****

**Department of Environmental Sciences**

**College of Sciences**

**University of Salahaddin**

**Subject: Limnology Theory**

**Course Book – (2nd Year) 1st Course**

**Lecturer's name Professor Janan Jabbar Toma**

**Academic Year: 2023/2024**

**Course Book**

|  |  |  |
| --- | --- | --- |
| **1. Course name** | **Limnology** | |
| **2. Lecturer in charge** | **Janan Jabbar Toma** | |
| **3. Department/ College** | **Environmental Sciences - Sciences** | |
| **4. Contact** | **e-mail: janan.toma@su.edu.krd**  **Tel: (optional) 009647504529857** | |
| **5. Time (in hours) per week** | **For example Theory: 2 Supervision**  **Practical: 2** | |
| **6. Office hours** | **Every day before and after the lecture except off day** | |
| **7. Course code** |  | |
| **8. Teacher's academic profile** | \* Graduated at the Department of Community of the Health, Erbil Technical Institute/ Medical Institute (1992-1993).  \* Graduated at the Department of Biology, Salahaddin University/ College of Science (1996-1997).  \* M.Sc. in Fresh Water ecology and Phycology at the Salahaddin University, (2001). Thesis title “**Limnological study of Dokan Lake, Sulaimaniyah –Kurdistan Region Of Iraq**”.  I have 37 articles (36 published and the one accepted for publishing) which include:  **1-Limnological study of Dokan lake, Kurdistan Region of Iraq.1-Thermal stratification and oxygen distribution relation.**  **2-Check List of Algae in Iraq-2004.**  **3-Daily variations in chemical stratification and algal population throughout vertical profiles of Dokan lake. Kurdistan region, Iraq. I-Chemical stratification trends.**  **4-Daily variations in chemical stratification and algal population throughout vertical profiles of Dokan lake. Kurdistan region, Iraq. II. Algal population responses to chemical stratification.**  **5-Weekly and spatial variation of Physico-Chemicals variables and Algal composition in Kasnazan Impoundment, Erbil, Iraq .**  **6-Study Efficiency of both drinking water purification projects (Ifraz and Ankawa) in Erbil, Iraq.**  **7-Study some Physico-chemical and bacteriological properties in Shaqlawa groundwater, Erbil. Iraq.**  **8-An ecological and bacteriological study in Ankawa ground water, Erbil. Iraq**  **9-Trace Metal Composition in Ankawa Groundwater Erbil. Kurdistan of Iraq.**  **10-A study on Water Quality in Makhmur area, Kurdistan, Iraq.**  **11-Environmental and Biological Study of Arab-Kand waste water Channel in Erbil Governorate Region-Iraq.**  **12-An Ecological Study on Water to Some Thermal Springs in Koya-Erbil Province, Iraq.**  **13-Determinants Of The Microbiological Characteristics Of Erbil City Public Swimming Pools.**  **14-Trace Metal Composition in Shaqlawa Groundwater Erbil. Kurdistan of Iraq.**  **15-Water Quality of Various Trading markets of Potable Bottled Water in Erbil City, Iraq.**  **16-Physical and Chemical Properties and Algal Composition of Derbendikhan Lake, Sulaimaniyah .Iraq.**  **17-Determination of the trace metals in Bottled Water That Available in Erbil City, Iraq.**  **18-Limnological study in Dokan Lake, Kurdistan region of Iraq.**  **19-A Contribution to Algae Flora in Baghdad area, Iraq.**  **20-Assessment of Water Quality Index for Duhok Lake, Kurdistan region, Iraq.**  **21- Evaluating Raw and treated water quality of Greater Zab River within Erbil city by index analysis.**  **22-Effect of Storage Condition on Some Bottled Water Quality in Erbil City, Kurdistan Region-Iraq”.**  **23-Limnological study of Dokan, Derbendikhan and Duhok lakes, Kurdistan Region of Iraq**  **24- Quality Assessment of Some Bottled Water That Available in Erbil City, Iraq by Using Water Quality Index for Drinking Purposes.**  **25-Cyanophyta Recorded in Erbil,Kurdistan Region of Iraq.**  **26- Water Quality Assessment of Some Well Water in Erbil City by Quality index, Kurdistan Region-Iraq.**  **27-Application of Water Quality Index for Assessment Water Quality in Some Bottled Water Erbil City, Kurdistan Region, Iraq.**  **28-Check List of Algae in Iraq.**  **29- A study on a sulphur spring (Ain Al Kibrit) ecosystem along Tigris River Mosul, Iraq.**  **30- Efficiency of water treatment in some bottled water companies in Erbil city, Kurdistan region of Iraq.**  **31- Algal Survey in Wastewater Channel of Erbil City, Iraq.**  **32-Study algae and fungi interaction in some artificial open sand mine ponds in Kalak sub district- Duhok, Iraq.**  **33-Application the Idris equation to assess the nutrient status of Dokan and Duhok lakes in northern of Iraq.**  **34- Assessment of Water Quality and Trophic Status of Duhok Lake Dam.**  **35- Study of the efficiency of some water treatment unit that present in houses in Erbil city-Iraq.** 36-Study of the efficiency of some water treatment unit that present in houses in Erbil city-Iraq. | |
