THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY – LEVEL 05
FINAL EXAMINATION – 2005
MPJ5231 – THE NATURE OF SCIENCE
FOUR HOURS (ESSAY TYPE PAPER)
OPEN BOOK EXAMINATION

072

Date: 09th April 2006 **Time: 13 30 – 17 30 hrs.**

The questions are grouped in the following manner:

Section A : 1 -2
Section B : 3 – 7
Section C : 8 – 10

Please ensure that answers for questions in different sections are given on separate books. Mark your index number on each book.

Please answer a total of 6 (six) questions.

SECTION A

1. (i). Why was the "ether" hypothesis was so important for the earlier "Mechanical (Newtonian) world view" which was replaced by Einsteinian world view?
   (ii). What was the purpose of the Michaelson – Morley (M-M) experiment?
   (iii). In the face of the null result of the above mentioned M-M experiment, what was the ad-hoc modification that was proposed?
   (iv). Why Einstein did not need the above mentioned ad-hoc hypothesis in his Special Theory of Relativity?
   (v). What was Einstein's starting point in the face of the above mentioned crisis in the "Mechanical (Newtonian) world view"?
   (vi). What was Einstein's position regarding the following?
      (a). Time span between two events
      (b). Simultaneity of two events
      (c). Motion and rest of rigid bodies

2. (i). State the (Lorentz) Relativistic Velocity addition formula (all three components along x, y & z axes)

   (ii). Verify that the special Lorentz transformation satisfies
   $c^2dt^2 - dx^2 - dy^2 - dz^2 = c^2dt'^2 - dx'^2 - dy'^2 - dz'^2$

   (iii). F_1, F_2 and F_3 are three inertial frames. The mapping $F_1 \rightarrow F_2$, $F_2 \rightarrow F_3$ are special Lorentz transformations in x, y directions respectively such that the velocities of F_2 relative to F_1 and F_3 relative to F_2 are (v, o, o) and (o, v', o) respectively

   Show that the velocity of F_3 relative to F_1 is $\left(v,\ v'\sqrt{1-\frac{v^2}{c^2}},\ 0 \right)$.

SECTION B

3. (i). When you consider the two main streams of western philosophy, namely 'Rationalism' and 'Empiricism', how would you identify the approaches of Francis Bacon and Galileo regarding the methodology of science?
   (ii). Briefly explain the method of induction proposed by Francis Bacon.
   (iii). Briefly explain the method of hypothetico – deductivism proposed by Galileo.
   (iv). Explain how Galileo defended his hypothetico – deductive method by pointing out an advantage over the method of induction.

4. (i). How does the problem of induction raised by David Hume affect causality (cause and effect relationship) which is very important to science?
   (ii). Some of the tenets (principles) formulated by Logical Positivists are mentioned below.
      (a). The observations in science are 'pure' in the sense that they are theory-independent.
      (b). The hallmark of science is that its statements are systematically verifiable.
      (c). A theory is nothing more than a condensed version of well-ordered observational statements.
      What was the critique of Karl Popper regarding the above mentioned tenets (principles) formulated by Logical Positivists?

5. (i). Outline the important characteristics of a scientific theory, according to Karl Popper.
   (ii). Why did Popper reject ad-hoc modifications to theories?
   (iii). "Karl Popper's attempt to build a methodology on falsification of a hypothesis is too simple and not justifiable in the actual practice of science".
      Do you agree with the above statement?
      Justify your answer giving at least one example.

6. (i). Outline briefly how Thomas Kuhn utilized his concept 'Paradigm' to explain the following
      (a). Normal Science
      (b). Scientific Revolutions
      (c). Incommensurability
      (d). Uniqueness of science
   (ii). Explain briefly in the Kuhnian sense, the role of 'Scientific Community' with regards to the following.
      (a). Scientific Revolutions
      (b). Uniqueness of natural science

7. (i). Compare and contrast the views of Thomas Kuhn and Paul Feyerabend regarding the following
(a). Paradigm and the Uniqueness of science
(b). Incommensurability and Relativism of science
(ii). How does Feyerabend defend his position with regards to methodology of science, namely 'Anything Goes', using the historical episode involving Copernicus and Galileo?

SECTION C

8. Describe, compare and contrast the following critiques of the modern scientific enterprise; that is, its theories and applications.
(a). Feminist Critique
(b). New left critique
(c). Critique by Third world commentators.

9. Agriculture or Food cultivation for consumption by humans has been practised now for around 10,000 years. Within the past two centuries, intensive fossil fuel based agriculture, had increased yields by a significant amount but at a cost to the environment, and the fossil fuels are depleting.

Suggest some features of a 'new' science which could potentially improve agricultural output without being based on fossil fuels and without damaging the environment.

10. The following statement is made by a Neuro-physiologist (field in Bio-science). "The 'human mind' is nothing but a firing of neurons in the Brain, and it can be analysed as so".

What can you conclude about the following in relation to the above statement?
(a). Reductionism
(b). Determinism
(c). Materialism

Comment briefly on the cultural background to such a statement.
