AICE Environmental Management: Syllabus

The AICE Environmental Management syllabus recognises that human population growth has become the dominant factor producing environmental change. Since the majority of humans now live in cities, issues related to the growth of urban and industrial areas and the impact of rapid population growth are an important aspect of the syllabus.

Environmental management is concerned with both local and global issues and with the various ways in which societies, governments and economic activity (industry, agriculture and urban areas) use, misuse and attempt to manage both local and global environments. Whilst environmental management can often be presented in a negative light by emphasising pollution, exploitation and misuse, it is important to give recognition to the positive ways in which we manage our environment. Thus issues such as global warming, industrial pollution and the impact of rapid population growth need to be balanced with others like the creation of National Parks, sensitive urban design and sustainable management/ development.

The syllabus reflects a contemporary concern with sustainable management. Through their study of environmental management, it is hoped that candidates will learn to appreciate that the exploitation of the environment has often had a negative impact and that we should aim for a sustainable management of resources.

The syllabus focuses on environmental issues and their management at local, regional and global levels and is organised in three sections:

- **Key Questions (KQ):** These identify major aspects of the syllabus but are not intended as a prescriptive teaching programme. ***(Shown below in Bold, italic)***

- **Content:** The specific knowledge and skills you will learn in order to answer the key questions. (Shown below in regular type)

- **Notes for Guidance:** These offer some examples of the type of topics which are suitable and other suggestions for teachers. *(Shown below in regular, italic)*

Examination questions will be derived from the **Content** of the corse. Candidates should show knowledge and understanding of the points listed in the Content, and be able to handle information and solve problems relating to these points.

I.   **LITHOSPHERE:** the upper mantle of rock and crust, that forms the tectonic plates upon which the continents lie.

   A.   ***L KQ1: What are the key elements of the structure of the earth?***

      1.   Describe the internal structure of the earth, including the characteristics of the: core, mantle, asthenosphere.

      2.   Differentiate between oceanic and continental crust.

         a)   Describe how seismic wave data provides evidence of earth structure.

         b)   Plate tectonics:

            (1)   The major plates (*mapping the earth's plates*)

(2) Convection currents

(3) Ocean floor spreading

(4) Plate boundaries:

    (a) Destructive

    (b) Constructive

    (c) Conservative

    (d) Examples chosen from two contrasting regions e.g. The Atlantic with its mid-ocean ridge and evidence drawn from neighbouring continents with the Pacific. Case studies of a major volcanic eruption, a major earthquake; these studies can of course be combined with studies in Key Question 2.

(5) Post- Pangea plate movement supported by evidence from: (*Global evidence; fossil record including dinosaurs, coal measures.*)

    (a) paleo-magnetism

    (b) paleontology

    (c) geographic fit

B. L KQ2a: What natural hazards are derived from plate movement and how are they managed?

1. Earthquakes (e):

    (1) cause, process and effect

    (2) the Richter Scale

    (3) frequency

    (4) different impacts in LEDCs and MEDCs.

2. Volcanoes (v):

    a) types of eruption and their effects,

    b) contrasting explosive acid types with basaltic eruptions.

    c) Examples to be chosen from LEDCs (e.g. Pinatubo) and MEDCs (e.g. Etna or Unzun).

    d) Hazards: to include

        (1) tsunamis

        (2) landslides

        (3) ground deformation

        (4) volcanic ash, lava and hot ash clouds (nuee ardentes).

C. L KQ2b: What strategies can be employed to limit damage and loss of life?

1. Strategies for such natural hazards in LEDCs and MEDCs vary and may include:

    a) historic records (e,v)

    b) frequency (e,v)

c) seismic evidence (e,v)

d) tilt metres (v)

e) chemical analysis (v)

f) building design (e)

g) and rescue and aid (e,v)

D. L KQ3a: What natural and man-made processes contribute to different types and causes of mass- movement on slopes?

1. Rock weathering processes and the accumulation of debris on slopes.

2. Causes of mass movement: flows and slides including

   a) rock falls

   b) landslides

   c) earth slumps

   d) soil creep

   e) solifluction

   f) mudflows.

3. Human influences include deforestation and building.

4. A theoretical introduction backed up by a case study, e.g. Hong Kong, Rio de Janeiro, Sarno in Southern Italy, Himalayan Foothills.

E. L KQ3b: How are sudden mass-movements managed?

1. Slope management policies including:

   a) slope angle reduction

   b) afforestation

   c) drainage

   d) surface protection.

