Question 4 (Sample Variant 1)[25 marks]

(a) ***Theory of Statistical Inference (9 Marks)***
Answer the following questions on the theory of statistical inference.

(i) (4 Marks) Briefly describe the central limit theorem.

(ii) (1 Mark) Provide a brief description of the standard error.

(iii) (2 Marks) In the context of hypothesis testing, explain what a p-value is, and how it is used. Support your answer with a simple example.

(iv) (2 Marks) What is meant by Type I error and Type II error?

(b) ***Binary Classification (6 Marks)***
For following binary classification outcome table, calculate the following appraisal metrics.

(i) (1 Mark) Accuracy

(ii) (1 Mark) Recall

(iii) (1 Mark) Precision

(iv) (1 Mark) F-measure

	Predict Negative	Predict Positive
Observed Negative	9530	10
Observed Positive	300	160

(v) (2 Marks) Explain why the F-measure is considered a more informative measure of performance than the Accuracy score.

(c) ***Hypothesis Testing (9 Marks)***
In a computer hardware manufacturing plant, machine X and machine Y produce identical components. The management investigate whether or not there is a difference in the mean diameter of the components from both machines.

- A random sample of 144 components from machine X had a mean of 36.38 mm and a standard deviation of 3.0 mm.
- A random sample of 225 components from machine Y had a mean of 36.88 mm and a standard deviation of 2.8 mm.

A hypothesis test was used to determine whether or not the means are significantly different. A 5% significance level was used.

(i) (2 Marks) What is the null and alternative hypothesis?

(ii) (4 Marks) Compute the test statistic.

(iii) (3 Marks) What is your conclusion for this procedure? Justify your answer.