**Laboratory work 6-7: *Submarine Design: Unique Tanks On a Submarine***

**Task 1. Соотнесите английские слова и выражения и их перевод на русский язык:**

|  |  |
| --- | --- |
| 1) surface ship | 1. чертеж общего монтажа
 |
| 2) negative tank | 1. дизель-электрическая подводная лодка
 |
| 3) compensating tank | 1. подводная лодка с двойным корпусом
 |
| 4) free-flooding area | 1. план вместимости (емкости) цистерн
 |
| 5) a trimming moment | 1. дифферентная (уравновешивающая) цистерна
 |
| 6) fuel tank | 1. торпедоуправляющая цистерна
 |
| 7) the general arrangement drawing | 1. надводный корабль
 |
| 8) ballast tank vent | 1. корпус, устойчивый к давлению
 |
| 9) double hull submarine | 1. подъёмная цистерна
 |
| 10) the tank capacity plan | 1. заместительная цистерна
 |
| 11) torpedo operating tank | 1. [цистерна быстрого погружения](https://www.translate.ru/dictionary/ru-en/%D1%86%D0%B8%D1%81%D1%82%D0%B5%D1%80%D0%BD%D0%B0%20%D0%B1%D1%8B%D1%81%D1%82%D1%80%D0%BE%D0%B3%D0%BE%20%D0%BF%D0%BE%D0%B3%D1%80%D1%83%D0%B6%D0%B5%D0%BD%D0%B8%D1%8F)
 |
| 12) flood slit for ballast tank | 1. вентиляция балластной цистерны
 |
| 13) trim tank | 1. заливная щель для балластной цистерны
 |
| 14) diesel electric submarine | 1. топливная цистерна
 |
| 15) the pressure resistant hull | 1. дифферентующий момент
 |
| 16) hover tank | 1. зона свободного затопления
 |

**Task 2. Переведите следующие словосочетания на русский язык:**

1. in close vicinity to
2. the high external pressure
3. fuel oil consumption
4. due to consumption of stores
5. positively or negatively buoyant
6. free surface effects
7. the total pressure hull volume
8. the course keeping ability of the submarine
9. auxiliary means
10. space allocation
11. process of firing a torpedo
12. to adjust the weight
13. the situation to be tackled
14. to be a feasible option
15. to release water

**Task 3. Дополните предложения:**

1 Nuclear submarine is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Conning tower is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Propulsion machinery control room is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Sail plane is needed to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Diving plane is required to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Propeller is aimed to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. Reactor is aided to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. Steam generator is wanted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. Emergency electric motor is needed to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. Electricity production room houses \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. Engine room houses \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Task 4. Переведите текст с английского языка на русский, обращая внимание на выделенные слова и конструкции:**

**Though** some of the tanks *used in a submarine* are similar to that *used on surface ships*, most of them are different and unique to the nature of operation of a submarine, which makes it an important aspect to be studied in detail.

**For a quick glimpse**, did you know why a submarine uses a system of four tanks just in the process of firing one torpedo? We will first look into the tank plan of a diesel electric submarine and when we familiarize ourselves with their terminologies, we will study their functions, the reason behind their location, and other design aspects *related to them*.

**Tank Plan of a Submarine: Along with** the general arrangement drawing, the tank plan is prepared to locate the position of each tank. Their names, **along with** the fluid to be carried in them, is specified in the tank plan itself. The capacity of each tank is listed on a separate document *called the tank capacity plan*.



**Figure 1: Tank Plan of a Diesel Electric Submarine.**

**Compensating Tank:**

How when a submarine is positively or negatively buoyant, it takes actions to maintain a condition of neutral buoyancy by adjusting its weight? This is achieved with the help of a compensating tank, a component uncommon to the traditional concepts of ship design.

Compensating tanks are located at or in close vicinity to the longitudinal center of gravity of the submarine (refer Figure 1). The compensating tank can be emptied by a pump or high pressure air (in case of low noise operation), but for high pressure air to be a feasible option, the tank structure must be pressure resistant to the extent that it can withstand an internal pressure higher than the external pressure.

A submarine designer considers two special border loading conditions to estimate the capacity of the compensating tank for a particular design. The loading conditions are listed below:

***Load-Case 1:*** At the end of a very long, slow cruise in sea water with maximum density. At the end of a very long and slow cruise, all the consumables like fresh water, stores, food are used up, but relatively sufficient amount of diesel oil is left. The vessel is sailing in sea water of maximum density, which means buoyancy is higher. Both the conditions together require the compensating tank to be filled to its maximum capacity.