| **9. Keywords** | **Limnology, Lake, River, Wetland, Inland water** | |
| **10. Course overview:**  **The course will cover principle information about Limnology, and understanding of aquatic life requires knowledge not only of the organisms themselves but also of those external influences which directly or indirectly affect them. A suitable environment is necessary for any organism, since life depends upon the continuance of a proper exchange of essential substances and energies between the organism and its surroundings. And the study of the chemistry, biology, geology and physics of waters that are found within continents. In contrast, oceanography is the study of open waters. The course will give students a better understanding of the Environment that surrounded us.** | | |
| **11. Course objective:**  **The course will cover principle information about Limnology, and that deals all of inland water and some physical, chemical, biological and geological factors that effect in. The course will give students a better understanding of the different type of inland water, and teaching the student how protect the freshwater from of pollution** | | |
| **12. Student's obligation**  **When I ask the student for preparing in class, and in the exam, preparing and writing a report and discusses in class, this stimulate the students to become more active and able to learn more things about environment science.** | | |
| **13. Forms of teaching**  **Different forms of teaching will be used to reach the objectives of the course: power point presentations for the head titles and definitions and summary of conclusions, classification of Environmental health and any other illustrations, besides worksheet will be designed to let the chance for practicing on several aspects of the course in the classroom, furthermore students will be asked to prepare research papers on selective topics and summarise articles contents published in English into either Kurdish or Arabic language, those articles need to be from printed media or internet articles. There will be classroom discussions and the lecture will give enough background to translate, solve, analyse, and evaluate problems sets, and different issues discussed throughout the course.**  **To get the best of the course, it is suggested that you attend classes as much as possible, read the required lectures, teacher’s notes regularly as all of them are foundations for the course. Lecture’s notes are for supporting and not for submitting the reading material including the handouts.try as much as possible to participate in classroom discussions, preparing the assignments given n the course.** | | |
| **14. Assessment scheme**  **Your final grade will be derived as follows:**  **Quizzes: About 10 quizzes will be given throughout the semester. They will be given at the beginning of the class period and last 10 minutes.10% of your grade.**  **Exams: There will be three closed book exams given throughout the semester. Each test will be scheduled for 90 minutes.30% of your grade.**  **Final Exam: The Final Exam is Comprehensive in all course outlines.60% of your grade‌**  **Mean of two examinations: 30% Practical Examination 15%**  **Final examination: 60%**  **Final Exam: The Final Exam is Comprehensive in all course outlines.60% of your grade‌**  **Mean of two examinations: 30% Practical Examination 15%**  **Final examination: 60%** | | |
| **15. Student learning outcome**  **Limnology is one of the most important lecture in Environmental Sciences Department because the student in this course learn the student many things about Limnology that around us and can the student to water management , how water pollution control , guideline of safe and health water and increase the number of people who not full-time water can understand and apply its general concepts to a broad range of related disciplines all these things can students apply in our daily life for services the community** | | |
