PGDM/PGDM IB, 2014-16
Total Quality Management
DM443 / IB 416
Trimester – I & IV, End-Term Examination: September 2015

Time allowed: 2 hrs 30 min Max Marks: 50

Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means.** In case of rough work please use answer sheet.

Sections	No. of Questions to attempt	Marks	Marks
A	3 out of 5 (Short Questions)	5 Marks each	3*5 = 15
B	2 out of 3 (Long Questions)	10 Marks each	2*10 = 20
C	Compulsory Case Study	15 Marks	15
		Total Marks	**50**

Section A

Q1. Select a firm (restaurant, hotel, airline, manufacturer) and list the several costs related to quality failure. Estimate these costs?

Q2. "A Standard or Specification refers to precise statement that formalizes the requirements of the customer, It may relate to product, process or a service". Differentiate between the two terminologies with their intended application in quality management?

Q3. Explain how quality affects productivity. How we measure productivity. Discuss the implications on cost?

Q4. Taguchi states that quality should be measured in dollars as it relates to the loss-to society caused by a product during its life cycle. Discuss the concept of Taguchi loss function in light of this statement?

Q5. In an electrical circuit, the capacities of the component should be between 24 and 40 picofarads (pF). A sample of 25 components yields a mean of 30 pF and standard deviation of 3 pF. Calculate the process capability index Cpk, and comment on the performance. If the process is not capable, what proportion of the product in nonconforming, assuming a normal distribution of the characteristics.

Section B.

Q1.
a. "Zone of indifference" is understood as the "Optimum" segment of quality cost. Discuss the relationship of quality with cost and its behavior using "Total quality cost curve"?
b. Quality improvement is a phase wise evolutionary phenomena and with each phase its relation with cost changes. Discuss how to measure and report this phenomenon?
(5 marks each) **Turn over**

Q2.

The Zoomer Golf Company has experienced a steady decline in sales of golf bags over last three years. The basic golf bag design has not changed over the period, and Zoomer's CEO, Akash Chug, has decided that the time has come for a customer-focused overhaul of the product. Chug read about a new design method called QFD in one of his professional magazines, and he commissioned a customer survey to provide data for design process. Customer considered the following requirements essential for any golf bag they would purchase and rated Zoomer's bag (X) against two competitors bags (A) and (B) on those requirements.

Customer requirements	Competitive Assessment
	1 2 3 4 5
Lightweight	B A X
Comfortable carrying strap	X B A
Stand upright	X B A
Sturdy handle	X B A
Easy to remove/replace clubs	X B A
Easy to identify clubs	X BA
Protect Clubs	B X A
Plenty of compartments	B X A
Place for towel	B A X
Place for Scorecard/pencil	XBA
Easy to clean	X B A
Attractive	X A B

Construct a house of quality for golf bags. Then write a brief report to Mr. Chug recommending revisions to the current golf bag design and explaining how those recommendations were determined.

Q3.

A. Urban Ladder is manufacturer of executive furniture for corporate institutions. There is a regular complaints for tables they manufacture. In order to control the quality of its furniture (tables), its QC manager selects 15 tables at random and inspects the numbers of scratches on each of them. The following results are obtained.

Sample No.	No. of defects	Sample No.	No. of defects
1	13	8	0
2	9	9	2
3	19	10	5
4	7	11	7
5	8	12	11
6	10	13	9
7	12	14	13
		15	1

Prepare the stable chart based upon the above data. If in case process is out of control, then please specify the steps to be taken by the QC manager. Also outline the Quality Assurance facts QC manager should know?

B. National Power Corp. has commissioned a new power plant at Kurgi. During the run of the plant, the following observations were made by drawing 10 samples (of samples size 4) drawn at equal interval of 1 hour.

Turn over

Voltage of power generated

	Observation 01	Observation 02	Observation 03	Observation 04
1	211	223	217	215
2	215	218	215	214
3	228	224	217	222
4	214	218	221	212
5	220	225	221	223
6	216	222	216	213
7	223	233	235	230
8	214	218	223	220
9	205	214	230	211
10	212	218	224	221

Create the control charts by using the above data. Also comment on as to what should be the quality assurance factor for such type of business?

Section C

National Thermal Power Corporation (NTPC), a 'Navaratna Company', established in November 1975 for thermal power generation in the country has presently an installed capacity of 21,749 MW.

