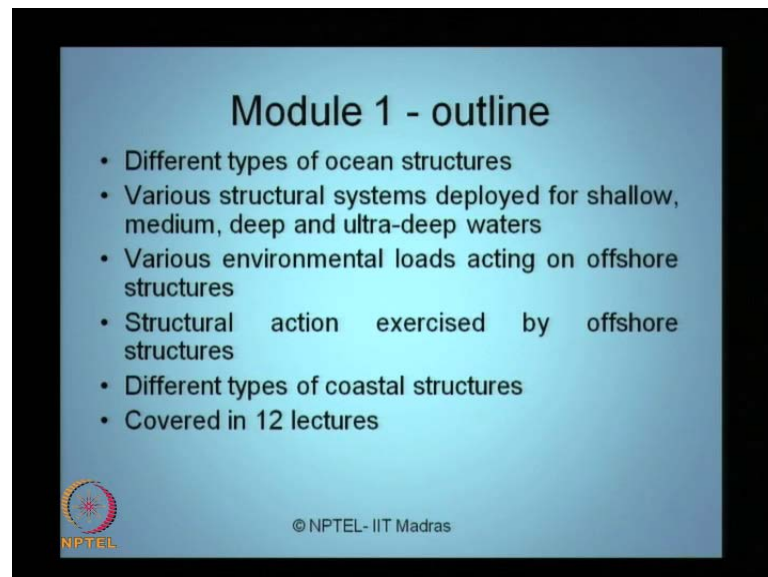


**Ocean Structures and Materials**  
**Prof. Dr. Srinivasan Chandrasekaran**  
**Department of Ocean Engineering**  
**Indian Institute of Technology, Madras**

**Module - 1**  
**Lecture - 12**  
**Tutorials on Module I**

Welcome to the lecture twelve on the first module of the course title ocean structures and materials under the braces of NPTEL, IIT Madras.

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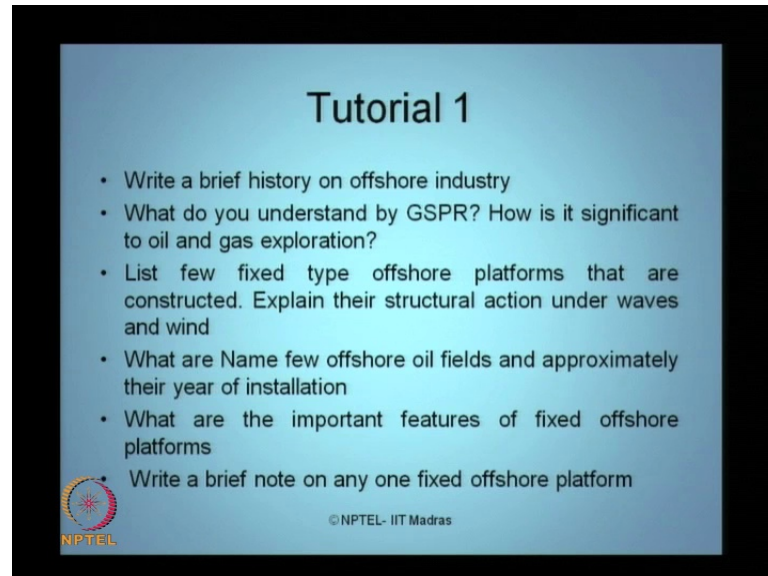


Ladies and gentlemen, in module one, we had a very brief out line of different topics to be consulted like, for example, we discussed about different types offshore structures, various structural systems deployed for shallow, medium, and deep water and ultra deep waters, various environmental loads acting on offshore structures. We also discussed about the structural action exercised by offshore structures; different types of coastal structures - their geometric behavior, their cross sectional dimensions, functional applications and their construction materials. We all covered all these modules in the past eleven lectures. Today is a twelfth lecture on module one on ocean structures and materials.

In lecture twelve, for the benefit of the readers we will discuss about some tutorial sheets, I want you to answer these tutorial sheets in sincere manner. Look into the

reference material suggested by me in the website as well as also cover up the lecture material as I discussed in the courses.