| **16. Course Reading List and References‌:**  **Required book:**  **1- A citizen's guide to understanding and monitoring lakes and streams. Michaud, J.P. 1991. Washington State Department of Ecology, Publications Office, Olympia, WA, USA 360-407-7472.**  **2- The Lakes Handbook volume 1 Limnology and Limnetic ecology.** **edited by P.E. O’Sullivan AND C.S. Reynolds.** **2004 by Blackwell Science Ltd a Blackwell Publishing company**  **3- LAKES AND RIVERS. Trevor Day. Copyright © 2006 by Trevor Day.**  **4- RIVERS OF THE WORLD.** **James R. Penn. 2001. Library of Congress Cataloging-in-Publication Data.**  **5- Stream Ecology Structure and function of running waters second Edition. J. David Allan & MarII M.Castillo. 2007 Springer.**  **6- Understanding Wetlands Fen, bog and marsh. S. M. Haslam . First published 2003 by Taylor & Francis.**  **7- WATER RESOURCES SYSTEMS ANALYSIS. Mohammad Karamouz Ferenc Szidarovszky Banafsheh Zahraie.** **© 2003 by CRC Press LLC Lewis Publishers is an imprint of CRC Press LLC.**  **8- WATER AT THE SURFACE OF THE EARTH. DAVID H. MILLER. COPYRIGHT 1 977, BY ACADEMPICR ESSI, NC.**  **9-HYDROSPHERE Freshwater Systems and Pollution. DANA DESONIE. 2008. An imprint of Info-base Publishing.**  **The core materials of the course consists of the above book, articles from media and internet, and lecture’s notes, make sure you read all the materials and prepare well before going for the examinations.**  **Students are encouraged to search for any other materials that may help improve their English language ability in reading, writing, listening and speaking plant communities' texts.** | | |
| **17. The Topics:** | | **Lecturer's name** |
| **Week 1:**  **Water:-**   * 1. **The Water Cycle**   **1.2. Where the Water Is**  **1.3. Water’s unique properties**  **PHYSICAL FEATURES OF WATER**  **1.4.PRESSURE**  **1.5. DENSITY**  **Week 2:**  **CHEMICAL CONDITIONS AND RELATED PHENOMENA**  **3.1. MOVEMENTS OF WATER**  **3.2. DISSOLVED GASES**  **3.3. Acidity, Alkalinity, and Neutrality of Water**  **3.3. Inorganic Nitrogen Compounds**  **3.4. Phosphorus**  **Week 3:**  **Introduction to Limnology**  **4.1. Definition of Limnology**  **4.2. Important of Limnology**  **4.3. Watershed**  **Week 4:**  **Watershed**  **Week 5& 6**  **Lakes**  **5.1. Structure of Lakes**  **5.2. Origin of lakes**  **6.1. Types of lakes**  **Week 7&8**  **Classification of lakes**  **7.1. Classification by Origins of Lakes**  **7.2. Classification by Nutrient Status**  **8.1. Temperature, Density, Stratification, and Mixing**  **Week 9:**  **General Lake Chemistry**  **9.1. Dissolved Oxygen**  **9.2. Nutrient**  **9.3. Primary production**  **9.4. Algal succession**  **9.3. Salt Lakes**  **9.5. Important Lakes in the worlds**  **Week 10:**  **Ponds**  **10.1. Pond characteristics**  **10.2. Food Chain in a Pond Ecosystem**  **Pond Characteristics**  **10.3. TEMPERATURE**  **10.4. LIGHT**  **10.5. CHEMICAL CONDITIONS**  **Week 11:**  **Rivers**  **11.1. Important of River**  **11.1. The Parts of a River**  **11.2. How Rivers Sculpt the Land**  **Week 12 & 13:**  **River Zonation**  **12.1. SOME BASIC CHARACTERISTICS OF RIVERS**  **12.2. CLASSIFYING RIVERS**  **Week 14:**  **Groundwater**  **14.1. Important of groundwater**  **14.2. Movement of Groundwater**  **14.3. Springs and Wells**  **Week 15:**  **Wetlands**  **13.1. Inland wetlands**  **13.2. Coastal wetlands**  **13.3. Economic Benefits of Wetlands**  **Week 15 & 16:**  **Swamps**  **15.1. Forested Swamps**  **15.1. Mangrove Swamps**  **Marshes**  **16.1. Types of Marshes**  **Week 17:**  **17. Pools** | | **Janan Jabbar Toma**  **ex:(2 hrs)** |
| **18. Practical Topics (If there is any)** | |  |
|  | |  |
| **19. Examinations:**  **I Put Type of Examination (A and B with typical answer )**  **Examination**  **(A)**  **Q1) Fill the following blanks with suitable answers:- (10 Marks)**  **1-Groundwater derived from rainfall and infiltration within the normal hydrological cycle. This kind of water is called ----------------------.**  **2-Areas where groundwater reaches the surface (lakes, streams, swamps, & springs) are called ------------------------.**  **3-The Creon is the uppermost zone at the source of the river. It is further divided into the**  **-----------------------------and the ---------------------------------.**  **4-One of the most important processes of erosion is the removal and transport of -------------------------------- produced by weathering.**  **5-Rivers are ideal examples of natural systems. The energy that drives the flow of water ultimately comes from the ----------------- and from ---------------------.**  **Q2) Give an example for the following:- (Choose only Five) (10 Marks)**  **1-River that discharges more sediment into the sea than any other river**  **2- The world’s fifth-longest river 3- Lake sometimes does a vanishing act**  **4- Largest lake in the world 5- Aquifuge Rocks 6-Biotic Lake**  **Q3) Write about the following:- (25 Marks)**  **1- Water is essential to life**  **2- Boiling of egg takes longer time at higher altitudes**  **3- Silica concentrations can limit diatom production if concentrations become depleted in surface waters.