THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF TECHNOLOGY – LEVEL 04
FINAL EXAMINATION – 2013/14
MPJ4131 – HISTORY OF TECHNOLOGY
THREE HOURS (ESSAY TYPE PAPER)
OPEN BOOK EXAMINATION (OBE)

Date: 15th August 2014 **Time: 1330 hrs. – 1630 hrs.**

Answer any four (4) questions only. All questions carry equal marks

(1). Read the following passage and answer the following questions.

The numerous small village tanks in the dry zone have always been something of an enigma to irrigation engineers. The one-mile to an inch topographical maps of Sri Lanka show nearly 15,000 of these small tanks, of which over 8,000 are in working condition today. Tradition has it that some 30,000 of these small tanks had been constructed down the ages, and there is a reference in the chronicles to 20,000 in the ancient province of Ruhuna alone in the 12th century A.D.

A former Director of Irrigation during the British period, J.S. Kennedy, had presented a landmark paper entitled "Scientific Evolution and Development of Village Irrigation Works in Ceylon". He has stated in his paper that because there were so many small village tanks in the dry zone, it was unlikely that all of them had functioned at one and the same time. This could have meant that all these tanks were not meant to be used for irrigated agriculture continuously, but that each tank could be rested with the fields dependent on it lying fallow, from time to time. Unfortunately, however, irrigation engineers later misinterpreted Kennedy as meaning that the small tanks were intended for irrigated agriculture only until such time as they were replaced by some large reservoir or reservoir cum diversion system. The small tank would thus have been a stage in the development of irrigation systems in ancient Sri Lanka. This unfortunate misconception became the unofficial dogma of the Irrigation Department. In 1956, it was given legitimacy by Brohier, one of the acknowledged authorities in the field, who presented a four-stage theory for the evolution and development of the ancient irrigation systems. This theory justified the replacement of small village tanks by large storage reservoirs.

The physical features of the ancient irrigation systems of Sri Lanka fit into Kent Flannery's analysis of cultural complexity based on general systems theory. Flannery said that segregation (or decentralization) and centralization were two key processes responsible for social formations and social change. The small village tanks correspond to segregation, while the interconnected large storage reservoirs and diversion channels correspond to centralization. The small village tank represents an irrigation eco-system. It is the whole drainage basin, not just the body of water, that must be considered as the minimum eco-system units.

The present estimate of 30,000 small tanks in the whole dry zone is not excessive. If on average we take two small tanks to make up a single village settlement, these 30,000 small tanks could support a total of 15,000 village settlements, even today. Each tank village would have its own ecological or natural subsystem. In ancient times, each of these segregated

villages would have had its own economic, religious, social and perhaps even political subsystem, that fitted into the larger complex of systems in the whole national social matrix. The ancient tank villages should have been restored and used as the basis for settlements. If this had been done, a more ecologically sable system would have been made possible, despite the destabilizing effects of intensive inputs that are currently in vogue.

This in turn could have led to new attitudes of self-reliance and non-dependence among the settlers themselves. It would have been a unique example of learning from the traditional irrigation eco-systems of ancient Sri Lanka.

(i). What was the explanation given by J.S. Kennedy regarding the large number of small village tanks in the dry zone?

(ii). What was the unfortunate misconception (or misinterpretation) made by the irrigation engineers regarding the above mentioned explanation given by J.S. Kennedy?

(iii). What were the roles of small village tanks and large storage reservoirs, according to Kent Flannery's general systems theory?

(iv). According to the above passage, what would have been implemented as a unique example of learning from the traditional irrigation eco-systems of ancient Sri Lanka?

(v). What could have been the benefits of implementing such a course of action as mentioned in your answer for the above question (iv)

(2). Read the following passage and the relevant session of the course material of MPJ4131, and answer the following questions.