With an ambitious growth plan to become a 56,000 MW plus company by the year 2017, NTPC has redrafted its corporate plan (2002-2017) in view of the emerging competitive market under the new electricity act 2003 and the new opportunities in the power sector. With the dues of UP electricity board to NTPC increasing every year, NTPC came out with the option of taking over poorly performing plants in support of its vision, which was the main reason of this plant being a part of NTPC.

Originally known as Feroz Gandhi Unchahar Thermal Power Plant (FGUPP), the foundation stone was laid by none other than the late Prime Minister Mrs Indira Gandhi in June 1981 for the construction of 5 units of 210 MW. This plant, which was under Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited, with 2 units of 210 MW commissioned on 21/11/88 and 22/03/89 was handed over to NTPC on 13 February 1992, becoming the first take-over plant for NTPC. It was a challenge to bring it at par with other NTPC projects, as it was performing poorly at a mere 18% PLF (power load factor). FGUTPP performance from the time of the takeover has been improving steadily and is now at par with other NTPC stations, having achieved a PLF of 87.43% in the year 2003-04. The FGUTPP turnaround has been wonderfully brought out in the book, India 2020- A Vision for the New Millennium by none other than the first man of our country, President A.P.J. Abdul Kalam. FGUTPP has been awarded with ISO 9001: 2000, ISO 14001: 1996, and OH5A5 18001: 1999 certificates for its quality management, environment management, and occupational health and safety management systems. The FGUTPP power station with a running capacity of 840 MW, receives coal from the coal mines, which is then crushed in the crushers to a size of 25 mm and fed to the unit bunkers. The coal as per the requirement is pulverized in the coal mills and then burnt in the boiler. The water in the boiler drum gets converted into high-pressure (about 150 Kg/sq. cm) and high temperature (540°C) steam that is then sent to the turbine where it is expanded to produce mechanical energy. The turbine is coupled to a generator that rotates along with the turbine to produce electric power. The fuel gas coming out from the boiler, are let out to the atmosphere, through the electrostatic precipitator (having an efficiency of 99.97%) where the dry ash is collected and sent to silos, keeping the environment clean. The ash collected in silos is sent in bulkers/closed trucks for cement manufacturing. It is also used for the manufacture of ash bricks in FGUTPP. The power thus generated is transmitted through 220 KV lines and distributed to the various beneficiary states of the country.

Turn over

In its pursuit of excellence, FGUTPP applied for the CII-EXIM Bank award for Business Excellence in the year 2004. Under the section 'processes' of this model, the following clause (Clause 5.e.) has to be addressed:

Clause 5.e. Customer relationships

This includes the following aspects.

5 e.1. Getting to know the customer's daily routine requirements and fulfilling them. Also, addressing the complaints, etc. received from the feedback sought from the customers.

5 .e.2 Determining the level of satisfaction of the customers in relation to the products and services by using surveys regularly and enhancing it by creativity and innovation.

5.e.3 Informing the customers about the responsible use of products.

NTPC FGUTPP addressed this clause of the model in the document prepared by it for the award as under:

The generation based on availability-based tariff and as per the schedule given by the grid on 15 minutes interval caters in a big way to the requirement of the customers. Monitoring of the generation on the real time basis and operation of the machine in FGMO (free governing mode operation) mode enhances the customer relationship, resulting in wholehearted appreciation. The feedback about generation is normally conveyed telephonically by NRLDC (Northern Region Load Dispatch Centre) to the station shift in-charge as and when required. If the verbal communication system is not working, written communications are sent.
Action is immediately taken on these feedback/complaints by the shift in-charge concerned. Unresolved cases are taken up by the commercial section with the authority concerned. These are also discussed in the OCC (Operation Co-ordination Committee) meetings held every month. The expectations and concerns of the customers are discussed in the acc meetings and as per their requirement; a schedule is given to the station that is being monitored on real time basis. As per the requirement of the grid, annual overhauls for the station are planned, and sometimes even deferred to accommodate the needs, expectations, and concerns of the customer.
For operating the station in FGMO mode, NTPC FGUTPP was widely acknowledged by its customers and received letters of appreciation. As an innovative and creative measure, NTPC has offered incentive schemes to state electricity boards for timely payment of billed amounts and has also taken measures for conversion of the arrear amounts to government bonds. NTPC believes in the philosophy that you can only improve if you take your associates and customers along with you and improve their conditions for a better future. The APDRP (Accelerated, Power Development Reforms Programme) that has been taken up by the electricity boards, is aimed at improving the working culture and the financial strength of the electricity boards.
Road shows were also conducted to create awareness amongst the general masses in order to improve the health of the sick electricity boards. Real time generation management system is aimed at enhancing customer relationship. The policy of NTPC FGUTPP has always been to help the grid during the periods of low or high grid frequency by operating the machine in FGMO mode to ensure that customers receive quality power. As per the power requirement of the customer, they plan their annual overhauls and also postpone it if the need arises. The new ABT (availability based tariff) came into existence in Dec '2002 wherein the norms were very stringent and the incentive was less and penalization was on the higher side. As it is valid only to central public sector units, such as NTPC, supplying to the Northern Region Grid, the matter was taken up from NTPC to overcome various deficiencies in the generating band and operation of the station in FGMO mode.