**  **4- Founder of limnology 5-Life History Strategies**  **6-Ecological succession 7-Mixolimnion**  **8-Mesotrophic lake 9-aestival ponds 10-connate waters**  **Q4) Choose the correct answers from the following :- (20 Marks)**  **1- The highest lake in the world ------------------, at about 16,000 ft (about 5,000 m) above sea level. (Caspian, Nan Tso, Asal, Aral)**  **2- Typical ponds differ from lakes in the absence of most truly --------------------- animals and plants. ( Limnetic, Littoral, Photic, A photic)**  **3- Running water is the major cause of erosion, not only because it can --------------- and erodes its channel. ( rolling, sliding, abrade, peddling)**  **4- A water molecule, however, is shaped more like a ------------------- or a banana. It is bent in the middle. ( boomerang, cleave range, mid range, opposite range)**  **5---------------------- currents seldom occur in inland lakes but may be present in large waters such as the Great Lakes.(returning, true vertical, horizontal, vertical)**  **6- Alkalinity is a related concept that is commonly used to indicate a system’s capacity to buffer against ---------------** impacts. ( alkaline, salt, neutral, acid)  **7- Limnology is the study of the chemistry, biology, geology and physics of waters that are found within --------------------. ( arid, land, continents, contanents)**  **8- ---------------- is frozen rain drops while falling through air at subfreezing. (hail, glaze, frost, sleet)**  **9- --------------- water can be defined as water with less than 500 parts per million (ppm) of dissolved solids. ( saline, brackish, fresh, brine)**  **10- ----------------------- they are organisms feeding on the remains of dead organisms and on the waste products of metabolism, progressively degrading it to less complex chemical structures. (** **decomposers, detritivores, nectrophs, consumer)**  **Q5)Draw and label the following :- (Choose only five) (15 Marks)**  **1-oxbow lake 2- Alluvial rivers**  **3-The depth to the water table during wet and dry seasons 4-Lakes zonation**  **5-Winter stratification in Eutrophic lake 6- Solid status of water**  **Typical answer (A)**  **Q1) Fill the following blanks with suitable answers:- (10 Marks)**  **1-Groundwater derived from rainfall and infiltration within the normal hydrological cycle. This kind of water is called meteoric water.**  **2-Areas where groundwater reaches the surface (lakes, streams, swamps, & springs) are called discharge areas.**  **3-The crenon is the uppermost zone at the source of the river. It is further divided into the eucrenon (spring or boil zone) and the hypocrenon (brook or headstream zone).**  **4-One of the most important processes of erosion is the removal and transport of rock debris (regolith) produced by weathering.**  **5-Rivers are ideal examples of natural systems. The energy that drives the flow of water ultimately comes from the Sun and from gravity.**  **Q2) Give an example for the following:- (Choose only Five) (10 Marks)**  **1-River that discharges more sediment into the sea than any other river (Ganges River)**  **2-** **The world’s fifth-longest river (Congo (Zaire) River)**  **3- Lake sometimes does a vanishing act (Lake Eyre)**  **4- Largest lake in the world (Caspian Sea or Lake)**  **5- Aquifuge Rocks (basalt, granite )**  **6-Biotic Lake (Lake Okeechobee in Florida)**  **Q3) Write about the following:- (25 Marks)**  **1-** **Water is essential to life**  **Sol)Because** **It is part of the physiological process of nutrition and waste removal from cells of all living things .**  **2-** **Boiling of egg takes longer time at higher altitudes**  **Sol)** **At higher elevations (lower atmospheric pressure) water’s boiling temperature decreases. This is why it takes longer to boil and egg at higher altitudes. The temperature does not get high enough to cook the egg properly.**  **3-** **Silica concentrations can limit diatom production if concentrations become depleted in surface waters.**  **Sol)** **Silica or silicon dioxide (SiO2) is a key micronutrient in diatom production, a very common algal group, and is taken up during the early growing season.**  **4-** **Founder of limnology**  **Sol)** **It has been contended that F. Simony should be regarded as the founder of limnology because he was said to be the first to discover (about 1850) thermal stratification.