Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B. TECH (INDUSTRIAL AND PRODUCTION ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2019

SUBJECT: QUALITY CONTROL AND RELIABILITY ENGINEERING

[MME 3212]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Use of SQC tables is permitted.

1A. Explain the term “Grade” with regard to quality. **(02)**

1B. Explain the process capability analysis. **(03)**

1C. A machine shop produces steel pins. The width of 100 pins was checked after machining and data was recorded as shown below. Find the mean and standard deviation. What percentage of the pins manufactured has width of 9.52 mm to 9.63 mm?

Width in mm	Frequency
9.50 - 9.51	2
9.52 - 9.53	6
9.54 - 9.55	20
9.56 - 9.57	32
9.58 - 9.59	22
9.60 - 9.61	8
9.62 - 9.63	6
9.64 - 9.65	4

(05)

2A. List the conclusions drawn from Shewhart’s bowl drawing experiments. **(02)**

2B. Explain the causes of quality variation. **(03)**

2C. A process has been operating in control at a μ of 65.00 mm and a σ of 0.15 mm with upper and lower control limits on the $\overline{X}$ chart as 65.225 mm and 64.775 mm respectively. Specifications on the dimension are 65.00 ± 0.50 mm.

(i) What is the probability of not detecting a shift in the mean to 64.75 mm on the first subgroup sampled after the shift occurs? The subgroup size is 4.

(ii) What proportion of non-conforming product results from the shift described in part (i)? Assume a normal distribution of this dimension.

(iii) Calculate the natural tolerance limits, C_p and C_{pk} for this process considering the shift in the mean. **(05)**

3A. Define Type I error with regard to control charts. How it is reduced? **(02)**

3B. What proportion of a frequency distribution would you expect to fall outside $\overline{X} \pm 2.8\sigma$ limits:

(i) if nothing is known about the form of the distribution?

(ii) if it is known to be approximately normal?

(iii) If it is known only that it satisfies the conditions for Camp-Meidell inequality? **(03)**

3C. Daily inspection records are maintained on production of a special design electronic device. 100 items have been inspected each day for past 21 days. A total of 546 items failed during a particular severe heat stress test. The four highest and lowest values of p are:

Highest	Lowest
0.46	0.18
0.33	0.18
0.31	0.20
0.31	0.21

(i) Compute the central line and three sigma control limits for a p chart. Is the process operating in control?

(ii) Recommend an aimed at value p_0 and three sigma control limits for continued use of p chart. **(05)**

4A. Explain the appraisal costs and prevention costs with regard to cost of quality. **(02)**

4B. Explain : (i) ASN (ii) AOQ (iii) ATI **(03)**

4C. A double sampling plan is n_1 = 25, c_1 = 1, n_2 = 50, c_2 = 3. Assume lot size is large in comparison with sample size. The incoming lots are 4.0 % defective. Compute:

(i) the probability of acceptance of the lot on the first sample.

(ii) the probability of rejection of the lot on the first sample.

(iii) the total probability of acceptance of the lot P_a. **(05)**

5A. Write a note on acceptance sampling tables. **(02)**

5B. With a sketch explain the “Bathtub Curve”. **(04)**

5C. Two mating parts A and B have an average clearance of 0.015 cm. Control charts indicate the standard deviations of the dimensions A and B to be 0.002 cm and 0.006 cm respectively. Find the probability of clearance being greater than 0.018 cm. Assume the distributions to be normal and assembly at random. **(04)**