SOLUTION

Internal Assessment Test 1 – March.2019

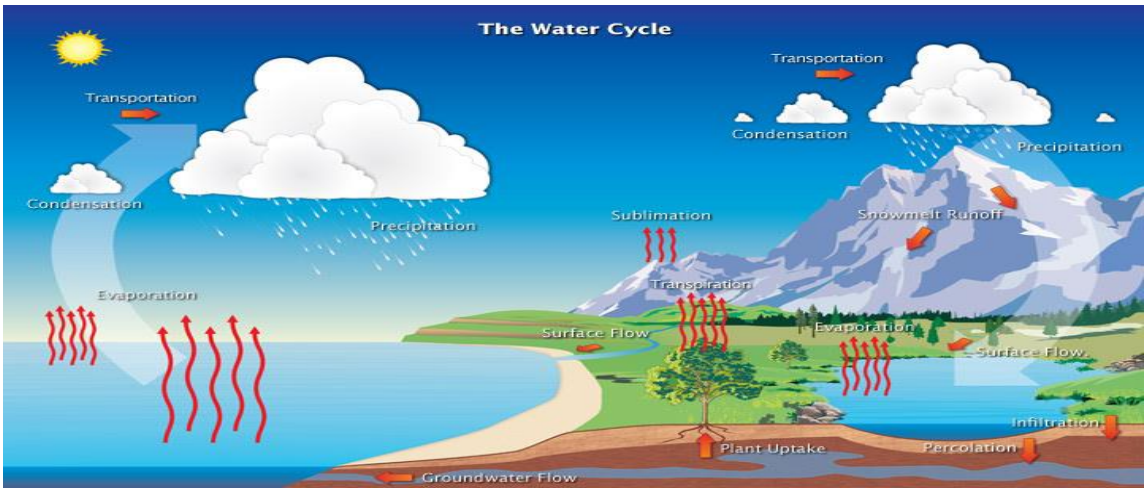
Sub:	Water Resource Management							**Code:**	15CV661
Date**:**	07/03/2019	Duration:	90mins	Max Marks:	50	**Sem:**	VI	**Branch:**	CIVIL

Q.1 a) a) With a sketch, explain Hydrologic cycle
b) What is water scarcity? What are the contributing factors of water scarcity?

Solution a)

The **hydrological cycle** is the circulation of **water** within the hydrosphere of Earth in different forms such as liquid, solid and gaseous states. It also denotes the uninterrupted exchange of **water** between the land surface, oceans and subsurface and the organisms.

There are **four** main stages in the water cycle. They are evaporation, condensation, **precipitation** and collection. Let's look at each of these stages. Evaporation: This is when warmth from the sun causes water from oceans, lakes, streams, ice and soils to rise into the air and turn into water vapour (gas)



- The hydrological cycle is the circulation of water within the hydrosphere of Earth in different forms such as liquid, solid and gaseous states.
- It also denotes the uninterrupted exchange of water between the land surface, oceans and subsurface and the organisms.
- The hydrologic cycle begins with the evaporation of water from the surface of the ocean.

Hydrological Cycle Processes

Components and Processes of the Water Cycle

Components	**Processes**
Water storage in oceans	Evaporation Transpiration Sublimation
Water in the atmosphere	Condensation Precipitation
Water storage in ice and snow	Snowmelt runoff to streams
Surface runoff	Streamflow freshwater storage infiltration
Groundwater storage	Groundwater discharge springs

Solution b)

Water scarcity is the lack of sufficient available **water** resources to meet the demands of **water** usage within a region. It already affects every continent and around 2.8 billion people around the **world** at least one month out of every year. More than 1.2 billion people lack access to clean drinking **water**. Water scarcity or water crisis or water shortage is the deficiency of adequate water resources that can meet the water demands for a particular region. Whenever there is a lack of access to potable and fresh water for drinking and sanitation, the situation means that the water is scarce. Water scarcity thus pertains to a situation where there is water shortage, water crisis, and the lack of access to quality water.

The **water scarcity** is mostly man made due to excess population growth and mismanagement of **water** resources. Some of the major **reasons for water scarcity** are: Traditional techniques of irrigation **causes** maximum **water** loss due to evaporation, drainage, percolation, **water** conveyance, and excess use of groundwater.