**  **5-Life History Strategies**  **Sol)** **In ecology refers to the selective processes involved in achieving fitness by certain organisms. Such processes involve, among other things, fecundity and survivorship; physiological adaptations; modes of reproduction**  **6-Ecological succession**  **Sol) The classical ecological definition of plant succession involves a predictable set of vegetative changes through a series of discrete stages (seres).**  **7-Mixolimnion**  **Sol) The more superficial layers of lake, where mixing is possible, constitute the mixolimnion.**  **8-Mesotrophic lake**  **Sol) lie between the oligotrophic and eutrophic stages. Devoid of oxygen in late summer, their hypolimnion limit cold water fish and cause phosphorus cycling from sediments.**  **9-aestival ponds**  **Sol) those which contain some water throughout the open season but freeze to the bottom in winter have been called aestival ponds).**  **10-connate waters**  **Sol)** **Groundwater encountered at great depths in sedimentary rocks as a result of water having been trapped in marine sediments at the time of their deposition. This type of groundwater is referred to as connate waters.**  **Q4) Choose the correct answers from the following :- (20 Marks)**  **1-** **The highest lake in the world Nan Tso, at about 16,000 ft (about 5,000 m) above sea level .(Caspian, Nan Tso,** **Asal, Aral)**  **2- Typical ponds differ from lakes in the absence of most truly limnetic animals and plants.( Limnetic, Littoral, Photic, A photic)**  **3-** **Running water is the major cause of erosion, not only because it can abrade and erode its channel.( rolling, sliding, abrade, peddling)**  **4-** **A water molecule, however, is shaped more like a boomerang or a banana.** **It is bent in the middle. ( boomerang, cleave range, mid range, opposite range)**  **5-True vertical currents seldom occur in inland lakes but may be present in large waters such as the Great Lakes.(returning, true vertical, horizontal, vertical)**  **6- Alkalinity is a related concept that is commonly used to indicate a system’s capacity to buffer against acid impacts. ( alkaline, salt, neutral, acid)**  **7- Limnology is the study of the chemistry, biology, geology and physics of waters that are found within continents. ( arid, land, continents, contanents)**  **8- Sleet is frozen rain drops while falling through air at subfreezing.**  **(hail, glaze, frost, sleet)**  **9- Fresh water can be defined as water with less than 500 parts per million (ppm) of dissolved solids. ( saline, brackish, fresh, brine)**  **10- Detritivores they are organisms feeding on the remains of dead organisms and on the waste products of metabolism, progressively degrading it to less complex chemical structures. ( decomposers, detritivores, nectrophs, consumer)**  **Q5)Draw and label the following :- (Choose only five) (15 Marks)**  **1- oxbow lake**  **Sol)**    **2- Alluvial rivers**  **Sol)**    **3-The depth to the water table during wet and dry seasons**  **Sol)**  **chwattab**  **4-Lakes zonation**  **Sol)**    **5-Winter stratification in Eutrophic lake**  **Sol)**    **6- Solid status of water**  **Sol)**    **Exam(B)**  **Q1) Put the correct word in the suitable place from the following sentences:- (10 Marks)**  **(Sedimentary rocks, Fassil, terraces, Fossil, Delta, Braided, pebbles, Potholes, Volcanic rocks, tributaries, distributaries, dendritic )**  **1- --------- water if fresh may be originated from the fact of climate change phenomenon.**  **2-A good example of a rock with high porosity and low permeability is vesicular -------------------- .**  **3-As a river enters a lake or the ocean, its velocity suddenly diminishes, and most of its sediment load is deposited to form a ----------------------.**  **4-The rotational movement of the sand, gravel, and boulders acts like a drill and cuts deep holes known as ----------------------.**  **5-A river’s collecting system consists of the network of ---------------------------- in the headwater region that collect and funnel water and sediment to the main stream.**  **Q2) Write differences between the following terms:- (15 Marks)**  **1- ponds and lakes biologically 2- Lake Baikal and Lake Superior**  **3- mixotrophy and heterotrophy 4- Aquitard and Aquifuge**  **5- Natural Levees and Oxbow lake**  **Q3) Explain the following:- (20 Marks)**  **1- Most of the water on Earth is in a liquid form rather than as vapor**  **2- On a hot summer day, beach sand may quickly warm to the point that it is too hot to stand on while ocean water warms only a little.