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The image shows a slide titled "Tutorial 1" with a list of tasks. The slide has a light blue background and a black border. The tasks are listed in a bulleted format. In the bottom left corner, there is the NPTEL logo, which consists of a stylized sun or starburst icon above the text "NPTEL". In the bottom right corner, there is a small copyright notice: "© NPTEL- IIT Madras".

## Tutorial 1

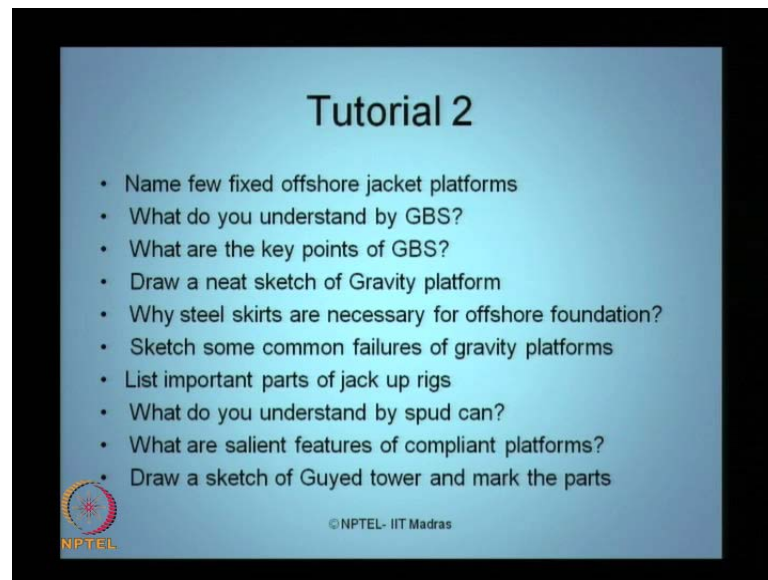
- Write a brief history on offshore industry
- What do you understand by GSPR? How is it significant to oil and gas exploration?
- List few fixed type offshore platforms that are constructed. Explain their structural action under waves and wind
- What are Name few offshore oil fields and approximately their year of installation
- What are the important features of fixed offshore platforms
- Write a brief note on any one fixed offshore platform

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Let us see the tutorial sheet number one. We have discussed about brief history of offshore industry. So, I want you to recollect the information which we presented about the history of growth of offshore industry year wise and location wise. We also discuss something about GSPR. I want you to recollect this term; I want you to understand what is meant by GSPR? Also let me know how is it significant to oil and gas exploration industry? Can you now list few fixed type of offshore platforms that are constructed worldwide? We have given it in a tabular column; we have identified the deepest fixed platform, the shallowest fixed platform, the total number of fixed type of platforms constructed elsewhere in the world. Can you also explain their structural action against or under the wave and wind action?

What are naming few offshore fields and approximately their year of installations. What are the important features of fixed offshore platforms as you understand from the lecture? Write the brief note on any one type of fixed offshore platform as you understand. Try to explain the complete constructional features, the operational features, the cost, installation time, water depth and other technical details of any one fixed type offshore platform which we are discussing in the presentation.

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The image shows a slide titled "Tutorial 2" with a list of 11 bullet points. The slide has a light blue background and a black border. In the bottom left corner, there is a small NPTEL logo. In the bottom right corner, there is a copyright notice: "© NPTEL- IIT Madras".

## Tutorial 2

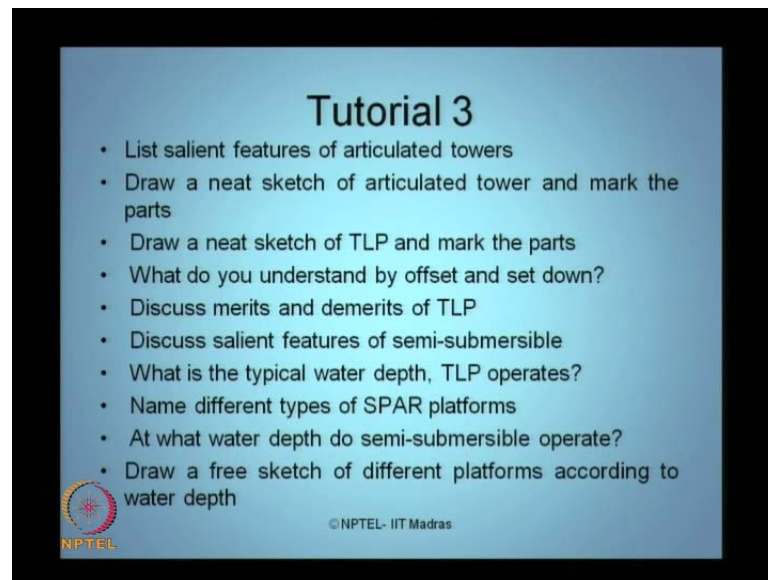
- Name few fixed offshore jacket platforms
- What do you understand by GBS?
- What are the key points of GBS?
- Draw a neat sketch of Gravity platform
- Why steel skirts are necessary for offshore foundation?
- Sketch some common failures of gravity platforms
- List important parts of jack up rigs
- What do you understand by spud can?
- What are salient features of compliant platforms?
- Draw a sketch of Guyed tower and mark the parts

