25)**

(i) Assuming that Motorola follows a continuous review policy, what safety inventory should the warehouse aim for when using sea or air transportation? How many days of safety and cycle inventory will Motorola carry under each policy?

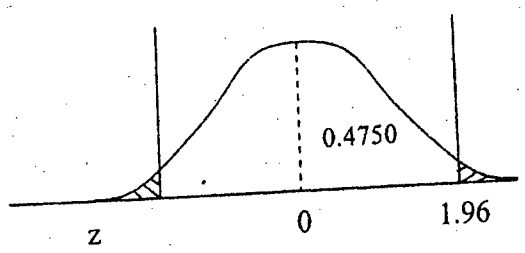
(ii) Under a continuous review policy, do you recommend sea or air transportation if Motorola does not own the inventory while it is in transit? Does your answer change if Motorola has ownership of the inventory while it is in transit?

(b) What are the pros and cons of the various measures of product availability? **(10)**

8. (a) The Knitting Company (TKC) is planning production for its four styles that are popular during Christmas. All four styles have demand that is normally distributed. The best selling style has an expected demand of 30,000 and a standard deviation of 5,000. Each of the other three styles has an expected demand of 10,000 with a standard deviation of 4,000. Currently all sweaters are produced before the start of the season. Production cost is $20 per sweater and they are sold for a wholesale price of $35. Any unsold sweaters at the end of the season are discounted to $15 and they all sell at that price. It costs $2 to hold the sweater in inventory for the entire season if it does not sell. How many sweaters of each type should TKC manufacture? What is the expected profit from this policy? **(25)**

(b) How can you distinguish operational risk from disruption risk in a supply chain? Explain with suitable examples and diagram. **(10)**

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

L-4/T-1/IPE **Date: 11/03/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2016-2017

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**.

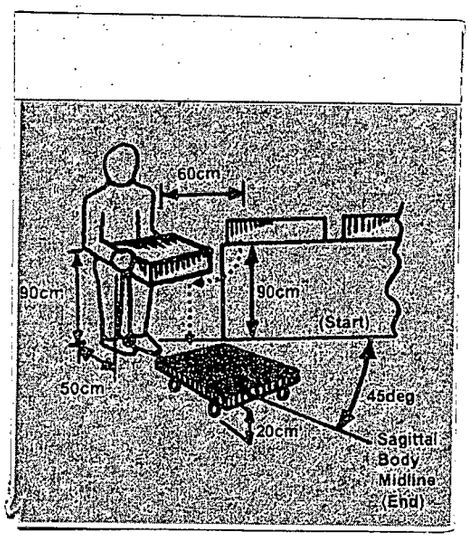
1. (a) Develop a model to reduce discomfort, effort and energy for a particular task. **(20)**

   (b) How muscle contract, extend, and grow? Briefly describe. **(10)**

   (c) Differentiate between macro ergonomics and micro ergonomics. **(5)**

2. (a) Briefly describe the principles of hand tool and device designs with necessary figures. **(20)**

   (b) Consider task shown in following figure. **(15)**



The task is moving trays from conveyor belt and putting them on cart and doing the reverse periodically. If feet are fixed,

(i) What are the available methods of lifting or lowering the object from or to the cart in order to apply NIOSH lifting equation?

(ii) How will you determine maximum limit of load one should carry considering the following variations:

- Work shift: 4 hours or 8 hours
- size and shape of load
- gripping criterion
- lift/min: 0.5 to 2.

Contd P/2

IPE 407

3. (a) Differentiate power grip and precision grip with examples. How will you improve grip quality for power tool handle? **(18)**

(b) In a microbus design, you want to place the hand clutch used for changing gears just beside the steering wheel instead of its traditional position which is in the middle of the two seats at front. **(8)**

(i) Do you think, new design will be more ergonomic? Clarify.

(ii) What anthropometric measurements do you need to consider for this new design such that this new design would not create new problems in terms of ergonomics.

(c) What types of tasks deteriorate your neck curve? Briefly explain. **(9)**

4. (a) Differentiate between variant method and generative method. Describe a grasp posture generation method for a particular object with necessary figures. **(15)**

(b) What do you mean by Posture Evaluation Index? How could you apply this index? Describe with a suitable example. **(14)**

(c) Rabbi is very studious. He studies at least 8 hours a day regularly in reading table. But most of the time he does so in a poor posture, especially, in a slouched one. **(6)**

(i) What future problem he may have for his posture?

(ii) It has been observed that he is slowly gaining weight though he thinks he does enough physical work and is enough frugal in his food habit. Do you think, his weight gaining has correlation with his posture? Justify your answer.

SECTION – B

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

Assume suitable value for any missing data.

5. (a) Illustrate some challenges for implementing occupational health and safety problem in the readymade garment industry of Bangladesh. Cite suitable examples to support your answer. **(15)**

(b) A well-documented workplace safety program must contain six core elements. What are those? Explain those in brief. **(12)**

(c) What do you mean by system safety? **(8)**

6. (a) Describe the physical and procedural measures to direct energy in wanted channels and control unwanted releases to prevent industrial accidents. Justify your answer with suitable examples in the context of Bangladesh. **(20)**

(b) How can you use O'SHA 300, 301, and 300A forms for recording and maintaining work-related injuries and illness? **(15)**

Contd P/3

IPE 407

7. (a) Explain the classes of fires and fire extinguishers. **(15)**

(b) Narrate Heinrich's Domino theory of accident causation with appropriate examples in the context of manufacturing industries of Bangladesh. **(12)**

(c) Briefly explain toxicology with the help of a dose-response relationship diagram. **(8)**

8. (a) Suppose you want to ergonomically design a video display terminal (VDT) for your reading room. To do so, you need to consider some important parameters. For examples, **(2+5+20=27)**

(i) Flexibility in set depth
(ii) Flexibility in eye level and wrist level
(iii) Maintaining proper pelvic posture and proper neck support
(iv) Flexibility in arm rest and foot rest

- Do you need to consider some other parameters? If yes, mention them.
- Why are these parameters important for designing a VDT of your reading room?
- How will you incorporate each of the above four parameters for designing the VDT? Illustrate with necessary sketches.