Joseph Needham, the well known author of the monumental work "Science and Civilization in China" gives a list of discoveries, inventions and concepts which travelled from China to the West and had a seminal influence in precipitating the scientific revolution in Europe. In this list Needham has included three inventions which changed the whole face and state of things throughout the world, namely printing, gunpowder and the magnetic compass. Chinese technology at least had reached a level of sophistication not yet attained in any part of the world, as late as the 15th century AD.
Therefore the celebrated question (also referred to as the Needham question) namely "Why China could not produce either modern science or an industrial revolution on the English pattern?" has attracted (and still attract) the attention of many scholars.

The 20th century Chinese philosopher Yu-Lan Fung had a great influence on Needham's thinking about Confucianism and Taoism. In his seminal 1922 essay "Why China Has No Science?" Fung argued that science, in the Anglo-Saxon sense of the term, had no place in Chine "because the Chinese concern themselves solely with the mind, whereas Europeans concern themselves with knowing and controlling matter. He explained that since the Song Dynasty in the 10th century, the Chinese mind has been shaped by the forces of Confucianism, Taoism, and Buddhism. This so-called "Neo-Confucianism" continues to form the essence of Chinese philosophy today. Its basic tenet is that all conduct should be focused inward on the

mind, and that happiness and meaning come from within. "They had no need or interest in analyzing the external world because it was their minds that they wished to conquer and nothing else. Fung noted that in contrast, Descartes and Bacon, the two great philosophers of western science, had distinct notions of the purposes of science: "Descartes said that it is for certainty; Bacon said that it is for power.

According to Fung, the Taoist belief that there is only one certainty, which is that nature holds all goodness and virtue, negated any need for scientific certainty. Confucians in turn, had no need for scientific certainty since they sought to know only themselves within the context of self-reflection and discovery. They had no need for scientific power because there was no external force they wished or needed to conquer. Moreover, Confucians could see no use in science if "intellectual certainty and the power to conquer the external world are not included in the idea of good". This overview reveals the key differences between the Chinese and European philosophies of science, and their bearing on The Needham Question. Fung maintained that Europeans were focused on the external world, the world of the atoms, the human body, structures, tools, and weapons. In contract, the Neo-Confucians, heavily influenced by Taoist and Buddhist thinking believe that everything good is already within each person for eternity. So there is no use in searching externally for certainty, power, meaning, happiness, or logic.

In short, the Neo-Confucian beliefs that have dominated Chinese culture, politics and society for over 1,000 years hold that scientific methods and inventions designed to harness nature are fruitless exercises that detract from the pursuit of happiness and goodness. As literary critic Kenneth Rexroth noted in his review of Science and Civilization in China, Vol. 4:

Chinese science is radically, fundamentally different, and demands a willed, sympathetic reorientation of perspective on the nature of nature . Chinese scientific thought has been far more organic than mechanical, permissive than authoritarian in its interpretation of Nature's ways.

(i) (a). State the celebrated Needham question.
(b). Explain briefly the reasons for raising that question.

(ii). (a). What were the three inventions transmitted from China to Europe that changed the whole world?
(b). Explain briefly how the Europeans utilized those three inventions to change the whole world.

(iii). According to the above passage, why did the Chinese philosopher Yu-Lan Fung dismiss (ignore) the Needham question as irrelevant in the Chinese Cultural Context?

(iv). (a). State the three major philosophies that shaped the Chinese mind.
(b). Compare and Contrast the views of Chinese and European philosophers of science regarding the external world (nature) and man, according to the philosopher Fung.

(v). Compare and contrast the world views (views towards Nature) of Chinese and Europeans according to Kenneth Rexroth.

(3). Read the following passage and the relevant session of the course material of MPJ4131, and answer the following questions.

The Islamic scholar, Seyyed Hossein Nasr, has made the following comments in his splendid volume on Islamic science.

