THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY – LEVEL 05
FINAL EXAMINATION – 2007
MPJ 5231 – THE NATURE OF SCIENCE
FOUR HOURS (ESSAY TYPE PAPER)
OPEN BOOK EXAMINATION

Date : 29th April 2008 **Time : 13.30 hrs-17.30 hrs**

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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 'Ether" hypothesis?
(ii). Write short notes on the following
(a). Length contraction hypothesis
(b). The relation between mass and energy according to the special theory of relativity.
(c). Velocity of light according to special theory of relativity.

(iii). Two events P and Q occur simultaneously in a frame F and 300,000 km apart on its x-axis. Find the velocity of the frame F′, moving parallel to the x-axis of frame F, in which event P precedes Q by 10 seconds. ($c = 300{,}000\ km.s^{-1}$).

(iv). A spaceship travels between two space-stations, A and B at a speed of $1.8 \times 10^8\ ms^{-1}$ in a time of 4.0 s as measured in the spaceship. If A and B are at rest relative to the Earth, what is the distance AB with respect to
(a) the pilot of the spaceship
(b) an observer at rest on the Earth? ($c = 3.0 \times 10^8\ ms^{-1}$)

(Hint: Use either the Time Dilation formula or the Length Contraction formula)

(2). (i). Show that the Lorentz transformation equations for Space-Time coordinates in the Special Theory of Relativity can be reduced to corresponding Galilean transformation equations in Newtonian Mechanics.
(ii). Consider the case where identical twins both initially at rest in an inertial frame. They take-off in two rockets in exactly opposite directions. Let both of them travel with the same acceleration relative to the initial rest frame, at any given instant. Having travelled equal distances, they turn back and come

to rest at the origin of the initial rest frame. Which of the two travellers with be younger at the end of their journeys?

(iii). (a). Derive the velocity transformation equations for x, y, z directions

(b). Using the standard notation express u_x, u_y and u_z (frame S) in terms of corresponding quantities measured in the moving frame S′.

(c). Hence show that if $v = a \,.\, c$ and $u'_x = b.c$ then $u_x = \dfrac{(a+b)}{((1+ab)}.c$

(v is the velocity of S′ w.r.t. S and use standard notation)

(iv). A radioactive nucleus is moving with a velocity c/5 relative to a laboratory (S) when it emits a beta-particle with a velocity 0.4c relative to the nucleus (S′). What is the velocity (in terms of x and y components) of the beta-particle relative to the laboratory (S), if, it is emitted

(a). in the direction of motion of the nucleus relative to S

(b). perpendicular to the motion of the nucleus relative to S

SECTION B

(3). Compare and contrast the views of Inductivists and Hypothetico-Deductivists regarding the following.

(i). The method of science

(Explain briefly the two methods employed by the above two schools)

(ii). The theoretical terms

(4). Write short notes for the following, with regards to Logical Positivists,

(i). Observations are primary and pure

(ii). The relationship between a theory and observation-statements

(iii). Verifiability of scientific statements.

(5). (i). How did the Logical Positivists try to defend the principle of induction from the attack of David Hume?

(ii). "Logical Positivists failed to show that observations are theory-independent". Give three (03) reasons to justify the above statement.

(iii). (a). How did Karl Popper demolish the tenet (principle) of Logical Positivists namely "the verifiability of scientific statements"?

(b). What was the alternative proposed by Karl Popper to the above mentioned tenet of Logical Positivists?

(6). (i). Karl Popper drops the concept 'Truth' and replaces it with the new concept 'Verisimilitude'.

How does Popper relate this concept 'Verisimilitude' to justify the progress of successive theories?

(ii). What is the major drawback of Popper's method of falsification?

Give an example to justify your answer.

(7). (i). How does Thomas Kuhn distinguish or characterize 'science' from other areas of knowledge?

(ii). (a). Briefly explain the role of a paradigm in a particular area of knowledge, according to Thomas Kuhn.

(b). Use Newtonian Physics as a paradigm to justify your answer to the above question (a).

(iii). Compare and contrast 'normal science' and 'revolutionary science'.

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SECTION C

(8). 'Modern science if looked at from any perspective, is termed to be underlined by a materialistic philosophy'. Explain as to what you understand by the above statement.

(9). When there is a genuine paradigm change, the assumptions, beliefs and world views are overthrown. Could you use the concept of time as in Newtonian and Einsteinian physics to illustrate this?
As an approximation could you show how time on earth can be measured by a simple clock?

(10). Write a short critique of modern science from the Sri Lankan Cultural perspective. What do you think is the underlying philosophical basis of Sri Lankan Culture?