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Let us talk about tutorial two. In tutorial two we will discuss about naming few fixed offshore jacket platforms which have been constructed in the else part of the world. What do you understand by the term GBS? What are the key points of a gravity base structure? Draw a neat sketch of a gravity platform and explain salient components of this platform. Why steel skirts are been necessary for offshore foundation? We have discussed about improving lateral stability of gravity base structures. We also discussed about some covering problems related to large foundation requirement of gravity base structures, how they are overcome by means of steel skirt piles. Can you sketch some common failures of gravity platforms? There are four types of failures which we identified in the first or second lecture. So, try to look into these notes and identify and elaborate some of the failure modes of gravity platforms. Can you also list important parts of a jack up rig?

Ladies and gentlemen, try to recollect the name why a jack up rig name is suggested for this kind of a drilling rig. What do you understand by a spud scan system of a foundation system of any offshore platform? What are the salient features of a compliant platform? Ladies and gentlemen, try to recollect the word the meaning of compliancy. So, we already discussed classical platforms which are compliant in nature which has got two distinct set of frequencies of structural vibrations, which make them enable to act as soft as well as flexible platforms as well and the given action of wave winds and current. Draw a sketch of a guide tower and mark the vital components of a guide platform.


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The image shows a slide titled "Tutorial 3" with a list of tasks. The slide has a light blue background and a black border. The text is as follows:

### Tutorial 3

- List salient features of articulated towers
- Draw a neat sketch of articulated tower and mark the parts
- Draw a neat sketch of TLP and mark the parts
- What do you understand by offset and set down?
- Discuss merits and demerits of TLP
- Discuss salient features of semi-submersible
- What is the typical water depth, TLP operates?
- Name different types of SPAR platforms
- At what water depth do semi-submersible operate?
- Draw a free sketch of different platforms according to water depth

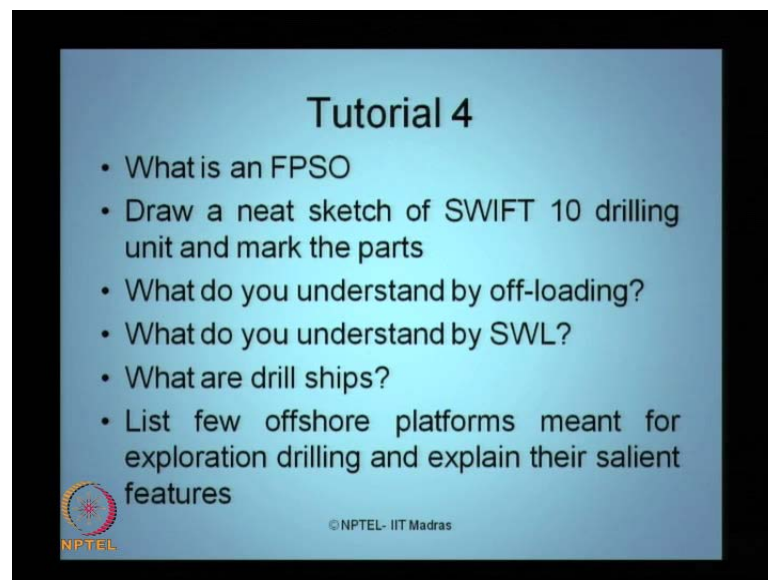
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After successfully answering tutorial one and two, let us look into questions on tutorial number three. Tutorial number three wants you to write, list salient features of articulated towers; we discussed about AT - articulated towers. What are the vital components of an articulated tower, what is the structural action under which articulated tower encounters the environmental loads in a way successful manner. Draw a neat sketch of an articulated tower and mark the parts. Draw a neat sketch of a tension leg platform which is one of the most successful deep water installations in offshore industry. Mark the vital components of a tension leg platform; also recollect the lecture explaining you why the platform is named as tension legs. How tension is imposed on these tendency when the platform is of so large volume in size being installed in the offshore site.

