Metrology and Quality Assurance (MCL134)

Part A Metrology

Max. Marks 15

Total time allotted is 75 (actual exam time) +15 (uploading time) = 90 minutes. Uploading should be done before 11:00 am on the day of the exam which is 20th September 2021.

All questions are compulsory. All parts of the same question to be answered at one place only. You may assume realistic values of any missing data in problems if required.

1. Why is the bar which is used to define the "metre" made out of a special alloy and why is the cross section of the bar so important? Why the surfaces of the slip gauges need to be superfinished? 1+1=2
2. Justify the statement "End standards are not subjected to parallax error" with suitable practical example. Explain in details why a machined product may not be made precisely to a given dimension? 1+3=3
3. Why does an increase in dimensional measurement accuracy of a product may lead to an exponential increase in its cost of production? With neat sketches explain and define the following terminologies as used in Metrology – (a) Tolerance of a hole, (b) Allowance between a shaft and a hole. Why unilateral tolerance is mostly preferred over bilateral one? 1+1+1=3
4. What are the IT numbers as used in dimensional metrology? Find the type of fit for the symbol 25 H7/g6. The fundamental deviation of shaft is given by - $2.5D^{0.34}$. Also provide the suitable sketches to show the type of fit which is resulted. 1+2=3

5. In an interchangeable assembly, shaft of size $\Phi\ 64^{+0.04}_{-0.01}$ mm mate with hole of size $\Phi\ 64^{+0.03}_{+0.02}$ mm. Find the maximum interference (in microns) in the assembly. 1
6. For ring gauges which are to be used for measuring a shaft specified by 20h7 what type of possible tolerances may be provided in the GO ring gauge and in the NO GO ring gauge with proper justification? 1
7. Explain the working principle of a Johanson Mikrokator mechanical comparator and also mention the possible method of calibrating of such a comparator. 2

Part B Quality Assurance

Make use of well labelled diagrams.

MAX MARKS 15

Q 1.

In order to meet government regulations, the contained weight of a product must equal or exceed the labeled weight 99.8% of the time. Control charts for $\bar{X}$ and σ are maintained on the weight of the contents using a subgroup size of 10. After 20 subgroups, $\Sigma \bar{X}$ =731.4 and $\Sigma\sigma$ =9.16. Estimate the value of σ' assuming that the process is in statistical control. If the label weight is 34 (Lower specification Limit), does the process meet federal requirements? What is Average Over-Fill and how can it be reduced? 5 marks

Q 2.

All points have fallen within control limits on $\bar{X}$ and R charts for a certain quality variable. A sudden change in the process occurs that **increases** the process setting by 0.50 σ', but does not change the process dispersion σ'.

a) What percentage of points are expected to fall outside the control limits on $\bar{X}$ chart, and what % age on R chart? Assume sample size of 8.

b) What would be the average run length (ARL) for $\bar{X}$ chart in terms of number of observations?

5 marks

Q 3.

a) What are the costs due to Type 1 and Type 2 errors. How do we strike a balance between the two.

b) When is a process not capable of meeting the specification limits even when it is in control? What is process capability index is this case? What would you do in such a situation?

5 marks