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Reg. No.: \_\_\_\_\_

Name: \_\_\_\_\_

## APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE SPECIAL EXAMINATION, SEPTEMBER 2016

## BE103 INTRODUCTION TO SUSTAINABLE ENGINEERING

Max. Marks: 100

Duration: 3 Hours

## Part A

*(Answer (a) OR (b) part of each question;**Answers should be short; Not more than 6 sentences)*

- A1(a) i) Give an example of a technology which has contributed positively to sustainable development. (2)  
 ii) Illustrate the three pillars of sustainable development? (3)
- OR
- A1(b) The highly industrialized countries (known as Annex I Parties) have a legally binding obligation under the Kyoto Protocol to achieve quantified reductions in their enormous Green House Gas (GHG) emissions. In this context, what do the terms CDM and CERs refer to? (1+4)
- A2(a) Suggest any one method of sustainable waste water treatment. (5)  
 OR
- A2(b) Write a short note on any local environmental issue (can be based on your own study) (5)
- A3(a) Demonstrate the basic concept of Life Cycle Assessment (LCA) with an example. (5)  
 OR
- A3(b) What is meant by biomimicry? Give 3 examples for the applications of biomimicry. (2+3)
- A4(a) i) What do you mean by green building design? (2)  
 ii) What is GRIHA rating? (3)
- OR
- A4(b) What are the impacts of a non sustainable transportation system? Suggest any one method to reduce the impacts. (5)
- A5(a) List out the major renewable energy sources available. (5)  
 OR
- A5(b) Suggest suitable sustainable systems to generate hot water and electricity for a hostel in Kerala. (5)
- A6(a) Propose a sustainable method to meet the power requirements of a small island 50 km away from the shore. (5)

OR



- A6(b) The temperature at the core of the earth is very high. Is there any method available to utilize this energy for generating electricity? (5)
- A7(a) What do you mean by Industrial symbiosis. How it is related to sustainability? (5)
- OR
- A7(b) List out any 5 principles of green engineering. (5)
- A8(a) Slum formation is the major threat for urbanization. Discuss the reasons behind slum formation. (5)
- OR
- A8(b) What is meant by urbanization? Write 2 push factors and 2 pull factors for people moving from rural to urban areas. (1+2+2)

### Part B

*(Read the Stories/Cases/Data set as the case may be, and answer ALL questions. Each FULL question carries 10 Marks.)*

#### Case 1

### TRANSFORMING OUR WORLD: THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

*(Excerpts from UN Declaration on sustainable development goals)*

#### Introduction

- 1) We, the Heads of State and Government and High Representatives, meeting at the United Nations Headquarters in New York from 25-27 September 2015 as the Organization celebrates its seventieth anniversary have decided today on new global Sustainable Development Goals.
- 2) On behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and people-centred set of universal and transformative Goals and targets. We commit ourselves to working tirelessly for the full implementation of this Agenda by 2030. We recognize that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development. We are committed to achieving sustainable development in its three dimensions - economic, social and environmental - in a balanced and integrated manner. We will also build upon the achievements of the Millennium Development Goals and seek to address their unfinished business.
- 3) We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries; to build peaceful, just and inclusive societies; to protect human rights and promote gender equality and the empowerment of women and girls; and to ensure the lasting protection of the planet and its natural resources. We resolve also to create conditions for sustainable, inclusive and sustained economic growth, shared prosperity and decent work for all, taking into account different levels of national development and capacities.

#### Module 1

##### B1.

- (a) When was Sustainable Development Goals signed and by whom? (2)
- (b) How many years are set for achieving the Sustainable Development Goals? (1)
- (c) As per the declaration what is the indispensable requirement for sustainable development? (2)

- (d) What are the basic resolutions of the declaration? (5)

### Case 2

#### WMO: Atmospheric greenhouse gases reach record high

November 9th, 2015 | Climate change News Via UN News Centre

The World Meteorological Organization (WMO) announced today that the amount of greenhouse gases in the atmosphere reached yet another new record high in 2014. WMO's Greenhouse Gas Bulletin, says that between 1990 and 2014 there was a 36 per cent increase in radiative forcing – the warming effect on our climate – because of long-lived greenhouse gases such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) from industrial, agricultural and domestic activities. The report also highlights the interaction and amplification effect between rising levels of CO<sub>2</sub> and water vapour, which is itself a major greenhouse gas. Warmer air holds more moisture and so increased surface temperatures caused by CO<sub>2</sub> would lead to a rise in global water vapour levels, further adding to the enhanced greenhouse effect. "We will soon be living with globally averaged CO<sub>2</sub> levels above 400 parts per million as a permanent reality," WMO Secretary-General Michel Jarraud said. "We can't see CO<sub>2</sub>. It is an invisible threat, but a very real one. It means hotter global temperatures, more extreme weather events like heat waves and floods, melting ice, rising sea levels and increased acidity of the oceans. "Excess energy trapped by CO<sub>2</sub> and other greenhouse gases is heating up the Earth surface which leads to increase in atmospheric water vapour which in turn is generating [and] trapping even more heat," he added, underlining that carbon dioxide remains in the atmosphere for hundreds of years and in the ocean for even longer.