While you understand the structural behavior of a tension leg platform then you must be able to understand what you mean by offset and set down of a TLP? Can you also discuss some of the salient advantages and disadvantages of a tension leg platform? Discuss also the salient features of semi-submersibles; this is one of the kinds of floating structure which we discussed in detail. So, also look at some of the salient features of semi-submersibles. What is the typical water depth at which TLP can operate? If TLP is got to be constructed in shallow waters, what to do the demerit or structural disadvantage of a TLP in shallow waters. On the other hand, can you tell me why TLP are more suitable for deep waters? What is that structural advantage you gain by deploying TLP in deep water?

Name different types of spar platforms, we discussed different kinds of spar platforms. We also showed you a literature where spar platforms are installed in various parts of the world. Their structural phenomena, the geometric shape and size, their approximation dimensions and their oil production capacity is well, so name these platforms and try to explain at least one platform in detail. At water depth similar to TLP, can you tell me also at what kind of water depth semi-submersibles are feasible to operate? Why a semi-submersible cannot operate in a different water depth other than recommended in the literature? Draw a free sketch of different platforms related to their installation of water depth. We have shown a very nice comprehensive picture for you were different kinds of offshore platforms are installed at the various water depths starting from shallow water to as deep as 2000 meters.

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A slide titled "Tutorial 4" with a list of six bullet points. The slide has a light blue background and a black border. In the bottom left corner, there is a small NPTEL logo. In the bottom right corner, there is a copyright notice: "© NPTEL- IIT Madras".

**Tutorial 4**

- What is an FPSO
- Draw a neat sketch of SWIFT 10 drilling unit and mark the parts
- What do you understand by off-loading?
- What do you understand by SWL?
- What are drill ships?
- List few offshore platforms meant for exploration drilling and explain their salient features

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After successfully answering tutorial number one, two, and three, let us put tutorial four for the benefit of readers back again. In tutorial four, I want to do explain what do you understand by the term FPSO? What do you understand by FSO, and can you typically sketch an FPSO to be very specific, I want you to draw a neat line diagram of one of the drilling platform by name SWIFT 10. This available in the open source of literature look at this platform SWIFT 10, identify the salient features of this platform and mark the vital components of this platform by drawing a neat sketch of a drilling unit called SWIFT 10. Now FPSO, what do you understand by off loading? Why off loading is a

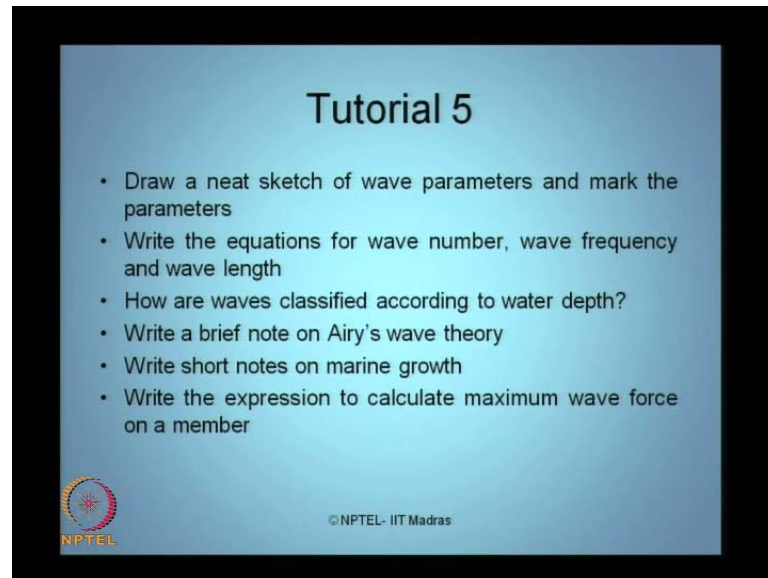
very important element of in FPSO, what are the merits if we have a platform which has an off loading system as well.