**  **3- The amount of oxygen derived from green plants depends upon a number of things**  **4- pioneered or refined the field of Paleolimnology**  **5-19th-Century coal miners used to keep a caged canary with them in the mine shaft**  **6-watershed succession**  **7-Monimolimnion 8-winterkill 9-Landslide lakes 10- Important functions Aquifers**  **Q4)Correct the bold words from the following sentences:- (20 Marks)**  **1- Salt lakes are all ephemeral, which means that they do not have outlets.**  **2- Ponds with sand bottoms or those receiving inflowing, clay-bearing waters are likely to have high turbidity.**  **3- The transporting system is the main network stream, which functions as a channel through which water and sediment flow from the collecting area toward the ocean.**  **4- Congo River is the world's second-longest river and by far the largest by volume.**  **5- A water molecule, however, is shaped more like a boomerang or a banana. It is straight in the middle.**  **6- Temperature does not cause any significant change in viscosity.**  **7- If pure water existed in nature impossibility, of course, it would be a biological desert, since no organism could continue to death in it.**  **8- Limnology is now commonly defined as that branch of science which deals with biological productivity of fresh waters and with all the causal influences which determine it.**  **9- Climatology, however, refers specifically to the study of the landforms on the earth and the processes that change them over time.**  **10-Soils retain sodium and potassium to a greater degree than chloride or nitrate; therefore, sodium and potassium are not as useful as quality indicators.**  **Q5)Draw and label the following:- (Choose only five) (15 Marks)**  **1-Meanders and Point Bars 2- Bedrock Rivers, or non-alluvial 3-Groundwater zones**  **4-Bacteria role in the food chain 5-Flowing (Lotic) Systems 6-Karstic lakes**  **Typical answers(B)**  **Q1) Put the correct word in the suitable place from the following sentences:- (10 Marks) (Sedimentary rocks, Fassil, terraces, Fossil, Delta, Braided, pebbles, Potholes, Volcanic rocks, tributaries, distributaries, dendritic )**  **1-Fossil water if fresh may be originated from the fact of climate change phenomenon.**  **2-A good example of a rock with high porosity and low permeability is a vesicular volcanic rock.**  **3-As a river enters a lake or the ocean, its velocity suddenly diminishes, and most of its sediment load is deposited to form a delta.**  **4-The rotational movement of the sand, gravel, and boulders acts like a drill and cuts deep holes known as potholes.**  **5-A river’s collecting system consists of the network of tributaries in the headwater region that collect and funnel water and sediment to the main stream.**  **Q2) Write differences between the following terms:- (15 Marks)**  **1-** **ponds and lakes biologically**  **Sol)** **Typical ponds differ from lakes in the absence of most truly limnetic animals and plants. Pond organisms, therefore, are essentially of the littoral and benthic types.**  **Another difference exists; vizبمعنى ., the usual diversification of the littoral area of lakes into different habitats has no counterpart in ponds, since the littoral area of the latter is practically uniform.**  **2- Lake Baikal and Lake Superior**  **Sol) Because of Lake Baikal’s great depth, however, it has the highest volume of any lake and contains about 20 percent of the liquid freshwater on Earth’s surface Baikal is the most biodiversity lake in the world. Importance: The world’s deepest lake and the biggest by volume.**  **Superior has the greatest surface area of any freshwater lake in the world. Lake Superior holds about 10 percent of the planet’s entire supply of surface freshwater**  **Importance: The world’s largest freshwater lake in terms of surface area**  **3- mixotrophy and heterotrophy**  **Sol) The category of mixotrophs is very adaptable since autotrophy and heterotrophy can be alternative or exclusive, depending on environmental conditions. A particular form of mixotrophy is performed by some species (protozoa and coelenterate) containing symbiotic algae in their protoplasm.**  **4- Aquitard and Aquifuge**  **Sol)** **An aquitard is a partly permeable geologic formation. It transmits water at such a slow rate that the yield is insufficient. Pumping by wells is not possible.**  **An aquifuge is a geologic formation which doesn’t have interconnected pores. It is neither porous nor permeable. Thus, it can neither store water nor transmit it.