### Module 2

B2.

- What does the WMO's Greenhouse Gas Bulletin say about the increase in warming effect on our climate? (3)
- As per WMO's report, how does the interaction and amplification effect of CO<sub>2</sub> and water vapour levels enhance greenhouse effect? (3)
- What are the problems of greenhouse gases? (2)
- Suggest any method to reduce CO<sub>2</sub> level in atmosphere. (2)

### Case 3

#### The three-and-a-half pound microchip: Environmental implications of the IT revolution

**PUBLIC RELEASE: 5-NOV-2002 AMERICAN CHEMICAL SOCIETY**

Microchips may be small, but their impact on our world has been huge. And this impact goes beyond the obvious effects of e-mail, cell phones and electronic organizers: A new study shows that the "environmental weight" of microchips far exceeds their small size. Scientists have estimated that producing a single two-gram chip -- the tiny wafer used for memory in personal computers -- requires at least 3.7 pounds of fossil fuel and chemical inputs. The results have crucial implications for the debate on dematerialization -- the concept that technological progress should lead to



radical reductions in the amount of materials and energy required to produce goods. The microchip is often seen as the prime example of dematerialization because of its high value and small size, but the new findings suggest this might not be the case. The researchers performed a life cycle assessment of one 32-megabyte DRAM chip, tracing it through every level of production, from raw materials to the final product. In doing so, they estimated the total energy, fossil fuels and chemicals consumed in production processes. Fossil fuel use correlates with carbon dioxide emissions, and chemical use is suggestive of potential pollution impacts on local air, water and soil. Each chip required 3.5 pounds of fossil fuels, 0.16 pounds of chemicals, 70.5 pounds of water and 1.5 pounds of elemental gases (mainly nitrogen).

### Module 3

B3.

- (a) What does the life cycle assessment of one 32-megabyte DRAM chip reveal? (3)
- (b) Elaborate on the debate on dematerialization. (3)
- (c) What are the estimated amount of fossil fuel and chemicals required for producing a single two-gram chip? (2)
- (d) Discuss the importance of life cycle analysis from the above report. (2)

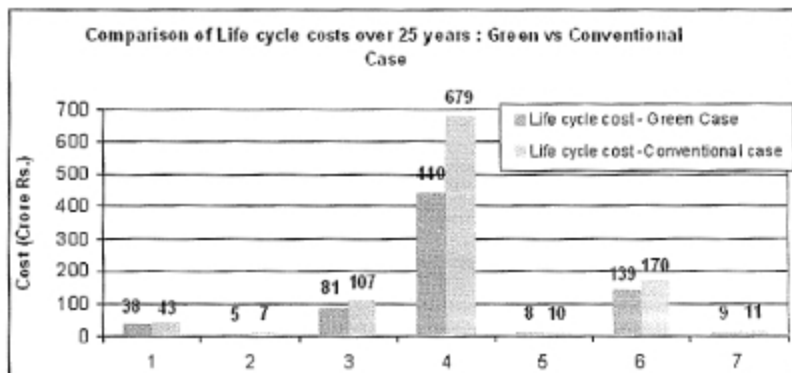
### Case 4



**The Energy and Resources Institute**  
Creating Innovative Solutions for a Sustainable Future

Life cycle cost of energy efficient buildings Although the concept of green buildings is gradually gaining popularity in India, it has still not become an integral part of the construction industry. One of the key reasons is the general apprehension of the building industry that green buildings are not viable from a business perspective. The capital cost involved in a green building is the biggest deterrent in allowing large-scale adoption of the concept by the construction industry. To address this issue, TERI conducted a study to assess the economic feasibility of incorporating energy-efficient design features in buildings with reference to improvement in their energy performance. The results showed that investing in green buildings is a profitable venture. Though the initial costs are high, the pay back period is less than that of conventional buildings. Strategies that are integrated in the building and services design, and energy-efficient equipments installed to improve the energy performance of buildings, contribute towards the high initial investment as compared to conventional buildings (the difference is between 4% and 32 %). But, the paybacks of just 1-3 years, adjusted rate of returns of 19-30%, and cash savings accrued from the former not only compensate for this initial cost increment but also provide benefits to the owners throughout the life time of the building. The results were arrived at by calculating a cost-benefit analysis of select buildings in India.