***Load-Case 2:***At the end of a very short, fast cruise in sea water with minimum density. **In this condition,** the consumables have been partially used up, and the diesel fuel is completely consumed. **Since** the sea water density is minimum, the buoyancy is least. **In such a case,** the water required in the compensation tank would be minimum.

**In actual case,** when a submarine begins its cruise, the volume of water in the compensating tank is somewhere between those *corresponding to the two border cases*. It has to be observed by parametric studies, that compensating tanks usually have volume of 2.5 to 3 percent of total pressure resisting volume of the submarine. This data is also used by designers in the preliminary design stages.

**Trim Tanks:**

Trim tanks are used to maintain the longitudinal center of gravity just under the center of buoyancy, **so that** the submarine can be maneuvered to a neutral trim condition. These tanks are equal in size, and are located inside the pressure hull and as far forward and aft as possible so that the trimming moment *caused by them* is maximized (note the trim tanks in Figure 1). The trim tank system consists of two pairs of tanks, one pair at forward (port and starboard), the other at the aft (port and starboard).

**Task 5. Закончите предложения, используя инфинитив цели:**

1. Ballast tanks are used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Compensating tanks are needed to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Trim tanks are required to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Fuel tanks are wanted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Negative tanks are necessary to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Torpedo operating tanks are essential to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Task 6. Вставьте пропущенные предлоги и соединительные слова по смыслу:**

*Prepositions to be used*: against, to, from, into, over, by, for, around, of

*Connecting words to be used*: in addition to, therefore, since, in order to, in order for, except, when

The basic construction \_\_\_ a submarine consists of the pressure hull, the tanks, which are built \_\_\_\_\_\_\_\_\_\_\_\_\_ the pressure hull, and the superstructure. The pressure hull, which includes the conning tower, is the principal part. This hull must be watertight and airtight and able to resist the water pressure \_\_\_\_\_\_\_\_\_ submerged. The hull is circular \_\_\_\_\_\_\_ maximum strength and is reinforced \_\_\_\_\_\_ steel frames \_\_\_\_\_\_\_\_\_\_ its entire length.

Fitted \_\_\_\_\_\_\_\_\_\_\_ the pressure hull are the tanks. There are ballast tanks, which control the buoyancy \_\_\_\_\_\_ the boat, and fuel tanks.

The main ballast tanks are completely flooded, when the boat is submerged. Some of these main ballast tanks are divided \_\_\_\_\_\_\_ port and starboard tanks.

This is a cross section. The tanks have flood ports open to the sea. The main vent valves control the escape of air when flooding the tanks.

These are emergency vent valves. They are used in case \_\_\_\_\_ damage to the main vents or to prevent accidental flooding.

\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_ the submarine to submerge both sets of vents must be open to flood the tanks. \_\_\_\_\_\_\_\_\_\_\_ the tanks are open to the sea when submerged, the pressure is the same on both sides. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the outer skin of these and similar tanks is not made as strong as the pressure hull.

\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_ surface air under pressure is admitted to blow the water \_\_\_\_\_\_\_\_\_ the tanks. High-pressure air at first followed \_\_\_\_\_\_\_\_\_ low pressure air.

These two main ballast tanks operate in the same way \_\_\_\_\_\_\_\_\_\_\_\_\_ that they are not divided and have no emergency vents.

\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_ the main ballast tanks, there is a group of variable ballast tanks. These are used to control the trim and buoyancy of the submarine. They are the forward trim tank, the after trim tank, two auxiliary tanks and the forward and after water-round-torpedo tanks.

These variable ballast tanks are only partly filled and the sea water can be pumped \_\_\_\_\_\_\_ one tank \_\_\_\_\_ another or to sea.

The construction of the modern submarine employs the latest developments in science and engineering to make it a formidable weapon \_\_\_\_\_\_\_\_\_\_\_\_ the enemy men.