F. L KQ4: What are the major causes of soil deterioration and erosion and how can they be prevented?

1. Soil formation and characteristics including:

   a)   texture

   b) biotic and abiotic components

   c) idealised soil profiles characteristic of moist and arid conditions in temperate and tropical areas. (*Soil profiles to include: temperate podzols and brown earths, tropical laterites and rain forest soils.*)

   d) Soil erosion and deterioration through:

      (1) agriculture

      (2) deforestation

(3) grazing

(4) salinisation

(5) compaction.

    e) Management strategies involving the sustainable use of soils for agriculture.

    f) Studies should use examples from MEDCs and LEDCs. (*Case studies where possible should be local or text derived; e.g. Southern England, Himalayan foothills, USA Dustbowl.*)

G. L KQ5a: What pressures has human activity placed upon the resources of the lithosphere?

1. The nature of renewable *(water - HEP, tide and waves, wind and solar energy)*, non-renewable *(coal, oil and natural gas)* and recyclable resources.

2. Energy resources in LEDCs and MEDCs including:

    a) demand and the depletion of resources in MEDCs

    b) LEDC priorities in the use of fossil fuels

    c) the depleting of reserves of fossil fuels.

    d) Strategies to include sustainable use of fossil fuels through:

        (1) developing renewable resources

        (2) conserving energy

        (3) Strategies may be illustrated by contrasting the policies of two countries or by using resources; e.g. wind, water and nuclear energy in France with coal in India.

3. Land as a resource under pressure from:

    a) urban sprawl *(Pressure from urban sprawl can be illustrated through examples such as Sao Paulo, Mumbai, London, Tokyo and Paris.)*

    b) economic development

        (1) surface mining

        (2) reservoirs

4. *Case studies contrasting the policies of one MEDC (e.g. Germany) with a LEDC (e.g. India).*

H. L KQ5b: How can these resources be managed sustainably for future generations?

1. The management of areas of outstanding natural beauty : conservation areas/National Parks.

II. **HYDROSPHERE:** The body of water, present as ice, liquid water or water vapour.

A. ***H KQ1: How is water stored and transferred globally and locally? The main storage zones of water and the percentages of water held in each.***

1. The natural flows and stores within both the global and local (drainage basin) water cycles.

2. The global system includes the transfer between ocean/ seas, atmosphere and land;

    a) it should refer to the conditions under which the volume of solid, liquid and gaseous water will change.

    b) The local water cycle includes evaporation, precipitation, interception, runoff, infiltration and ground water.

    c) Groundwater stores are to include the features of natural aquifers:

        (1) confined

        (2) unconfined

        (3) perched

3. The global (closed) system in conjunction with the more localised open system, which could be a local drainage basin. It is possible to undertake the local element of this study through field work.

4. Examples of natural aquifers can be on a small local scale or of the scale of the Australian Basin.

B. ***H KQ2: What has been the impact of human activity on the quantities of water in natural stores?***

1. The impact of climatic change and global warming on sea and ice volumes.

2. The impact of rising sea levels

    a) both in the past as with ice ages and

    b) currently through the increased likelihood of flooding in low-lying areas

3. The impact of agriculture and the supply of water for industrial and domestic use upon natural supplies of water.

    a) *Diminishing water supplies as a result of agriculture could include the Aral Sea, Prairies, Australian Artesian Basin.*

    b) *Shortages due to urban and industrial demand may include Mexico City, Middle East, London Basin.*

    c) *Again there is an opportunity to research local water supplies and supply.*

4. Emphasis on the fragility of the global climate with reference to both falling (past) and rising sea levels (current and future).

C. ***H KQ3a: How can water supply be sustained?***

1. The management of water supply on a local and regional scale, including:

    a) disparities in water resources

b) the demand for water and the supply of water

c) Dams, barrages and reservoirs

d) Water supply in arid countries to include ground water and desalinisation. (*Examples of desalinisation in Persian Gulf states, Malta.*)

e) *Examples chosen from contrasting areas such as USA (Colorado), China (Three Gorges), Nigeria or Ghana.*

D. H KQ3b: What are the environmental consequences of the artificial storage of water?

1. Advantages:

   a) water supply

   b) recreation

   c) power

   d) environment

   e) local climate.

2. Disadvantages:

   a) cost

   b) silting

   c) socio-economic

   d) environmental

E. H KQ4a: How does human activity lead to the pollution of water stores ?

1. Pollution of groundwater by metals, nutrients, and organic compounds.

2. Nutrient enrichment and eutrophication of lakes and rivers;

   a) the main sources of eutrophication and its effects.

   b) The impact of sewage disposal upon rivers, lakes and seas

   c) the main health and environmental problems associated with the disposal of sewage sludge.

