THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Mathematics and Philosophy of Engineering

Bachelor of Technology Honors in Engineering / Bachelor of Software Engineering Honors/ Bachelor of Industrial Studies

Final Examination (2019/2020)
MHJ4241: History of Technology
Duration: Three Hours
(Essay Type, Open Book Examination)

Date: 10th August 2020 (Monday) **Time: 9.30 hrs-12.30 hrs**

- ***Please answer a total FOUR questions only from the six questions given below.***
- ***Each question should be answered in a separate booklet. Mark your index number and the question number you are answering clearly on each booklet. Make sure that you submit FOUR booklets.***
- ***Number of pages in the paper is four(04).***
- ***Please do not copy directly from the text. If you have to quote, do so in inverted commas.***

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1) (i). Describe the role played by Dr. Gill Juleff to attract global attention to iron smelting technology practiced in ancient Sri Lanka. (60 marks)
(ii). What do you think are the reasons for the collapse of this ancient practice? Briefly explain (40 marks)

2) The numerous small village tanks in the dry zone, have always been something of an enigma to irrigation engineers. The one mile to inch topographical maps of the island show nearly 15,000 of these, 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 were about 20,000 in the ancient province of Ruhuna alone in the twelfth century A.D. In 1923, after heavy monsoon rains in the dry zone, a failure of one of these small tanks in the Mannar District triggered off a series of failures of further small tanks where the spill waters of one led into another down the chain. The resultant flood damaged the railway line near Medawachchiya, with much loss of life and damage to property. The Irrigation Department thereafter started a study of the ancient village tanks, and ten years later, J.S..Kennedy, then deputy director and later Director of Irrigation, presented a landmark paper to the Engineering Association of Ceylon, entitled 'Scientific Evolution and Development of Village Irrigation Works in Ceylon'. This comprehensive study was published as a handbook and became the basis for the restoration by the Irrigation Department of selected village works lying abandoned, or in need of improvement, in various parts of the dry zone of the island. However, it also led to a misconception regarding the usefulness of these village tanks, which was to become the basis of a misconceived dogma in the Irrigation Department in the years to come.

Kennedy 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. This is indeed quite a likely hypothesis. 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 at the fiftieth jubilee year of the Engineering Association of Ceylon (when it became the Institution of Engineers by Royal Charter). Later, in 1971, Joseph Needham republished this theory in his monumental work, Science and Civilization in China. This theory justified the replacement of small village tanks by large storage reservoirs.

The physical features of the ancient irrigation systems of Sri Lanka also fit into Kent Flannery's analysis of cultural complexity based on general systems theory. Flannery said that segregation 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 two significant properties in the dry zone were land and water. In the case of land, there were some private, monarchic and monastic ownership. However, collective ownership of lands and rotation of plots among the community was extensive. Chena cultivation was regulated. The distance of the village to the Chena and the extent of the Chena were limited. The Chena was owned by a collective for two to three years. Thereafter the land was left to the jungle.

Irrigation water had to be rationed. The different paddy fields that were close to the tank or on lower ground received more water. So, the fields were rotated among the families for equity.

Forest tanks were built in the jungle just above the village to provide drinking water to wild animals, to deter them from entering the village. Mountain tanks provided irrigation for Chena agriculture. Erosion control tanks intercepted silt before it entered the main tank. Backup tanks were built for desilting the main tanks while retaining the water.

Read the above passage and answer the following questions

(i). Explain briefly the views of J.S. Kennedy regarding the availability of large number of small village tanks in the dry zone. (20 marks)

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

(10 marks)

(iii). Explain briefly Kent Flannery's general systems theory regarding small village tanks and large reservoirs. (20 marks)

(iv). Explain briefly how land and water were utilized in the dry zone by the ancient Sinhalese in Paddy and Chena cultivation. (30 marks)

(v). Explain briefly the four types of ancient tanks. (20 marks)

03).(i). Explain briefly the contributions made by the following Indian Mathematicians (Give specific examples from Arithmetic and Algebra)

(a). Aryabhatta (20 marks)

(b). Brahmaguptha (20 marks)

(ii). Compare and contrast the approaches of the Indian Mathematician Bhaskara (about 1150 AD) and the Italian Mathematician Lagrange (about 1760 AD) in solving the Pellian equation $Cx^2 + 1 = y^2$ where x, y are integers, $C \neq 0$ and C is a given non-square integer. (60 marks)

04).(i). Explain briefly the types of sailing crafts used by the ancient Sri Lankans for navigation in Seas and Rivers respectively. (30 marks)

(ii). Explain briefly four (04) historical records to justify the use of sea-going crafts by the ancient Sri Lankans. (40 marks)

(iii). Briefly explain the types of wood used by ancient Sri Lankans for ship-building.

