Note: The exam sheet consists of four parts, each of which contains one article. Please read the articles and answer the questions carefully.

Part 1：

Please read the article and answer the following questions (Q1-Q3). (20%)

Remote pilotage is often discussed in the context of new technology that supposedly will revolutionize piloting and open up new and exciting possibilities for shore-based control of ships. This paper takes a different approach. By defining the act of piloting a vessel as control of a complex system, it is possible to shed new light on the role of the pilot and on the fundamental and technology-independent difficulties and possibilities of remote pilotage.

The concept of remote pilotage lacks a single, clear definition. The one perhaps seen most often (Hadley, 1999; Grundevik & Wilske, 2007) is the definition employed by EMPA and IMPA, which states that:

Remote pilotage is an act of pilotage carried out in a designated area by a Pilot licensed for that area from a position other than on board the vessel concerned to conduct the safe navigation of that vessel.

Fundamentally then, remote pilotage is an act of pilotage, carried out by a licensed pilot, from a position that is not on board the ship that is subject to the pilotage. This is a service that to some extent is provided in several European ports – in the Netherlands, Belgium, Germany, France, Italy and Malta (Koester et al., 2007) – when the weather conditions are severe enough to prevent pilots from boarding at the regular boarding point. Under such circumstances, certain ships might be remotely guided to calmer waters – where a pilot can board – with the aid of radio instructions from a shore-based pilot, who uses radar to monitor the progress of the ship. The service is only offered to ships that fulfill certain requirements on length and draft, and the master, the pilot and the port authority must all agree that the remote pilotage can be carried out safely. This service is not offered as a replacement for regular piloting. Rather, it is a backup solution used only when the alternative is that the ship awaits better weather.

(Excerpted from Bruno, K. and Lutzhoft, M (2009), "Shore-Based Pilotage: Pilot or Autopilot? Piloting as a control problem", Journal of Navigation, vol. 62, pp. 427-437.)

(1) Which statement is true? (A) Remote pilotage can replace regular piloting. (B) Remote pliotage can be deployed to guide vessels to calmer waters for pilot transfers during bad weather. (C) Remote pilotage can be carried out by pilotes not certified. (D) Remote pilotage means an act of pilotage implemented in a designated area by a pilot on board the vessel concerned to conduct the safe navigation of that vessel (8%)

(2) What is the objective of this article? (A) Giving the definition of remote pilotage. (B) Remote pilotage can be implemented using radar and radio communications. (C) Remote pilotage can facilitate the safety of pilot boarding process. (D) Remote pilotage is common in European ports.(6%)

(3) Remote pliotage can be regarded as useful in particular which circumstances? (A) Slight swell (B) Moderate swell (C) Calm sea (D) Phenomenal sea (6%)

Part 2：

Please read the article and answer the following questions (Q4-Q8). (30%)

Maritime navigation is a process that depends heavily and crucially on the navigator's experience and judgement, as there are no specific rules governing the optimum use of navigational systems and techniques apart from the general rules outlined in collision regulations (COLREGS) coupled with the traditional practices of seamanship. Currently, collision avoidance manoeuvres for local traffic or obstacles are usually performed under the navigator's own reaction and judgement, even though there are numerous navigational advising equipments available on the bridge (e.g. Automatic Identification System (AIS) and automatic radar plotting aid (ARPA)). Nevertheless, navigators usually take the safety of the ship as the first priority while the other aspects (e.g. fuel saving and transverse distance) are mostly treated as secondary issues having a lower priority. This practice was acceptable for many decades but increasing sea-borne trading has greatly elevated marine traffic so that congestion is now a significant problem. Furthermore, and particularly in littoral, the average cruise speed of ships is increasing. As a notable number of accidents at sea are associated with human error; so close range collision avoidance methods have become an important subject in marine navigation.

The majority of the studies in this area are focused on collision free manoeuvres and recently some investigations have been conducted on path planning. Traditionally path planning algorithms originate from:

i. Land-based robotic navigation e.g. rule-based expert systems or combinatorial motion planning,
ii. Iterative non-deterministic optimisation algorithms from other areas e.g. dynamic programming or genetic algorithm.

However, the major difficulties in adopting such approaches were the incorporation of COLREGS and the practise of seamanship. Unlike land-based navigation, the rules for ship encounters are unique and specific to each encounter. In addition to the regulations, the dynamics of ships are also highly complex and depend upon many factors such as hull-form and speed, as well as environmental conditions. There are still no universally agreed solutions to incorporate such factors and up to now all reported studies have either disregarded the regulations, employed specific databases or used different safety domain geometries to emulate COLREGS; and have assumed a highly simplified version of the ship dynamic model.