(c) Mention whether the following statements are TRUE or FALSE. **(½ ×16=8)**

(i) In poor light, iris expansion is related to the slight blurring.
(ii) Near visual work for long periods leads to astigmatism of eyes.
(iii) Illuminance is related to human eye while luminance is related to light falling on an object.
(iv) Color rendition index is the same to color contrast.
(v) The more the room reflectance power, the better it is always.
(vii) During reading, indirect lighting is good.
(vii) Both the monitor height and distance from the monitor screen lead to human eye muscle fatigue.
(viii) Less humidity in VDT environment along with less blinking leads to dry eyes.
(ix) Both amplitude and frequency of sound wave actually causes noise hazard.
(x) Exposing 80 dB sound all day long is not harmful as noise level is more than that 80 dB.
(xi) Cochlea hair cells are mainly responsible for converting the sound wave to electrical signals.
(xii) Both the amplitude and frequency sensation can be attributed to cochlea.
(xiii) In our ear, sound wave propagates through both the solid and liquid medium.
(xiv) Vertigo can be attributed to noise hazard.
(xv) Work rostering from a higher noise hazardous area to a lesser one with hearing protection devices can be a good preventive measure for noise hazard.
(xvi) Heat acclimatization is a psychological process of adaptation rather than a physiological adjustment to life in hot environment.

Table I
Horizontal Multiplier

H	HM	H	HM
in		cm	
≤10	1.00	≤25	1.00
11	.91	28	.89
12	.83	30	.83
13	.77	32	.78
14	.71	34	.74
15	.67	36	.69
16	.63	38	.66
17	.59	40	.63
18	.56	42	.60
19	.53	44	.57
20	.50	46	.54
21	.48	48	.52
22	.46	50	.50
23	.44	52	.48
24	.42	54	.46
25	.40	56	.45
>25	.00	58	.43
		60	.42
		63	.40
		>63	.00

Table 2
Distance Multiplier

D	DM	DM	DM
in		cm	
10	1.00	25	1.00
15	.94	40	.93
20	.91	55	.90
25	.89	70	.88
30	.88	85	.87
35	.87	100	.87
40	.87	115	.86
45	.86	130	.86
50	.86	145	.85
55	.85	160	.85
60	.85	175	.85
70	.85	>175	.00
>70	.00		

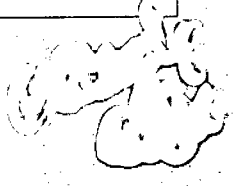


Table 3
Vertical Multiplier

V	VM	V	VM
in		cm	
0	.78	0	.78
5	.81	10	.81
10	.85	20	.84
15	.89	30	.87
20	.93	40	.90
25	.96	50	.93
30	1.00	60	.96
35	.96	70	.99
40	.93	80	.99
45	.89	90	.96
50	.85	100	.93
55	.81	110	.90
60	.78	120	.87
65	.74	130	.84
70	.70	140	.81
>70	.00	150	.78
		160	.75
		170	.72
		175	.70
		>175	.00

Table 4
Asymmetric Multiplier

A	AM
deg	
0	1.00
15	.95
30	.90
45	.86
60	.81
75	.76
90	.71
105	.66
120	.62
135	.57
>135	.00

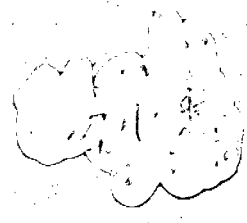


Table 5
Frequency Multiplier Table (FM)

Frequency Lifts/min (F)	Work Duration					
	≤1 Hour		1 but ≤ 2 Hours		2 but ≤ 8 Hours	
	V < 30 t	V ≥30	V< 30	V ≥30	V< 30	V≥ 30
≤0.2	1.00	1.00	.95	.95	85	.85
0.5	.97	.97	.92	.92	81	.81
1	.94	.94	.88	.88	75	.75
2	.91	.91	.84	.84	65	.65
3	.88	.88	.79	.79	55	.55
4	.84	.84	.72	.72	45	.45
5	.80	.80	.60	.60	35	.35
6	.75	.75	.50	.50	27	.27
7	.70	.70	.42	.42	22	.22
8	.60	.60	.35	.35	18	.18
9	.52	.52	.30	.30	00	.15
10	.45	.45	.26	.26	00	.13
11	.41	.41	.00	.23	00	.00
12	.37	.37	.00	.21	00	.00
13	.00	.34	.00	.00	00	.00
14	.00	.31	.00	.00	00	.00
15	.00	.28	.00	.00	00	.00
>15	.00	.00	.00	.00	00	.00

Table 6
Coupling Multiplier

Coupling Type	Coupling Multiplier	
	V < 30 inches (75 cm)	V≥ 30 inches (75 cm)
Good	1.00	1.00
Fair	0.95	1.00
Poor	0.90	0.90