What do you understand by SWL? We discussed about this various levels of water depth depending upon the tidal variation and astronomical tides etcetera. Can you recollect these and let me know what do you understand by the term SWL? Have you heard of drill ships, what do you understand by a term drill ship? How a drill ship is different from a conventional passenger vessel or a ship, why it is called as a drill ship. When you talk about drill ships try to understand what you mean by moon pool facility in a drill ship. Also think about how drill ships are anchored in position by what we called dynamic positioning system, what we in brief call DPS.

Also list few offshore platforms meant for only exploration and not for production. Now try to understand the difference between platform that are meant for exploration and platform that are meant for production and storage. Can you list some of the exclusive platforms which are constructed in offshore facility for exploration drilling only? What do you understand by exploration drilling, what are the different terminology in offshore drilling we had a dedicated lecture on subside drilling separately. So, look into these lectures and try to list down few offshore platforms meant for exploration drilling.

So, ladies and gentlemen, tutorials one, two, three, and four will like to tell you a brief overview of different types of platforms, their functional aspects, the structural form and geometry, their structural action under the waves, wind and current etcetera, in terms of their applicability for various water depths as we discussed in the previous lectures.

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The image shows a slide titled "Tutorial 5" with a list of six tasks. The slide has a light blue background and a black border. In the bottom left corner, there is a circular logo with a sun-like pattern and the text "NPTEL" below it. In the bottom right corner, there is the text "© NPTEL- IIT Madras".

## Tutorial 5

- Draw a neat sketch of wave parameters and mark the parameters
- Write the equations for wave number, wave frequency and wave length
- How are waves classified according to water depth?
- Write a brief note on Airy's wave theory
- Write short notes on marine growth
- Write the expression to calculate maximum wave force on a member

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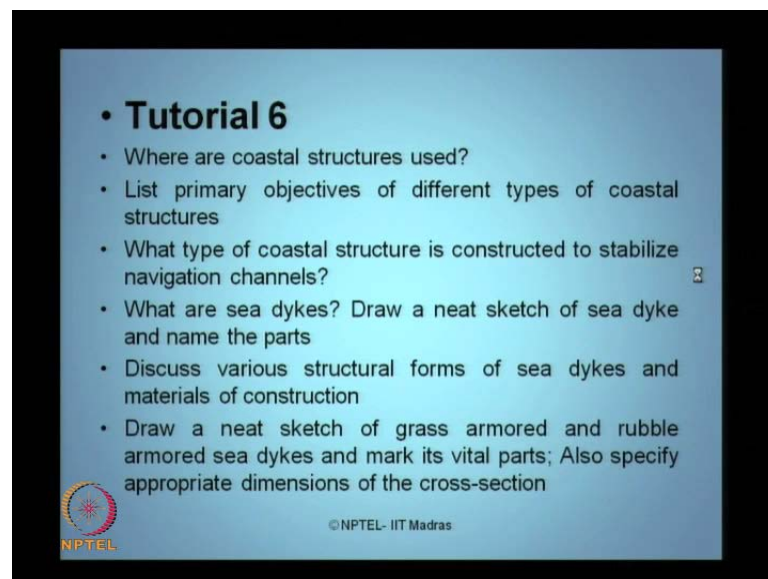
So, after understanding tutorial one, two, three, and four, let us come to fifth tutorial which will talk about neat sketch on wave parameters. Because we also discussed in one of the lecture module what are the different kinds of environmental loads that are acting on offshore structure. So, looking to that reference of two lectures on environmental loads one and two, I want you to answer the following questions as a part of the fifth tutorial of module one of the course ocean structures and materials. Draw a neat sketch of wave parameters and mark the parameters and explain them. Write the equations for wave number, wave frequency, and wave length. I am asking very simple questions for you to answer, so that I want you to test whether you can recollect all these terminologies easily from a lecture.