Effects of water scarcity. The effects of water scarcity can be grouped into these 4 broad areas—Health, **Hunger**, Education, and Poverty. Less water also means sewage does not flow, and mosquitoes are other insects breed on still (stagnant) dirty water. The result is deadly malaria and other infections.

It already affects every continent and around 2.8 billion people around the world at least one month out of every year.

More than 1.2 billion people lack access to clean drinking water.

Water scarcity involves water stress, water shortage or deficits, and water crisis. While the concept of water stress is relatively new, it is the difficulty of obtaining sources of fresh water for use during a period of time and may result in further depletion and deterioration of available water resources. Water shortages may be caused by climate change, such as altered weather patterns including droughts or floods, increased pollution, and increased human demand and overuse of water.

A water crisis is a situation where the available potable, unpolluted water within a region is less than that region's demand.

Water scarcity is being driven by two converging phenomena: growing freshwater use and depletion of usable freshwater resources.

Water scarcity can be a result of two mechanisms: physical (absolute) water scarcity and economic water scarcity, where physical water scarcity is a result of inadequate natural water resources to supply a region's demand, and economic water scarcity is a result of poor management of the sufficient available water resources.

CAUSES OF WATER SCARCITY

Water Pollution

Water pollution is yet another cause of water scarcity. The sources of water pollution include pesticides and fertilizers that wash away from farms, industrial and human waste that is directly dumped into rivers without treating it in water treatment plant. Oil spill on the ground, waste water leakage from landfills can seep underground and may pollute the groundwater making it unfit for human consumption.

Overpopulation

The rapid increase in human population combined by massive growth in industry sector have have transformed water ecosystems and resulted in loss of biodiversity. As population is increasing at an ever increasing rate, the demand for new resources will result in additional pressure on freshwater sources.

Agriculture

Agriculture uses majority of available freshwater. The sad thing is that about 60% of this water gets wasted due to inefficient agriculture methods and leaky irrigation systems. In addition to this, pesticides and fertilizers are washed away in rivers and lakes that further affect human and animal population.

EFFECTS OF WATER SCARCITY

1. Hunger
2. Poor Health
3. Poverty
4. Habitat Loss and Destruction to Ecosystems
5. Disappearance of Wetlands

Solutions for water scarcity

1. Recharging aquifers/groundwater
2. Water re-use and Effective Water Treatment Technologies
3. Desalination
4. Water Management
5. Infrastructure Repair and Maintenance
6. Water Conservation

Q. 3

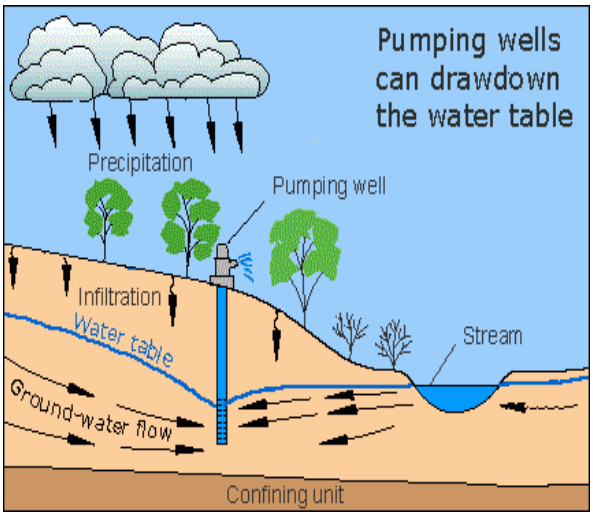
a) With a sketch, explain confined and un-confined aquifer?

