



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

Mid-Semester 8 Examination in Engineering: October 2015

Module Number: ME8323

Module Name: Production and Operations  
Management

[Two Hours]

[Answer all questions, each question carries five marks]

Q1.

- a) Briefly describe the difference between simple production system with moderate and extended production systems. [1.5 Marks]
- b) What are "Core Services" and "Value Added Services" of a business? [1.5 Marks]
- c) Name two evaluation methods use for DFA (Design for Assembly) and compare them. [1.0 Mark]
- d) Briefly explain four DFM (Design for Manufacturing) guidelines. [1.0 Mark]

Q2.

- a) Define the term "Productivity" and state three impact levels of improvement on it. [1.5 Marks]
- b) Briefly describe five key elements of productivity. [1.5 Marks]
- c) A student has to pay a tuition fee of \$ 150 per semester credit hours for one of the university in U.S.A. **The states supplement school revenue by matching student tuition, dollars per dollars.** Average class size for typical three credit course is 50 students. Labour costs are \$4000 per class, material costs are \$20 per student, and overhead costs are \$25,000 per class. Lecturer delivers the lecture work 14 hours per week the semester last for 13 weeks.
  - i) What is the multifactor productivity ratio?
  - ii) If lecturer works an average, what is the labour productivity ratio? [2.0 Marks]

Q3. A project has been defined to contain the activities shown in Table Q3.1, along with their time estimates for completion.

**Note:** You may use the Normal Distribution shown in Table Q3.2

- a) Calculate the expected time and the variance for each activity. [1.5 Marks]
- b) Draw the critical path diagram. [1.0 Mark]
- c) Show the earliest start, earliest finish times and latest start, latest finish times. [1.0 Mark]

- d) Calculate slack values for each activity. Hence deduce that the slack values of critical activities are zero. [1.0 Mark]
- e) What is the probability that the project can be completed in 25 weeks? [0.5 Marks]
- Q4. a) Define the term "Concurrent Engineering" and State five set of goals for concurrent design. [1.5 Marks]
- b) Briefly describe the importance of linear relationship between the response and signal in robust design methodology. [1.5 Marks]
- c) A scientist tries to design & develop a refrigerator for freeze food for long term preservation and to maintain food at cold temperature for short term preservation. To satisfy the above requirements he is going to design a freezer section and a chiller section. The temperature in the freezer section must be in the range of  $-18 \pm 2$  °C, it must be uniformly maintained and relative humidity must be kept in 50%. Sensor/compressor system, air circular system and condenser must be designed to perform these requirements. For the chiller section the temperature must be in the range of 2-3 °C and it must be uniformly maintained. Sensor/compressor system and air circular system must be designed to perform the requirements as well as for the chiller section.

You are asked to use Axiomatic Design method to analyze this problem.

- i). Identify Functional Requirements and the Design Parameters.
- ii). Develop the matrix A for mapping between Functional and Physical Domains.
- iii). Is this an Ideal design or Redundant Design or Coupled Design? Why?

[2.0 Marks]

**Table Q 3.1 Activity data for the project**

Activity	Time Estimates (weeks)			
	Optimistic (a)	Most Likely (m)	Pessimistic (b)	Immediate Predecessor(s)
A	1	3	5	-
B	3	4.5	9	-
C	2	3	4	B
D	2	4	6	A,C
E	4	7	16	D
F	1	1.5	5	C
G	2.5	3.5	7.5	F
H	1	2	3	F
I	4	5	6	B
J	1.5	3	4.5	H,E,G
K	1	3	5	I,J

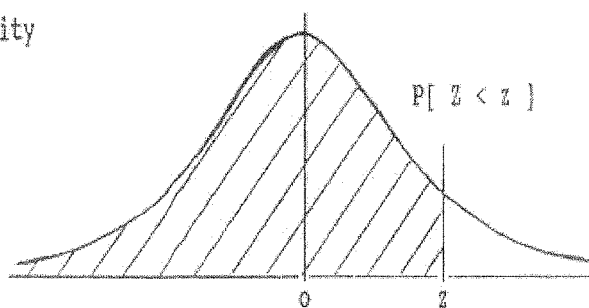
Table Q3.2 Normal Distribution

## STANDARD STATISTICAL TABLES

## 1. Areas under the Normal Distribution

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

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



$z$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
$z$	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
$P$	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000