How are waves classified according to water depth, what are different kinds of wave theories available or the applicable for different kinds of water depths? Can you write a very brief note on linear wave theory or what we called Airy's wave theory? So, we explained in a lecture very detail, how to estimate the water particle kinematics that is water particle velocity and acceleration in horizontal and vertical directions using Airy's linear wave theory. I do not want you to write those expressions remember those expressions because the expressions are available in the literature. I want you to write a very brief note on what do you understand by Airy's wave theory, what are assumptions made by this theory, why this theory has a limitation in application, and what are their

advantages of this theory when you want to do for preliminary analyze in design in offshore structures.


Can you also talk about the significance of studies of marine growth in offshore structural engineering? What do you understand by a marine growth? How is it important? What is the significance of a marine growth in terms of design of members in offshore structures? Write down the expression to calculate the maximum wave force on a member. Remember ladies and gentle man wave forces have different phase values and different locations. So, we had an empirical expression approximately derive based upon a theta max and from that we derive f max on a member. So, I want you to write down that expression very clearly, and also to calculate the wave force for a given member. I also gave a tutorial earlier down in the line, in the lecture; I hope you have solved all those six problems which I asked you to solve in the previous tutorial.

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**• Tutorial 6**

- Where are coastal structures used?
- List primary objectives of different types of coastal structures
- What type of coastal structure is constructed to stabilize navigation channels?
- What are sea dykes? Draw a neat sketch of sea dyke and name the parts
- Discuss various structural forms of sea dykes and materials of construction
- Draw a neat sketch of grass armored and rubble armored sea dykes and mark its vital parts; Also specify appropriate dimensions of the cross-section

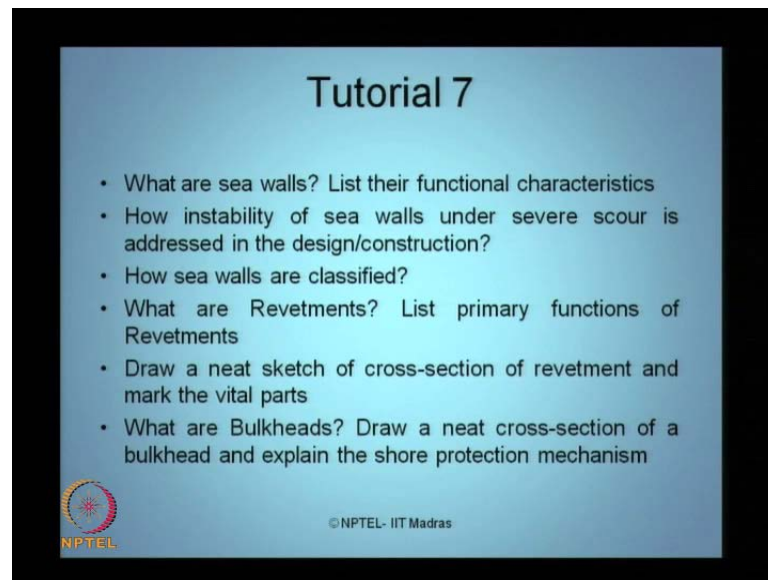
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After sincerely attending tutorial one to five, let us move to tutorial number six. Tutorial number six is dedicated to different kinds of coastal structures. In general, where are coastal structures deployed? List the primary objectives of different types of coastal structures that have been deployed in various parts of the world. What type of coastal structure is constructed to stabilize navigation channels in particular? Can you understand what is meant by sea dykes? Draw a neat sketch of a sea dyke and name the vital components of a sea dyke. Discuss various structural forms of a sea dyke and the



materials use for construction of a sea dyke. Also draw a neat sketch of grass armored and rubble armored sea dykes and mark it vital parts; specify appropriate dimensions of the cross section of a sea dyke.