**  **5- Natural Levees and Oxbow lake**  **Sol)** **a short but sharp increase in stream gradient, causing the river to completely abandon the old meander loop, which remains as a crescent-shaped lake known as an oxbow lake**  **Another key process operating on a floodplain is the development of high embankments, , called natural levees**  **Q3) Explain the following:- (20 Marks)**  **1-** **Most of the water on Earth is in a liquid form rather than as vapor**  **Sol) Without hydrogen bonding, water would be a gas like carbon dioxide at normal temperatures. Hydrogen bonding makes water molecules less likely to fly apart and form a gas. It is for this reason that most of the water on Earth is in a liquid form rather than as vapor.**  **2- On a hot summer day, beach sand may quickly warm to the point that it is too hot to stand on while ocean water warms only a little.**  **Sol)** **The specific heat of water is 5 times greater than of sand.**  **3- The amount of oxygen derived from green plants depends upon a number of things**  **Sol) (a) concentration of plants in a given cubic unit of water and (b) duration of effective light.**  **4- pioneered or refined the field of Paleolimnology**  **Sol) G.E.Hutchinson (1903-1991) was a British American biologist and physicist. He made great advancements in limnology beginning in 1950 and summarized much of the field of limnology in three volume text .Today, limnologists focus much of their attention on integrating idea from geology, physics, chemistry and biology into understanding lakes and rivers.**  **5-19th-Century coal miners used to keep a caged canary with them in the mine shaft**  **Sol) the especially-sensitive canary would signal the presence of dangerous, flammable gases by ceasing to sing, and dying.**  **6-watershed succession**  **Sol) is a process that circulates significant amounts of the watershed’s energy, water and materials from the a biotic environment back into the biotic.**  **7-Monimolimnion**  **Sol) The intermediate layer, where there is a sudden change in density at the upper edge of bottom layer accumulating salts or dissolved organic matter, is called chemocline.**  **8-winterkill**  **Sol) is a common problem in many shallow Wisconsin lakes. It happens in years when at least four inches of snow cover the lake, which prevents sunlight from reaching the water. All photosynthesis stops and plants begin to die and decompose. The extent of oxygen loss depends on the total amount of plant, algae and animal matter that decays.**  **9-Landslide lakes**  **Sol) formed as a result of catastrophic events for the deposition at the bottom of a valley of debris from a collapsed valley wall like Kumanon Lake.**  **10- Important functions Aquifers**  **Sol)** **(1) they transmit ground water from areas of recharge to areas of discharge,**  **and (2) they provide a storage medium for useable quantities of ground water.**  **Q4)Correct the bold words from the following sentences:- (20 Marks)**  **1-** **Salt lakes are all ephemeral, which means that they do not have outlets.**  **Sol) endorheic**  **2-** **Ponds with sand bottoms or those receiving inflowing, clay-bearing waters are likely to have high turbidity.**  **Sol) clay**  **3-** **The transporting system is the main network stream, which functions as a channel through which water and sediment flow from the collecting area toward the ocean.**  **Sol) trunk**  **4-** **Congo River is the world's second-longest river and by far the largest by volume.**  **Sol) Amazon River**  **5- A water molecule, however, is shaped more like a boomerang or a banana. It is straight in the middle.**  **Sol) bent**  **6-** **Temperature does not cause any significant change in viscosity.**  **Sol) Pressure**  **7- If pure water existed in nature impossibility, of course, it would be a biological desert, since no organism could continue to death in it.**  **Sol) live**  **8-** **Limnology is now commonly defined as that branch of science which deals with biological productivity of fresh waters and with all the causal influences which determine it.**  **Sol) inland waters**  **9- Climatology, however, refers specifically to the study of the landforms on the earth and the processes that change them over time.**  **Sol) Geomorphology**  **10-Soils retain sodium and potassium to a greater degree than chloride or nitrate; therefore, sodium and potassium are not as useful as quality indicators.**  **Sol) pollution**  **Q5)Draw and label the following:- (Choose only five) (15 Marks)**  **1- Meanders and Point Bars**  **Sol)**    **2- Bedrock Rivers, or non-alluvial**  **Sol)**    **3-Groundwater zones**  **Sol)**    **4-Bacteria role in the food chain**  **Sol)**    **5-Flowing (Lotic) Systems**  **Sol)**    **6-Karstic lakes**  **Sol)** | | |