Turn over

This resulted in negative unscheduled/Interchange (UI) on some occasions when the schedules given by NRLDC were full. Although the performance with respect to UI was negative in the last financial year, with tariff modification from April 2004, the performance of the station is showing an upward trend. Road shows have been conducted to create awareness amongst the general masses regarding proper use of power (including its conservation) and also how to avoid losses. Programmes have also been conducted at the corporate level for reducing T&D (transmission and distribution) losses that should benefit the customer for responsible use of power generated. Proper operation guidelines are also given to cement companies who carry dry fly ash in tankers from its premises to avoid spillage and leakages from the tankers in view to minimize environmental pollution. During the strike of UPSEB staffs, NTPC FGUTPP has sent their team members to different power stations and various distribution areas to manage the system and to avoid any inconvenience to the general masses who are finally its main customers. A team of auditors was sent by CII (Confederation of Indian Industry) to NTPC FGUTPP for auditing the plant for the CII-EXIM Bank award 2004.

1. Assume you are a member of the audit team. Identify the strengths of NTPC FGUTPP with respect to Clause 5.e. of the CII-EXIM Bank Award Model.
2. What are the opportunities for improvement of NTPC FGUTPP with respect to Clause 5.e. of the CII-EXIM Bank Award Model?
3. Which clauses of ISO 9001: 2008 would be partially addressing this clause (5.e.) of the CII-EXIM Bank Award Model?

Annexure 1 · *Factors for constructing variables control charts*

	Chart for Averages			*Chart for Standard Deviations*						*Chart for Ranges*						
Observations in sample, n	*Factors for Control Limits*			*Factors for Center Line*		*Factors for Control Limits*				*Factors for Center Line*		*Factors for Control Limits*				
	A	A_2	A_3	c_4	$1/c_4$	B_3	B_4	B_5	B_6	d_2	$1/d_2$	d_3	D_1	D_2	D_3	D_4
2	2.121	1.880	2.659	0.7979	1.2533	0	3.267	0	2.606	1.128	0.8865	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	1.1284	0	2.568	0	2.276	1.693	0.5907	0.888	0	4.358	0	2.575
4	1.500	0.729	1.628	0.9213	1.0854	0	2.266	0	2.088	2.059	0.4857	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	1.0638	0	2.089	0	1.964	2.326	0.4299	0.864	0	4.918	0	2.115
6	1.225	0.483	1.287	0.9515	1.0510	0.030	1.970	0.029	1.874	2.534	0.3946	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	1.04230	0.118	1.882	0.113	1.806	2.704	0.3698	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	1.0363	0.185	1.815	0.179	1.751	2.847	0.3512	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	1.0317	0.239	1.761	0.232	1.707	2.970	0.3367	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	1.0281	0.284	1.716	0.276	1.669	3.078	0.3249	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	1.0252	0.321	1.679	0.313	1.637	3.173	0.3152	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	1.0229	0.354	1.646	0.346	1.610	3.258	0.3069	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	1.0210	0.382	1.618	0.374	1.585	3.336	0.2998	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	1.0194	0.406	1.594	0.399	1.563	3.407	0.2935	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	1.0180	0.428	1.572	0.421	1.544	3.472	0.2880	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	1.0168	0.448	1.552	0.440	1.526	3.532	0.2831	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	1.0157	0.466	1.534	0.458	1.511	3.588	0.2787	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	1.0148	0.482	1.518	0.475	1.496	3.640	0.2747	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	1.0140	0.497	1.503	0.490	1.483	3.689	0.2711	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	1.0133	0.510	1.490	0.504	1.470	3.735	0.2677	0.729	1.549	5.921	0.415	1.585