3. Marine pollution and effects on aquatic and bird life and on the coastal environment.

4. Pollution of rivers and lakes by industrial spillage and river/lake pollution.

5. *There is plenty of scope for candidates to use local studies and link the examination requirements with the wide range of research projects on the topic.*

6. *Other case studies could include the Rhine, Ganges, the Mediterranean Sea and oil tanker spillage.*

F. H KQ4b: How can this form of pollution be managed?

1. via waste controls

2. local and regional policies.

III. **ATMOSPHERE:** The gaseous shell outside these two non-living components.

  A. ***A KQ1a: What are the structural components of the atmosphere ?***

   1. The structure of the atmosphere to include:

      a) troposphere

      b) stratosphere

      c) mesosphere

      d) thermosphere (ionosphere)

   2. Each zone described in terms of

      a) composition

      b) temperature

      c) density variation

   3. *Reference can be made to:*

      a) *models of atmospheric structure*

      b) *evidence from research (balloons) etc.*

      c) *Ozone and the absorption of UV radiation.*

      d) *The absorption of visible radiation by the earth's surface*

      e) *emission of thermal infra-red radiation and absorption by tropospheric gases.*

  B. ***A KQ1b: Why is it important to understand their characteristics?***

   1. The interaction of incoming and outgoing radiation within the troposphere and stratosphere

   2. 'the Earth's energy budget'

   3. The importance of the troposphere for weather and human activity.

  C. ***A KQ2a: What is the pattern of air movement in the troposphere?***

   1. Variations in global insolation.

   2. Regions of high and low pressure. (*The earth's temperature and pressure distribution/ seasonal variations.)*

   3. Global and local wind systems.

   4. The effects of land, relief and ocean currents.

   5. The location and characteristic features of the major climatic regions to include (*The study of climatic regions will be learned with the biomes included in the biosphere module.*):

      a) Equatorial

      b) Tropical Desert

      c) Savannah

      d) Monsoon

      e) Warm Temperate Climates

f)   Sub-Arctic

D. A KQ2b: how does it influence regional climates and local weather?

1. The formation and characteristics of:

   a) anticyclones (high pressure systems)

   b) temperate frontal depressions and tropical cyclones (hurricanes).

E. A KQ2c: What methods are employed to forecast weather patterns?

1. Weather forecasting in relation to these weather conditions

2. *Traditional text based studies or student investigations. The use of weather charts, satellite data in forecasting and recording weather data (visual and infrared photography).*

3. *Relevant case studies to illustrate drought and hurricanes.*

F. A KQ3: How does human activity affect the atmosphere?

1. The principle sources of CFCs and their role in stratospheric ozone depletion.

2. The role of gases such as carbon dioxide and methane in the enhanced 'greenhouse effect' and possible climatic consequences. *The likely impact of global warming on:*

   a) *raising sea levels*

   b) *increased storm intensity*

   c) *climatic change.*

3. Emissions of sulphur dioxide and nitrogen oxides and the formation of acid rain including effects upon buildings, water-courses and soils.

   a) *There is an opportunity to link industrial pollution with Key Question 5 in the Lithosphere module.*

   b) *Emissions from industrialised countries and transference to other countries.*

   c) *Reference can be made to studies in the UK and Sweden (1980s).*

   d) *Predicted and possible climatic and biospheric effects of global warming.*

   e) *Examples from the Antarctic and Northern Hemisphere. Where possible use local examples.*

G. A KQ4a: How can atmospheric pollution be controlled ? (Afforestation and the use of alternative energy sources.)

1. Reducing emissions through cleaning flue gases

2. Alternative energy

3. Afforestation

4. CFC free domestic appliances, sprays etc. (*Reference to controls on CFC emissions*)

5. The use of alternative sources of energy including:

   a) wind

   b) water

      c)   nuclear energy

   6. International controls/ protocols

   7. Recognising that pollution crosses international boundaries

H. A KQ4b: What are the problems involved with the global management of atmospheric pollution?

   1. The background to the difficulties in achieving a broad agreement in the reduction of atmospheric pollution.

   2. LEDC and MEDC examples: Kyoto and Buenos Aires (1998) and Rio de Janeiro (1992) meetings and the problems in achieving agreement. Reference to examples such as an LEDC and an MEDC to illustrate problems in controlling industrial pollution.

IV.   **BIOSPHERE:** The living organisms that have established themselves in the other three spheres.

   A. In this module, two contrasting ecosystems should be studied to a greater depth and should incorporate information from Key Questions 1, 2 and 3; ideally one of these studies can be based upon an area with which the students have some personal familiarity.

B. B KQ1a: What are the major abiotic and biotic factors, which drive and influence the distribution of different ecosystems?