(30 marks)

05) According to Francis Bacon, the three most important inventions namely printing, gunpowder and magnetic compass transmitted from China to Europe changed the whole face and state of things throughout the world.

With the invention of printing, the spread of knowledge and information occurred at an enormous rate. Let us briefly consider the main factors that led to the invention of printing by the Chinese before any other nation. Since printing is a mechanical extension of writing, the system of writing used is one of the most important factors affecting the development of writing. Chinese writing was from the very beginning characterized by an ideographic script which is basically composed of numerous separate strokes of different shapes. Thus, Chinese writing is more complicated and time consuming than the writing of most other languages (eg: English, Sinhalese, French, etc) which are characterized by alphabetical scripts. European writing, ever since the Polenicians developed the rudiments of the alphabetic language, has evolved into a system of symbols representing sounds. Its written components are merely substitutes for their spoken counterparts and have tended to evolve into simple signs composed of continuous lines. Copying in an alphabetic script is easier than in an ideographic script.

On the other hand, the English and Sinhala characters are called phonetic characters (Swaraakshara), which means symbols based on 'what you hear'. The Chinese characters are called ideographic characters (Rupaakshara), which means symbols based on pictures. It is likely, therefore, that the slower and more complicated process of copying Chinese writing must have resulted in a greater demand for mechanical aid in duplication in China than in Europe. Another factor that might have influenced the Chinese for the invention of printing was the huge population in China, compared to the European countries. In order to communicate the directives of the rulers to the people as quickly as possible, the Chinese administrators needed large number of copies of the relevant documents. Also, in that era, Mahayana Buddhism along with Taoism was widespread in China. Among the Mahayana Buddhists there was a belief that distributing large number of copies of Mahayana Sutras among devotees is a meritorious deed. These factors must have influenced the Chinese towards the invention of printing.

Chinese invented gunpowder and mainly utilized it to produce fireworks, to be used at the Chinese cultural festivals. Even today the Chinese are famous for Fireworks. But when the Europeans acquired gunpowder via Arabic merchants, they utilized it to produce guns. Europeans used their superior firepower to conquer other lands and nations.
With the invention of the magnetic compass by the Chinese, the sea travel or navigation became safer and quicker. Chinese sailed the seas well before the Europeans. The Chinese Silk Routes through the sea and land are well known. Chinese through their sea voyages exchanged goods and knowledge. For example, the Chinese Buddhist monk, Fa Hien visited Sri Lanka in the year 402 AD copied the sacred Buddhist texts like 'Tripitaka' from the Buddhist monasteries and returned to China in a sea voyage. He translated those sacred texts to Chinese language. According to the retired British Submarine Lieutenant- Commander and Author, Gavin Menzies, in the year 1421 a naval fleet led by the Chinese Admiral Zheng had landed in America prior to the European explorer Christopher Columbus who landed in America in 1492. Chinese never conquered those foreign lands that they visited. But when the Europeans landed in foreign lands, they conquered those countries and built colonies in order to exploit the vast natural resources of those countries.

Read the above paragraph and answer the questions given below.

(i). List three inventions that were invented by the Chinese and significantly contributed to change the world's history. Briefly discuss how those inventions contributed to change the world. (40 Marks)

(ii). Discuss the factors that led Chinese to invent printing earlier than any other nation in the world. (60 Marks)

06) (i). Briefly discuss the different types of irrigation systems used by the Muslims. (40 Marks)

(ii). Discuss why Islamic civilization constructed large irrigation systems and used number of water-lifting mechanisms? (60 Marks)