(*Contd*)

Annexure (Contd)

	Chart for Averages			*Chart for Standard Deviations*						*Chart for Ranges*						
Observations in sample, n	*Factors for Control Limits*			*Factors for Center Line*		*Factors for Control Limits*				*Factors for Center Line*		*Factors for Control Limits*				
	A	A_2	A_3	c_4	$1/c_4$	B_3	B_4	B_5	B_6	d_2	$1/d_2$	d_3	D_1	D_2	D_3	D_4
21	0.655	0.173	0.663	0.9876	1.0126	0.523	1.477	0.516	1.459	3.778	0.2647	0.724	1.605	5.951	0.425	1.575
22	0.640	0.167	0.647	0.9882	1.0119	0.534	1.466	0.528	1.448	3.819	0.2618	0.720	1.659	5.979	0.434	1.566
23	0.626	0.162	0.633	0.9887	1.0114	0.545	1.455	0.539	1.438	3.858	0.2592	0.716	1.710	6.006	0.443	1.557
24	0.612	0.157	0.619	0.9892	1.0109	0.555	1.445	0.549	1.429	3.895	0.2567	0.712	1.759	6.031	0.451	1.548
25	0.600	0.153	0.606	0.9896	1.0105	0.565	1.435	0.559	1.420	3.931	0.2544	0.708	1.806	6.056	0.459	1.541

For $n > 25$

$$A = \frac{3}{\sqrt{n}},\ A_3 = \frac{3}{c_4\sqrt{n}},\ c_4 = \frac{4(n-1)}{4n-3},$$

$$B_3 = 1 - \frac{3}{c_4\sqrt{2(n-1)}},\ B_4 = 1 + \frac{3}{c_4\sqrt{2(n-1)}},$$

$$B_3 = c_4 - \frac{3}{\sqrt{2(n-1)}},\ B_6 = c_4 + \frac{3}{\sqrt{2(n-1)}}.$$

Annexure 2 ***Mean values μ to obtain desired cumulative poisson probabilities****

No. of defectives (x)	0.99	0.95	0.90	0.50	0.10	0.05
0	0.010	0.051	0.105	0.693	2.303	2.996
1	0.149	0.355	0.532	1.678	3.890	4.744
2	0.436	0.818	1.102	2.674	5.322	6.296
3	0.823	1.366	1.745	3.672	6.681	7.754
4	1.279	1.970	2.433	4.671	7.994	9.154
5	1.785	2.613	3.152	5.670	9.275	10.513
6	2.330	3.286	3.895	6.670	10.532	11.842
7	2.906	3.981	4.656	7.669	11.771	13.148
8	3.507	4.695	5.432	8.669	12.995	14.434
9	4.130	5.426	6.221	9.669	14.206	15.705
10	4.771	6.169	7.021	10.668	15.407	16.962
11	5.428	6.924	7.829	11.668	16.598	18.208
12	6.099	7.690	8.646	12.668	17.782	19.442
13	6.782	8.464	9.470	13.668	18.958	20.668
14	7.477	9.246	10.300	14.668	20.128	21.886
15	8.181	10.035	11.135	15.668	21.292	23.098
16	8.895	10.831	11.976	16.668	22.452	24.302
17	9.616	11.633	12.822	17.668	23.606	25.500
18	10.346	12.442	13.672	18.668	24.756	26.692
19	11.082	13.254	14.525	19.668	25.902	27.879
20	11.825	14.072	15.383	20.668	27.045	29.062
21	12.574	14.894	16.244	21.668	28.184	30.241
22	13.329	15.719	17.108	22.668	29.320	31.416
23	14.088	16.548	17.975	23.668	30.453	32.586
24	14.853	17.382	18.844	24.668	31.584	33.752
25	15.623	18.218	19.717	25.667	32.711	34.916
30	19.532	22.444	24.113	30.667	38.315	40.690
35	23.525	26.731	28.556	35.667	43.872	46.404
40	27.587	31.066	33.038	40.667	49.390	52.069
45	31.704	35.441	37.550	45.667	54.878	57.695
50	35.867	39.849	42.089	50.667	60.339	63.287

* Tabulated values are the means of poisson distribution. For value $x = 2$, $pr = 0.90$ mean value $\mu - 1.102$. This means that

when $\mu = 1.102$. $\sum_{i=0}^{2} \frac{e^{-\mu}\mu^{i}}{i!} = 0.90$