(Excerpted from Tam, C. K., Bucknall, R and Greig, A. (2009), "Review of Collision Avoidance and Path Planning Methods for Ships in Close Range Encounters", Journal of Navigation, vol. 62, pp. 455-476.)

(4) What is the aim of this article? (A) Discussion of the difficulties encountered in path planning algorithms for close range collision avoidance. (B) Maritime navigation depends heavily and crucially on the navigator's experience and judgement. (C) Close range collision avoidance methods have become an important subject in marine navigation. (D) Congestion is currently a significant problem (6%)

(5) In this article, which factor does not play crucial role in collision avoidance manoeuvres? (A) Navigation's reactions (B) Experience (C) Talent (D) Judgement (6%)

(6) What is the meaning of "increasing sea-borne trading has greatly elevated marine traffic" in this article? (A) The increasing sea-borne trading has greatly influenced marine traffic. (B) The increasing sea-borne trading has greatly raised marine traffic. (C) The increasing sea-borne trading has greatly impaired marine traffic. (C) The increasing sea-borne trading has greatly formed marine traffic. (6%)

(7) Which area does "littoral" mean in this article? (A) Open sea (B) Shallow water (C) Coast area (D) Inland waterway(6%)

(8) What does "emulate" mean in this article? (A) Compete with (B) Replace (C) Disregard (D) Ignore(6%)

Part 3：

Please read the article and assign the most suitable heading for each section (Q9-Q13) from the list of headings shown below the article. It is noted that there are more headings than sections so you will not use all of them. (20%)

Section A

An EI Niño is a temporary change in the climate of the Pacific ocean, in the region around the

equator. You can see its effects in both the ocean and atmosphere, generally in northern hemisphere winter. Typically, the ocean surface warms up by a few degrees Celsius. At the same time, the place where hefty thunderstorms occur on the equator moves eastward. Although those might seem like small differences, it nevertheless can have big effects on the world's climate.

Section B

Usually, the wind blows strongly from east to west along the equator in the Pacific. This actually piles up water (about half a meter's worth) in the western part of the Pacific. In the eastern part, deeper water (which is colder than the sun-warmed surface water) gets pulled up from below to replace the water pushed west. So the normal situation is warm water (about 30°C) in the west and cold (about 20°C)in the east.

In an EI Niño, the winds pushing that water around get weaker. As a result, some of the warm water piled up in the west slumps back down to the east and not as much cold water gets pulled up from below. Both these tend to make the water in the eastern Pacific warmer, which is one of the hallmarks of an EI Niño.

But it does not stop there. The warmer ocean then affects the winds- it makes the winds weaker! So if the winds get weaker, then the ocean gets warmer, which makes the winds get weaker, which makes the ocean gets warmer… this is called a positive feedback and is what makes an EI Niño grow.

Section C

The ocean is full of waves but you might not know how many kinds of waves there are. There is one called a Rossby wave that is quite unlike the waves you see when you visit the beach. It is more like a distant cousin to a tidal wave. The difference is that a tidal wave goes very quickly with all the water moving preety much in the same direction. In a Rossby wave, the upper part of the ocean, say the top 100 meters or so, will be leisurely sliding one way, while the lower part, starting at 100 meters and going on down, will be slowing moving the other way. After a while they switch directions. Everything happens very slowly and inside the ocean and you cannot even see them on the surface. These things are so slow, they can take months or years to cross the oceans. If you had patience to sit there while one was going by, you would hardly notice it; the water would be moving 100 times slower than walking speed. But they are large, hundreds or thousands of kilometers in length, so they can have an effect on things. Another wave you rarely hear about is called a Kelvin wave and it has some characteristics in common with Rossby waves but is somewhat faster and can only exist close to the equator.

EI Niños often start with a Kelvin wave propagating from the western Pacific over towards South America. Perhaps you saw, on the TV news, the movie for the EI Niño of 1997/1998? It showed whitish blob moving along the equator from Australia to South America. That is one of the hallmarks of a Kelvin wave, the early part of the EI Niño process.

When an EI Niño gets going in the middle or eastern part of the Pacific, it creates Rossby waves that drift slowly towards Southeast Asia. After several months of travelling, they finally get near the coast and are reflected back. The changes in interior ocean temperature that these waves carry with it "cancel out" the original temperature changes that made the EI Niño in the first place. The main point is that it shuts off when these funny interior-ocean waves travel all the way over to the coast of Asia, get reflected and travelled back, a process that can take many months.

Section D

A strong EI Niño is often associated with wet winters over the southeastern U.S. as well as drought in Indonesia and Australia. Keep in mind that you are not guaranteed these effects even though there is an EI Niño going on; but the EI Niño does make these effects more likely to happen.

Section E

A strong EI Niño can last a year or more before conditions return to normal. If you read the bit above about Rossby and Kelvin waves then you know that it lasts more or less as long as it takes the interior-ocean waves to travel all the way over to the coast of Asia, get reflected and travel back.