Islamic science, which is taken in this work to include disciplines concerned with the study of the cosmos, embraces a wide spectrum of intellectual activity, from the study of plants to algebra, carried out over more than a millennium by many races and people spread over the middle belt of the earth from Spain and Morocco to eastern Asia. Because of its traditional character, this science is not limited in scope or meaning as is the modern discipline with the same name. The Islamic sciences, even in the more limited sense considered here, which exclude the religious and many branches of the philosophical sciences, are considered at once with the world of nature, of the psyche and of mathematics. Because of their symbolic quality, they are also intimately related to metaphysics, gnosis and art, and because of their practical import they touch upon the social and economic life of the community and the Divine Law which governs Islamic society.

(i). According to the above passage, explain briefly the range of disciplines (areas of study) and the geographical location of regions belonging to Islamic science.

(ii). According to the above passage what are the salient features of Islamic sciences?

(iii). Explain briefly the following Islamic (Middle-Eastern) technologies.

(a). Basin Irrigation (b). Perennial Irrigation
(c). Terrace Irrigation (d). Qunat
(e). Gravity Dam (g). Arch Dam

(4). Read the following passage and answer the following questions.

Living in an island, the inhabitants of Sri Lanka were well acquainted with sailing in the sea from an early period. Reference is found in old literary works to Sinhala people undertaking sea voyages to distant places like *Suvannbhumi* (Myanmar). Several ancient *Brahmi* inscriptions mention donors of caves by the epithet "*vanija*" (trader). The "*Demada*" (sea-captain) is given a seat at the same level as the king, as seen in King Vijayabahu's place in the citadel, permanently carved in stone, an indication of the importance attached to shipping and trade.
Ptolemy in his 1st century map shows Sri Lanka much larger than mainland India, probably indicative of its relative importance in the ancient trade routes. Cosmos Indicopleustes who probably visited Sri Lanka in the 6th century, terms Sri Lanka "mediatrix" (the central point) in the global traffic of the time.

Li Chao, the mandarin (Chinese) reports that many foreign ships arrived at An-nan and Kuang-Chou each year, among them ' the ships from the Lion Kingdom (Sinhala-desa) were the largest, with stairways for loading and unloading which were several feet in height. Li Chao further speaks of visits paid by Sri Lankan vessels to China each year. The security of

sea is of such importance that the ancient chronicle '*Chulavamsa*' says that King Moggallana (495-512 AD) initiated a "*Sagararakkham*' or a 'watch of the sea'.

Anuradhpura, the premier city for over a thousand years between 5th century BC to 11th century AD , developed using the port dues generated by *Mantai* and *Tiriyaya*, the two major ports that connected the Silk route of the sea across the island of Lanka.

From what remains today, we can identify the *pahure, oru, angula, paru* and *ma-del paru* as the last of the old forms. The first is a bamboo craft, and thus, is not a "boat". The rest are all dual-elements craft: having either twin (log) hulls or a single (log) hull and attached outrigger.
The *oru* alone reached the sea and developed into a handy sea-going craft, transforming itself to fit every type of fishing at sea. But it remained a fishing craft, only, until it cut the umbilical cord to the dugout log. When the dugout was replaced by a keel-log, then a keel-plank, and plank-built hulls were adopted, the sea-going cargo ship with an outrigger – the *yathra dhoni*, or *maha oruwa* was born.

(i). According to the above passage, state three factors that could be drawn from various local sources that indicate the importance attached to shipping the trade in ancient Sri Lanka.

(ii). Briefly describe three foreign sources mentioned in the above passage that indicate the importance of Sri Lanka as a central point in the global sea routes and the high quality of our ancient ships.

(iii). (a). State the type of ancient sailing crafts that are still available today.
(b). Explain briefly the evolution of the ancient sea-going cargo ship "*yathra dhoni*" starting from '*oru*'

(5). (i). Explain briefly the unique features of the ancient iron smelting technology used in the Samanalawewa area in Balangoda.
(Hint: your answer should mention about the raw materials, energy sources, furnace structure, maintaining of steady high temperature inside the furnace).

(ii). Explain briefly the factors that led to the invention of printing by the ancient Chinese before any other nation.

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