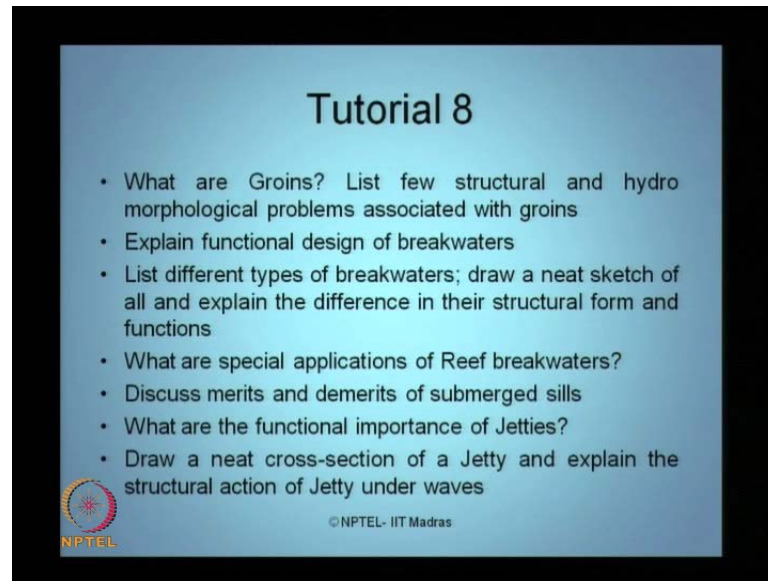
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Let us talk about tutorial number seven. Tutorial number seven will be focusing on again structures related to coastal protection. Can you tell me, what are sea walls? What do you understand by sea walls? List their functional characteristics. How instability of sea walls under severe scour is addressed in the design and construction? Ladies and gentlemen, discuss back again the construction aspects of a sea wall, we talked about reinforcing the toa wall in a sea wall inverse slope and we also said why toa wall should be protected, and why is covering should not be there on the sea wall layers. How sea walls are actually classified? Are they classified based upon the depth of construction, are they classified based upon the material, are they classified based upon the type and shape of geometry, please let me know how are you classifying sea walls from the literature.

Can you tell me, what you understand by revetments or revetment similar to soil retaining structures? List primary functions of a revetment, which is being used one of the protection for coastal structures. Draw a neat sketch of cross-section of a revetment and mark the vital parts of the revetment. What are bulkheads in your understanding? Draw a neat cross-section of a bulkhead and explain the shore protection mechanism that is offered by a bulkhead.

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A slide titled "Tutorial 8" with a light blue background and a black border. The title is centered at the top. Below it is a bulleted list of seven items. In the bottom left corner is the NPTEL logo, and in the bottom right corner is the text "© NPTEL- IIT Madras".

**Tutorial 8**

- What are Groins? List few structural and hydro morphological problems associated with groins
- Explain functional design of breakwaters
- List different types of breakwaters; draw a neat sketch of all and explain the difference in their structural form and functions
- What are special applications of Reef breakwaters?
- Discuss merits and demerits of submerged sills
- What are the functional importance of Jetties?
- Draw a neat cross-section of a Jetty and explain the structural action of Jetty under waves

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Ladies and gentlemen, this is the last tutorial sheet; we have for module number one. What are groins? Have you heard of this name groins? List few structural and hydro morphological problems associated with groins. Groins are actually coastal protection structures which are constructed perpendicular to the shore line there can be many shapes of drawings as well. So, what are groins, how are they constructed, what are the material being used, what are the appropriate dimensions of a groin, what is structural form being recommended in the literature for groins.

Can you explain the functional design of a breakwater? The moment we hear the term breakwater, we discussed many types of breaking water starting from bottom fixed type, floating type, brief breakwaters etcetera. So, can you tell me how functional designs of breakwaters are done in the literature? Can you list different types of breakwaters, if so can you draw a neat sketch of all of them and explain the difference in their structural form and their actions? What are special applications of reef breakwaters? If a breakwater is submerge, what are those hazardous things which will happen to a swimmer and boats.

Discuss merits and demerits of submerged sills. What are submerged sills? What are the functional importance of a jetty? What do you understand by one of the coastal protection structure which you call as jetties? What are the different shapes of jetties, how are they constructed, what is geometric form, what is the structural function of a

jetty, what is the functional importance of construction of jetty. Can you draw a neat cross-section of a jetty and explain the structural action of jetty under waves, wind, and current.

Ladies and gentlemen, this module covering with twelve lectures will be able to complete the brief introduction on different kinds of ocean and coastal structures that are deployed in various parts of the world. I am sure that you will attempt all these tutorials sincerely. Whatever doubts in questions you have, you want you can easily communicate to me in an email at [drsekaran@iitm.ac.in](mailto:drsekaran@iitm.ac.in).

Thank you very much. We look forward for you to sent module two.