**Слова для запоминания:**

negative tank,

compensating tank,

fuel tank,

ballast tank,

torpedo operating tank,

trim tank,

hover tank,

conning tower,

sail plane,

diving plane,

upper rudder,

nuclear boiler room,

electricity production room,

emergency electric motor,

turbo-alternator,

airlock,

steam generator

a trimming moment,

the longitudinal center of gravity,

positive buoyancy,

negative buoyancy,

neutral buoyancy,

a neutral trim condition

**Соединительные слова и выражения**

|  |  |
| --- | --- |
| **Категория** | **Слова и выражения** |
| [Причина и](https://www.englishdom.com/blog/slova-svyazki-v-anglijskom-yazyke/#10) следствие | **because (of)** - потому что; так как; затем что; ибо; ввиду того, что; **so** - же; насколько; чтобы, таким способом, указанным образом, с тем чтобы; так; **accordingly** - соответственно; таким образом; следовательно; поэтому; в соответствии; **thus** - следственно, таким образом, в силу этого, так что, благодаря этому; **consequently** - следовательно; в результате; поэтому; вследствие этого; **hence** - следовательно; в результате; отсюда; **therefore** - по этой причине; вследствие этого; следовательно; потому; **as** – так как, ; оттого что; в связи с тем что; в силу того, что; **due to (the fact that)** – в связи с, согласно (тому что), по причине, исходя из, из-за, вследствие; **owing to** – по; из-за; вследствие; по причине; благодаря; **since** – по той причине что, учитывая, что. |
| [Сравнение](https://www.englishdom.com/blog/slova-svyazki-v-anglijskom-yazyke/#30) | **similarly** - подобным образом; так же; аналогично; подобно; сходно; точно так же; **likewise** - также; более того; тоже; так же, таким же образом; **whereas** - исходя из того, что; с учётом того, что; в связи с тем, что; **on the other hand** - зато; с другой стороны; но с другой стороны; впрочем; однако; **except** - за вычетом / исключением; кроме как; не говоря о; помимо; **by comparison** - для сравнения, в то время как; сравнительно; **when compared to** - по сравнению с; **equally** - в равной степени; одинаково; равно; наравне; **in the same way** - точно таким же образом; подобным образом; |
| [Контраст](https://www.englishdom.com/blog/slova-svyazki-v-anglijskom-yazyke/#30), противопоставление | **however** - однако; **yet** - при этом, с другой стороны, впрочем, в то же время; **still** - при этом; **on the other hand** - хотя, с другой стороны, что же касается; **otherwise** - без этого, в противном / ином случае; **on the contrary** - как раз наоборот, совсем наоборот, на самом деле, напротив; **in contrast** - в отличие от этого; для сравнения; напротив; **unlike** - в отличие; **instead of** - взамен; чем (вместо чего-л.); вместо; **alternatively** - или же; вперемежку; поочерёдно; иначе; наоборот; **but** – но, ведь; всего; исключая;  |
| Уступка | **though** – хотя, **even though** - но хотя; несмотря на то,что; и хотя; даром что; **after all** - ведь, как-никак, не стоит забывать что, к тому же, напоследок; **although, even** – даже если |
| [Дополнение](https://www.englishdom.com/blog/slova-svyazki-v-anglijskom-yazyke/#50) | **and** - и, причем, а не, при этом, а также, тогда как; **also** - тоже; притом; при этом, а еще, также, в том числе, кроме того; **even** - вровень; даже; точно; хоть; на одном уровне; ровно; **again** - снова, опять же, вновь; ещё раз; к тому же; кроме того; вдвое; **further** - к тому же, также, еще; к тому же; **similarly** - подобным образом; так же; аналогично; подобно; сходно; точно так же; **as well as** - а также; а также и; так же как; также; заодно и; **apart from** – кроме. исключая; наряду; не говоря о; независимо; оставляя в стороне; **besides** – кроме того; помимо того; также; вдобавок к тому; кроме; помимо; кстати; **in addition** – к тому же; **moreover** – кроме того; более того; сверх того; к тому; мало того; **too** – очень; крайне; также; тоже; к тому же. |
| [Последовательность](https://www.englishdom.com/blog/slova-svyazki-v-anglijskom-yazyke/#70) | **first** - в первую очередь, во-первых, первоначально; **second** - во вторую очередь, во-вторых, в следующих, далее; **third** - в-третьих, в третью очередь, третье; **next** - далее, следующим шагом, потом; затем; после; **then** - затем, позже; после чего, то время; в дальнейшем; **when** - затем, когда, позже; **following** - исходя из этого, в результате, вследствие; **now** - теперь, нынче, вот, итак, в настоящее время; **at this point** - на данный момент, на этой стадии; на этом месте, пока что; **after** - после; **eventually** - в конечном счёте; в итоге; со временем; однажды; **finally** - наконец, в конце; в заключение; под конец; в конце концов; в конечном счёте; **lastly** - на последнем месте, в конце; в заключение; под конец, наконец; **previously** - предварительно; заранее; ранее; прежде; раньше; уже. |