   1. The biotic and abiotic factors which control the distribution of the world's major biomes

   2. A survey of the global system followed by a study of the distribution of the following biomes:

      a) tropical rain forest

      b) monsoon rain forest

      c) tropical savannah

      d) desert

      e) temperate deciduous

      f) high latitude tundra

   3. The two contrasting case studies should be chosen from these. Whilst a biome can be considered a global scale ecosystem, ecosystems occur on a variety of scales within broad vegetation zones.

   4. Photosynthesis:

      a) its requirements and process.

      b) Photosynthesis and different wavelengths.

      c) The influence of light intensity and rainfall on plant productivity.

C. B KQ1b: What are the main components and characteristics of ecosystems and how are they structured?

   1. The characteristics of ecosystems in terms of their biotic and abiotic components:

      a) soil

b) temperature

c) rainfall

d) photosynthesis

e) net primary productivity

f) succession

g) biomass

h) biodiversity

i) trophic levels, food chains and webs

j) habitats and niches

2. The interaction of these components to be illustrated through relative size of the flows and stores of nutrients between vegetation, litter and soil.

D. **B KQ2: How has human activity both disrupted and destroyed ecosystems?**

1. The impact of the following upon terrestrial ecosystems:

a) agriculture

b) deforestation

c) exploitation

d) fires

2. The formation of :

a) plagioclimaxes

b) arrested successions

c) loss of biodiversity

3. The effects of clearing tropical rain forest for industrial and agricultural use.

4. The impact of commercial farming in MEDCs through mechanisation and the expansion of fields leading to the loss of local habitats.

5. The influence of human activity upon marine ecosystems; including:

a) coastal waters

b) oceans

c) coral reefs.

E. **B KQ3a: What methods have been used to preserve, conserve, and restore ecosystems?**

1. Methods to include:

a) National Parks

b) afforestation

c) maintaining biological diversity through e.g.

(1) pollution control

(2) changing agricultural systems

(3) ecotourism

(4) forest conservation

(5) wildlife management

(6) ecological islands

2. *Case studies as appropriate or a survey of conservation and restoration of ecosystems with reference to a broader range of examples.*

F. B KQ3b: To what extent have meetings between nations and pressure groups been important in highlighting environmental awareness and managing the biosphere?

1. The impact of international protocols (e.g. Rio de Janeiro and Montreal) and research and pressure from groups such as the WWF.

2. Sustainable development within conservation areas.

G. B KQ4: What has been the impact of population growth upon the resources of countries at contrasting levels of economic development?

1. Populationresources and carrying capacity: the population models of

    a) Malthus

    b) Boserup

2. The concepts of:

    a) overpopulation

    b) underpopulation

    c) optimum population

    d) A study of the population models followed by contrasting case studies e.g. Mauritius, India, UK. Examples can include China, UK or another European country and Canada or Australia.

3. Policies aimed at resolving these issues include:

    a) sustainable and more productive farming methods in LEDCs and MEDCs. (*Agricultural improvements can be illustrated through the Green Revolution, biotechnology etc.*)

    b) economic and social development. (*More general economic and social development through case studies including a MEDC and a LEDC.*)

    c) the sustainable provision of energy and industrial raw materials.

V. **INDIVIDUAL RESEARCH:** Candidates should produce a report of 1500–2000 words on an issue arising out of their course of study.

A. The report may focus on a local, regional, national or global issue.

B. Whilst the issue may derive out of the traditional areas of environmental science, the report must contain an investigation and evaluation of the management issues associated with the topic.

C. The research topic may be chosen from any part of the 4 units of this syllabus.

D. Whilst secondary source material is useful in providing background information, it is important that candidates use primary sources and collect field data.

E. Candidates may use sources of information other than those obtained from field study; these may include the internet, the media, documented data from companies and organisations.

F. The report is also a test of a candidate's ability to confine their report to the word limit of 2000 words; over-long reports may contain too much extraneous material which may count against the candidate at final marking.

G. Candidates are expected to clearly identify an environmental management issue and then organise their report into the following stages of:

1. An introduction identifying an issue expressed through a hypothesis or question.

2. A methodology, which outlines the investigative avenues used for the study and justifies their use.

3. A results and analysis section.

    a) This should form the main part of the study and contain data expressed through illustrative techniques such as pictorial (diagrams and photographs), tables and graphs.

    b) This illustrative material should be analysed through detailed descriptions and explanations.

4. A conclusion which draws together the findings of the investigation.

5. An evaluation of the study which assesses its success and/or shortcomings.

H. To ensure that they comply with the requirements of the syllabus, Centres must seek approval for project titles, in advance, from CIE.

1. The approval form asks for candidate details, project title and a brief description for each candidate.

2. Centres must submit candidates' report proposals to CIE no later than: November 30th for the examination in the following May/June.