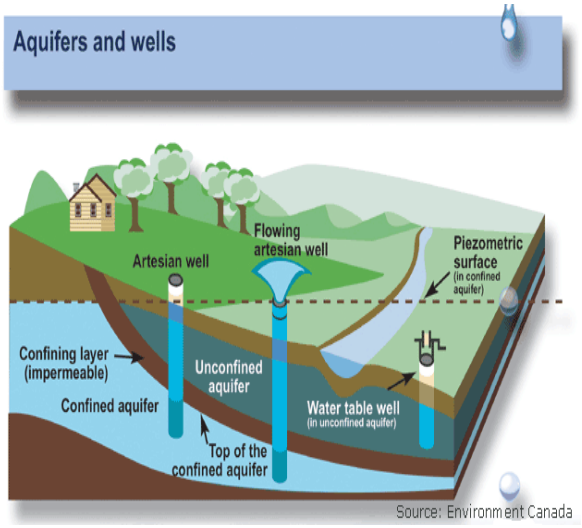
b) Briefly discuss about the scenario of water resource's availability on earth planet

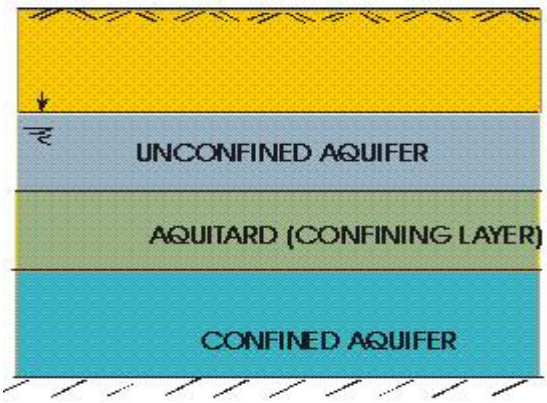
Solution: a) There are generally two kinds of **aquifers**: **confined and unconfined**. An **unconfined aquifer**, also called a water-table **aquifer**, is an **aquifer** which has the water table as its upper boundary. **Unconfined aquifers** occur near the ground surface

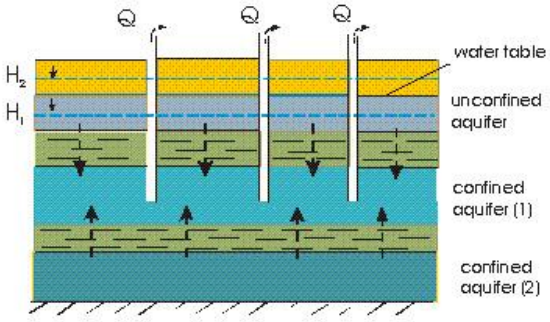
A confined aquifer is an aquifer below the land surface that is saturated with water. Layers of impermeable material are both above and below the aquifer, causing it to be under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

A water-table--or unconfined--aquifer is an aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall. Water-table aquifers are usually closer to the Earth's surface than confined aquifers are, and as such are impacted by drought conditions sooner than confined aquifers.









Surrounding Rock and Soil. **Unconfined aquifers** are typically below major water courses such as rivers. These systems provide a constant source of water that seeps down to **form** the **aquifer**. The strata of the **aquifer** itself **can** be comprised of porous rock such as limestone, or sand and gravel.

Confined aquifer

In this type of aquifer the ground water is confined under pressure by the over lying strata than the atmospheric pressure. So it is known as pressure aquifer.

It is generally occurs at significant depth below the ground surface.

Confined aquifers have very low storability values much less than 0.01

Low flow yield. Hydraulic conductivity is low to medium.

Unconfined aquifer

In this of aquifers the water table is formed in the upper surface of zone of saturation. So it is called as water table aquifer. It occurs near the ground surface. Unconfined aquifer have storability greater than 0.01, High flow yield, Hydraulic conductivity is medium.

