THE OPEN UNIVERCITY OF SRI LANKA
BACHELOR OF TECHNOLOGY - LEVEL 05
FINAL EXAMINATION – 2006
MPJ 5231– THE NATURE OF SCIENCE
FOUR HOURS (ESSAY TYPE PAPER)
OPEN BOOK EXAMINATION

047

Date: 05th April 2007 **Time: 1330 hr.-1730 hr.**

The questions are grouped in 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). What was the purpose of the Michaelson - Morley experiment?
   (ii). Express the Lorentz – Fitzgerald contraction hypothesis
   For what reason was the above hypothesis put forward?
   (iii). What was Einstein's response to the 'Ether' hypothesis?
   (iv). What was Einstein's starting point in the Special Theory of Relativity?
   (v). The two inertial frames of reference S and S', are such that S' is moving with velocity V along x – axis relative to frame S. The space-time coordinates of two events as measured by frame S are

   $x_1 = 6 \times 10^4$ m, $y_1 = z_1 = 0$ m , $t_1 = 2 \times 10^{-4}$ s
   and $x_2 = 12 \times 10^4$ m , $y_2 = z_2 = 0$ m , $t_2 = 1 \times 10^{-4}$ s

   (a). What must be the velocity of S' with respect to S if an observer in S' measure the two events occur simultaneously?
   (b). What is the spatial separation of the two events as measured by S'?

2. (i). Using the velocity transformation formula in the x – direction for frames $S \rightarrow S'$,
   Prove that

$$\left(1-\frac{U_x^2}{c^2}\right)^{1/2} = \frac{\left[1-\frac{U_x'^2}{c^2}\right]^{\frac{1}{2}}\left[1-\frac{V^2}{c^2}\right]^{\frac{1}{2}}}{\left[1+\frac{U_x' V}{c^2}\right]}$$

Contd.

Where U_x and U'_x are velocities of a particle in the x-direction relative to frames S and $S^{/}$ respectively, V is the velocity of frame $S^{/}$ with respect to frame S, and c is the velocity of light.

(ii). According to the Special Theory of Relativity (STR) the inertial mass m of an electron moving with speed v is given by $m = m_0 \left[1 - \frac{v^2}{c^2}\right]^{-1/2}$ where m_0 is the rest mass of the electron and c is the speed of light.

(a). Use this equation to explain what happens to the mass m, if the electron is accelerated to speeds very close to that of light.

(b). How does the theory (STR) forbid electrons from traveling at speeds greater than c?

SECTION B

3. (i). Briefly explain the method of induction advocated by Francs Bacon
(ii). What is the problem of induction raised by David Hume?
(iii). What was the argument put forward to defend the method of induction?
(iv). What was the drawback (fallacy) of the argument given in (iii)?
(v). How does this problem of induction effect causality (cause and effect relationship) which is very important to science?

4. (i). The argument on verification in science used by Logical Positivists goes as follows

$H \rightarrow P$	;	H implies P
P	;	P is true
$\therefore H$	;	Then H is true

Explain why the above argument is logically invalid.
How did Karl Popper overcome the difficulties inherent in the above argument?

(ii). Compare and contrast the views of Logical Positivists and Karl Popper regarding the Observations in Science.

5. For Karl Popper science is in a state of permanent revolution, but for Thomas Kuhn revolutions are a pretty rare occurrence in science.
Explain the above statement, clearly bringing out the views of Popper and Kuhn with regards to revolutions in science.

Give two well known revolutions in physics to justify Kuhn's view.

6. Explain briefly the following relations
   (i). Falsification and demarcation criteria for science
   (ii). Auxiliary hypotheses and the main drawback of the method of falsification
   (iii). Paradigms and incommensurability according to Thomas Kuhn.
   (iv). 'Anything goes' with regards to methodology of science according to Paul Feyerabend, citing Galileo's defence of Copernicus as example.

7. In the Ayurvedic tradition, it is stated that the material world can be described by five properties [Pancha – Maha Butha (PMB)]. Modern science describes ninety two elements which naturally occur in the material world. Use the term coined by Kuhn known as incommensurability and developed fully by Paul Feyerabend, to understand these differing world views.

   Some authors have translated the PMB to be a theory of five elements. Critique this translation .

SECTION C

8. "A new world view, where consciousness and materiality work in tandem, has far reaching consequences. It would then be possible to take account of a plethora of observations which science at present ignores. The other direction in which science should change is to adopt a more holistic world view. That is its constructions should incorporate multiple interconnected causations. The virus theory could stay, but the incompleteness of an invading pathogen theory of disease should be made obvious. Even more stunning would be the inclusion of a plethora of paranormal phenomena into mainstream science, death would no longer be regarded as an entry point to an 'abyss of nothingness', but a dramatic change in the station of existence; mitigating much of the terror and sadness which now pervades this event.".

   Read the above quote and assuming the author is right; answer the following questions:

   (a). If consciousness and materiality work in tandem, can we then reduce consciousness to the working of material forces, say in the human brain?

   (b). A holistic science would recognize that any single event may have more than one cause, for example a road accident. Could you use this example to show us, as to what you understand by the term 'multiple interconnected causations'?

   (c). Paranormal phenomena are not the normal experience of humans. Do they occur due to magical events? Or do they occur due to causes that we do not understand at present?

9. Which of these critiques on Modern Science do you consider to be the most radical and why?
   (a). A feminist critique of science
   (b). A critique by the 'New left' (after Marx)
   (c). Critique of modern science from Eastern Cultures

10. Disease is said to be caused by the invasion of a pathogen (Bacteria, Virus, etc) from the outside. Alternatively, it may be thought of as an imbalance in the human body. Do we have to reject one theory and accept the other? Suggest a way of incorporating both viewpoints in the effective control of disease.