Section F

EI Niños happen irregularly but if you want to impress people at cocktail parties, you might mention that we usually get one every three to seven years. Note the word "usually" : sometimes they turn up more frequently, sometime less.

Section G

On average, complex computer models designed to predict EI Niño can successfully do so 12 to 18 months in advance. However, it seems to vary by episode; sometimes EI Niños are predicted quite well, with plenty of advance notice from the models, while other times they are predicted poorly, with the models not picking them until the EI Niño has already started. Trying to fix the models is one of our research topics at Scripps.

List of Headings

i. How well can we predict EI Niños?
ii. What cause it?
iii. What is the solution to it?
iv. A non-technical decscrption
v. So what makes it stop growing?
vi. How long does it last?
vii. How often do we get them?
viii. What effects does it have?
ix. Who benefits from EI Niño?

(9) Section A:_____ (4%); (10) Section B:_____ (4%); (11) Section C:_____ (4%); (12) Section D:_____ (4%); (13). Section E: _____(4%);

Part 4：

Please read the article below and answer the following questions (Q14-Q18). (30%)

Greenhouse gases arise from a wide range of sources and their increasing concentration is largely related to the compound effects of increased population, improved living standards and changes in lifestyle. From a current base of 5 billion, the United Nations predicts that the global population may stabilise in the twenty first century between 8 and 14 billion, with more than 90 per cent of the projected increase taking place in the world's developing nations. The associated activities to support that growth, particularly to produce the required energy and food, will cause further increases in greenhouse gas emissions. The challenge, therefore, is to attain a sustainable balance between population, economic growth and the environment.

The major greenhouse gas emissions from human activities are carbon dioxide (CO2), methane and nitrous oxide. Chlorofluorocarbons (CFCs) are the only major contributor to the greenhouse effect that does not occur naturally, coming from such sources as refrigeration, plastics and manufacture. Coal's total contribution to greenhouse gas emissions is thought to be about 18 per cent, with about half of this coming from electricity generation.

The worldwide coal industry allocates extensive resources to researching and developing new technologies and ways of capturing greenhouse gases. Efficiencies are likely to be improved dramatically, and hence CO2 emissions reduced, through combustion and gasification techniques which are now at pilot and demonstration stages.

Clean coal is another avenue for improving fuel conversion efficiency. Investigations are under way into superclean coal (35 per cent ash) and ultraclean coal (less than 1 per cent ash). Superclean coal has the potential to enhance the combustion efficiency of conventional pulverised fuel power plants. Ultraclean coal will enable coal to be used in advanced power systems such as coalfired gas turbines which, when operated in combined cycle, have the potential to achieve much greater efficiencies.

Defendants of mining point out that, environmentally, coal mining has two important factors in its favour. It makes only temporary use of the land and produces no toxic chemical wastes. By carefully preplanning projects, implementing pollution control measures, monitoring the effects of mining and rehabilitating mined areas, the coal industry minimises the impact on the neighbouring community, the immediate environment and longterm land capability.

Dust levels are controlled by spraying roads and stockpiles, and water pollution is controlled by carefully separating clean water runoff from runoff which contains sediments or salt from mine

workings. The latter is treated and reused for dust suppression. Noise is controlled by modifying equipment and by using insulation and sound enclosures around machinery.

Since mining activities represent only a temporary use of the land, extensive rehabilitation measures are adopted to ensure that land capability after mining meets agreed and appropriate standards which, in some cases, are superior to the land's premining condition. Where the mining is underground, the surface area can be simultaneously used for forests, cattle grazing and crop raising, or even reservoirs and urban development, with little or no disruption to the existing land use. In all cases, mining is subject to stringent controls and approvals processes.

(14) The global increase in greenhouse gases has been attributed to (A) industrial pollution in developing countries. (B) coal mining and electricity generation. (C) reduced rainfall in many parts of the world. (D) trends in population and lifestyle. (6%)

(15) The proportion of all greenhouse gases created by coal is approximately (A) 14 per cent. (B) 18 per cent. (C) 27 per cent. (D) 90 per cent. (6%)

(16) Current research aims to increase the energy producing efficiency of coal by (A) burning it at a lower temperature. (B) developing new gasification techniques. (C) extracting CO2 from it. (D) recycling greenhouse gases. (6%)

(17) Compared with ordinary coal, new, "clean" coals may generate power (A) more cleanly and more efficiently. (B) more cleanly but less efficiently. (C) more cleanly but at higher cost. (D) more cleanly but much more slowly. (6%)

(18) To control dust at mine sites, mining companies often use (A) chemicals which may be toxic. (B) topsoil taken from the site before mining. (C) fresh water from nearby dams. (D) runoff water containing sediments. (6%)