#### Module 4

B4.

- What is the biggest deterrent in allowing large-scale adoption of the concept of green building by the construction industry? (2)
- Compare the average cost of green buildings and conventional buildings. (4)
- Substantiate the significance of green building based on the study by Teri. (4)

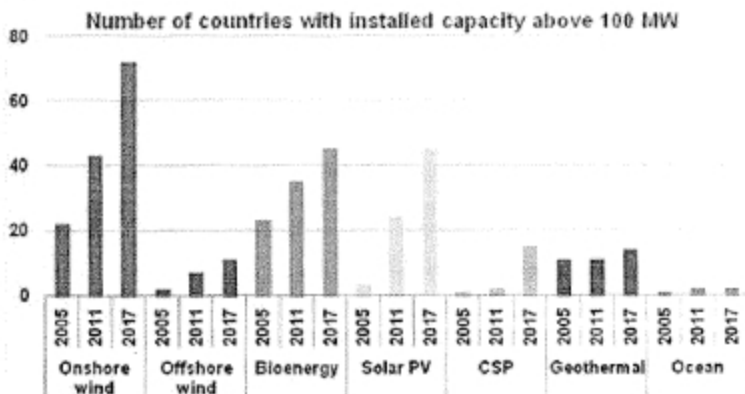
#### Case 5

##### IEA says renewable energy growth to accelerate

(<http://reneweconomy.com.au/2012>)

By Giles Parkinson on 6 July 2012

The International Energy Agency has delivered an optimistic outlook for renewable technologies, saying its deployment would accelerate even beyond the rapid growth of recent years, despite the winding back of incentives and subsidies in some countries.



## Module 5

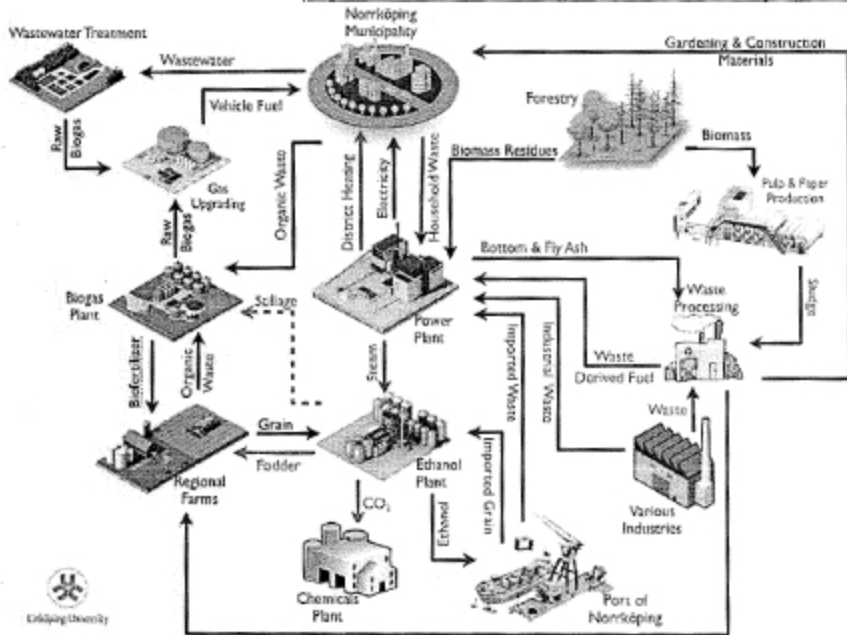
B5. Analyze the above graph and answer the questions below.

- Why does International Energy Agency present an optimistic outlook on renewable energy? (2)
- Which energy sector is popular among various countries? (2)
- Compare the approximate growth rate of various energy sectors over the period 2005- 2017. (4)
- Which energy sector has the fastest growth rate and which has the slowest growth rate? (2)

## Case 6

## Norrköping Industrial Symbiosis Network in Sweden

(<http://www.industriellekologi.se/symbiosis/norrkoping.html>)



## Module 6

- B6.
- Explain industrial symbiosis by detailed analysis of the above figure. (5)
  - How is waste-to-energy concept utilized in the Norrköping Industrial Symbiosis Network (5)