00138

THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY – LEVEL 05
FINAL EXAMINATION – 2016/2017
MPJ5231 – NATURE OF SCIENCE
FOUR HOURS (ESSAY TYPE PAPER)
OPEN BOOK EXAMINATION (OBE)

Date: 08th December 2017 **Time: 0930 hr. – 1330 hr.**

Answer any six (6) questions only

SECTION A

(1). (i). What is the relation between 'ether' and 'Maxwell's theory of electromagnetism'?
(ii). What was the purpose of the Michaelson-Morley (M-M) experiment?
(iii). State the hypothesis that was proposed to explain the null result of the M-M experiment.
(iv). What was the problem with Maxwell's laws of electromagnetism with regards to Galilean transformation?
(v). What was the solution proposed by Lorentz regarding the problem mentioned above (iv)?
(vi). 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 F, in which the event P precedes the event Q by 10 seconds. (velocity of light (c) = 3×10^5 km/sec)

(2). (i). State the Relativistic Velocity Addition Formula (all three components along x, y and z axes).

(ii). An astronaut is in a spaceship which is travelling with velocity 0.8c relative to an observer on the earth. He fires a proton in the direction of motion at a velocity of 0.3c relative to the spaceship. Find the velocity of the proton relative to the observer on earth. (c is the velocity of light).

(iii). According to the Special Theory of Relativity (STR) the inertial mass m of an electron moving with speed v is given by $m = m_0 \left[1 - \frac{v^2}{c^2}\right]^{-\frac{1}{2}}$ 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). Compare and contrast the views of Empirisists and Rationalists regarding knowledge?
(ii). Compare and contrast the views of the two schools of philosophy of science namely 'Inductivism' and 'Hypothetico-Deductivism' regarding the following
(a). Method of science
(b). Their claims on scientific knowledge
(c). Theoretical terms
(iii). Explain briefly the relevance of Francis Bacon's approach towards nature in the practice of science to the present-day scenario and the grave consequences that the whole world is facing today.

(4). (i). What was the critique of David Hume regarding the principle of induction?
(ii). What was the response of Hume to the problem of induction and causality (cause-effect relationship)?
(iii). Compare and contrast the views of Logical Positivists and Karl Popper regarding the following
(a). Observations (b). Theories of science (c). Method of science

(5). (i). Why did Karl Popper reject ad-hoc modifications to theories?
(ii). Explain briefly the views of Karl Popper regarding the 'progress of science'.
(iii). Explain briefly the main drawback of Popper's method of science.

(6). (i). How does Thomas Kuhn utilize his concept 'Paradigm' to explain the process of science?
(ii). Explain briefly the role of scientific community during
(a). Normal science
(b). Revolutions of science
(iii). How does Thomas Kuhn explain the following?
(a). Incommensurability of successive paradigms
(b). Uniqueness of science among other knowledge systems.

(7). (i) . Compare and contrast the views of Thomas Kuhn and Paul Feyerabend regarding the uniqueness of western science among other knowledge systems.
(ii). It is argued by many philosophers of science that western science is basically reductionist. Explain briefly the basic assumptions of this reductionism in western science.

SECTION C

(8). Read the following passage and answer the given questions.

Many people who have not studied science are baffled by scientists' insistence that animals and plants are machines, and that humans are robots too, controlled by computer-like brains with genetically programmed software. It seems more natural to assume that we are living organisms, and so are animals and plants. Organisms are self-organizing; they form and maintain themselves, and have their own ends or goals. Machines, by contrast, are designed by an external mind; their parts are put together by external machine makers and they have no purposes or ends of their own.

The starting point for modern science was the rejection of the older, organic view of the universe. The machine metaphor become central to scientific thinking, with very far reaching consequences. In one way it was immensely liberating. New ways of thinking became possible that encouraged the invention of machines and the evolution of technology.

Before the seventeenth century, almost everyone took for granted that the universe was like an organism, and so was the earth.
Seventeenth century science created a vision of the universe as a machine intelligently designed and started off by God. Everything was governed by eternal mathematical laws, which were ideas in the mind of God. This mechanistic philosophy was revolutionary precisely because it rejected the animistic view of nature taken for granted in Medieval Europe.

Mechanistic science rejected these animistic doctrines and expelled all souls from nature. The material world became literally inanimate, a soulless machine. Matter was purposeless and unconscious; the planets and stars were dead. In the entire physical universe, the only non-mechanical entities were human minds, which were immaterial, and part of a spiritual realm that included angles and God. No one could explain how minds related to the machinery of human bodies, but Rene Descartes speculated that they interacted in the pineal gland, the small pine-cone-shaped organ nestled between the right and left hemispheres near the centre of the brain.

(i). Compare and contrast the world views (views regarding animals, plants and universe) before and after the birth of western science in the 17th century in Europe.

(ii). Briefly explain the salient features of the mechanistic science according to the above paragraph.

(iii). How did Rene Descartes explain the interaction between mind and body.

(9). The following passage is taken from an article by Vandana Shiva, a physicist by training, a philosopher of science and a leading environmentalist.

Thomas Kuhn, Paul Feyerabend, Michael Polanyi and others have convincingly argued that modern science does not proceed according to a well-defined and stable scientific method. All that can be granted to reductionist science is that it is an approach, a way of looking, a mode of thought. Considering its predatory treatment of nature, attested to by the ecological crisis, it is indeed a very unreliable way.
Controlled experiment in the laboratory is a central element of the methodology of reductionist science. The object of study is arbitrarily isolated from its natural surroundings, from its relationship with other objects and observer(s). The context (the value framework) so provided determines what properties are perceived in nature, and leads to a particular set of beliefs about nature.
There is threefold exclusion in this methodology: (i). ontological, in that other properties are not taken note of; (ii). epistemological, in that other ways of perceiving and knowing are not recognized; and (iii). sociological, in that the non-expert is deprived of the right both of access to knowledge and of judging the claims of knowledge.

Science claims that since scientific truths are verifiable, they are justified beliefs and therefore universal, regardless of the social context. The verificationist model of science was forcefully presented by positivism. It claimed that verification was direct observation of the 'facts' of nature, free from the proclivities of the observer. This was, however, challenged by post-positivist philosophers. Kuhn, for example, showed that facts and data in science are determined by the theoretical commitment of scientists. In other words, scientific facts are determined by the social world of scientists, not by the natural world.

While the Kuhnian model challenged the neutrality of scientific facts, it failed to provide an adequate epistemological framework for handling the violence of reductionist science. By insisting that 'nature fits into the realistic boxes of paradigms', Kuhn rendered his model of science materially and politically vacuous. Moreover, he failed to take into account the value system of the larger society that determines the choice of scientific research. Value-determination in the Kuhnian model is done by scientific paradigms, not by social, political, economic interests. By restricting itself to the social world of scientists, the Kuhnian model is unable to deal with the more significant value-determination of scientific facts by the demands made on the science system by economic interests. Moreover, by restricting himself to the material world of the lab, Kuhn was unable to deal with those ecological situations in which reductionist claims are falsified by nature, as symbolized by ecological crises.

(i). Explain briefly the methodology and the salient factures of a controlled experiment according to the above passage.

(ii). What are the main drawbacks of the controlled experiment according to the above passage.

(iii). Compare and contrast the views of Verificationists (Positivists) and Thomas Kuhn regarding 'facts and data' in science, according to the above passage.

(iv). Explain briefly the drawbacks and limitations of the Kuhnian model by Vandana Shiva, according to the above passage.

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