Q.3 **b. Water Resource availability on planet**

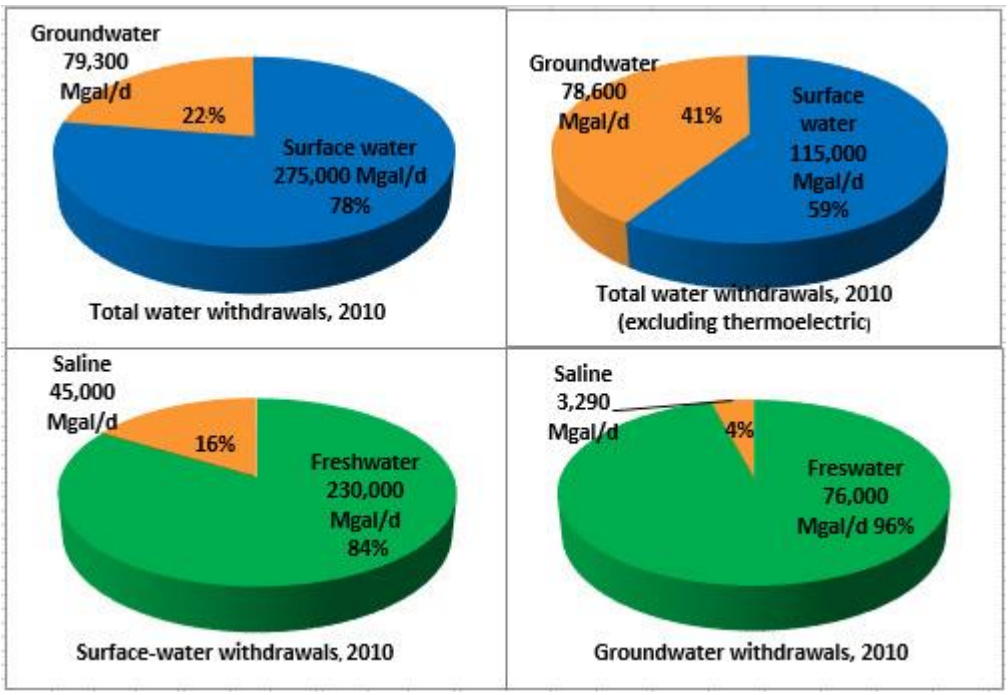
Solution:

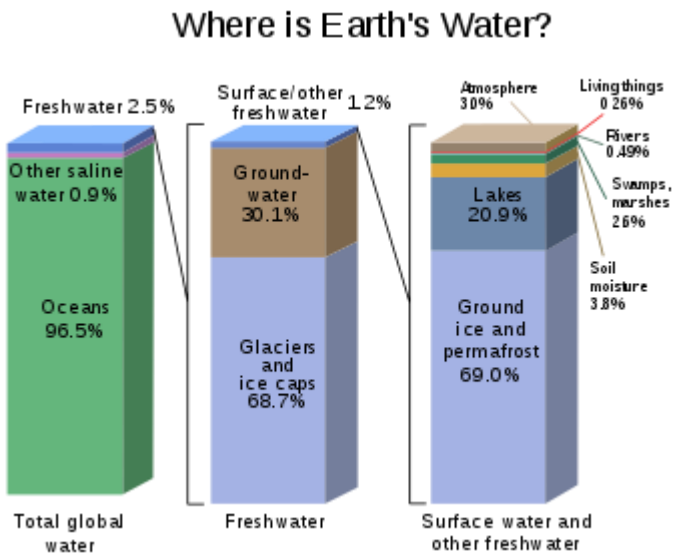
About 71 percent of the Earth's **surface** is water-covered, and the oceans hold about 96.5 percent of all Earth's water. Water also exists in the air as water vapour, in rivers and **lakes**, in icecaps and **glaciers**, in the ground as soil moisture and in aquifers.

Water, the most vital element for the survival on earth, has become one of the emerging environmental issues our ecosystems are facing today. Issues of water quantity, quality and availability are the three major concerns and are vital to the quality of the life on earth. The assessment of the global water resources can alarm us for its future consequences. Water crises are the challenges to the global environment communities, as water issues have been included under the agenda 21 of the United Nations Environment Program (UNEP).

The vast majority of water on the Earth's surface, over 96 percent, is saline water in the oceans. The freshwater resources, such as water falling from the skies and moving into streams, rivers, lakes, and groundwater, provide people with the water they need every day to live. Water sitting on the surface of the Earth is easy to visualize, and your view of the water cycle might be that rainfall fills up the rivers and lakes. But, the unseen water below our feet is critically important to life, also. How do you

account for the flow in rivers after weeks without rain? In fact, how do you account for the water flowing down a driveway on a day when it didn't rain? The answer is that there is more to our water supply than just surface water, there is also plenty of water beneath our feet.





Q.5 Explain the Technical, Institutional, Economic and financial aspects of water resources planning and management.

Solutions: **SYSTEM COMPONENTS, PLANNING AND MANAGEMENT**

INTRODUCTION

The main sources of water supply are surface and ground water which have been used for a variety of purposes such as drinking, irrigation, hydroelectric energy, transport, recreation etc. Often, human activities are based on the „usual or normal" range of river flow conditions. However, flows and storage vary spatially and temporally; and also they are finite (limited) in nature i.e., there is a limit to the services that can be expected from these resources. Rare or „extreme" flows or water quality conditions outside the normal ranges will result in losses to river-dependent, human activities. Therefore, planning is needed to increase the benefits from the available water sources. The purpose of water resources planning and management activities is to determine (i) How can the renewable yet finite resources best be managed and used? (ii) How can this be accomplished in an environment of uncertain supplies and uncertain and increasing demands, and consequently of increasing conflicts among individuals having different interests in the management of a river and its basin?

SYSTEM COMPONENTS

Water resources management involves the interaction of three interdependent subsystems: **1. Natural river subsystem in which the physical, chemical and biological processes takes place 2. Socio-economic subsystem,** which includes the human activities related to the use of the natural river system **3. Administrative and institutional subsystem** of administration, legislation and regulation, where the decision, planning and management processes take place Inadequate attention to one subsystem can reduce the effect of any work done to improve the performance of the others

PLANNING AND MANAGEMENT ASPECTS Technical aspects It is first necessary to identify the characteristics of resources in the basin, including the land, the rainfall, the runoff, the stream and river flows and the groundwater Technical aspects of planning involves Predicting changes in land use/covers and economic activities at watershed and river basin levels.

Estimation of the costs and benefits of any measures being and to be taken to manage the basin"s water resource including engineering structures, canals, diversion structures etc. Identification and evaluation of alternative management strategies and also alternative time schedules for implementing those measures.

Economic and Financial aspects :Water should be treated as an economic commodity to extract the maximum benefits as well as to generate funds to recover the costs of the investments and of the operation and maintenance of the system. Water had been treated for long as a free commodity. Revenues recovered are far below the capital cost incurred. Financial component of any planning process is needed to recover construction costs, maintenance, repair and operation costs. In management policies, financial viability is viewed as a constraint that must be satisfied; not as an objective whose maximization could result in a reduction in economic efficiency, equity or other non-monetary objectives

Institutional aspects: Successful project implementation needs an enabling environment. National, provincial and local policies, legislation and institutions are crucial for implementation of the decisions. The role of the government is crucial since water is (i) not a property right (ii) a resource that often requires large investment to develop and (iii) a medium that can impulse external effects. The main causes of failure of water resources development project are insufficient institutional setting and lack of a sound economic evaluation and implementation.

Q.6. What are the system components of water resources management? Explain Top down approach and Bottom up approach of integrated management policy.

SYSTEM COMPONENTS

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PLANNING AND MANAGEMENT – APPROACHES

Two approaches which lead to an integrated plan and management policy are

1. **From the top down or the command and control approach** □
2. **From the bottom up or the grass-roots approach**

Top down approach: Water resources professionals prepare integrated, multipurpose „master" development plans with alternative structural and non-structural management options. There is dominance of professionals and little participation of stakeholders. In this approach, one or more institutions have the ability and authority to develop and implement the plan. However, nowadays, since public have active participation in planning and management activities , topdown approaches are becoming less desirable or acceptable.

Bottom up approach: In this approach there is active participation of interested stakeholders – those affected by the management of the water and land resources. Plans are being created from the bottom up Water Resources Systems Planning and Management: Introduction and Basic Concepts: System Components, Planning and Management rather than top down. Top down approach plans do not take into consideration the concerns of affected local stakeholders. Bottom up approach ensures cooperation and commitment from stakeholders. The goals and priorities will be common among all stakeholders by taking care of laws and regulations and by identifying multiple alternatives and performance criteria. Tradeoffs are made between conflicting goals or measures of performance.

Q. 7. Explain the necessity of water resource planning and management.

Solution:

NEED FOR PLANNING AND MANAGEMENT

Planning and management of water resources systems are essential due to following factors:

(1) Severity of the adverse consequences of droughts, floods and excessive pollution. These can lead to a) Too little water due to growing urbanization, additional water requirements, in stream flow requirements etc. Measures should be taken to reduce the demand during scarcity times

b. Too much water due to increased flood frequencies and also increase in water requirements due to increased economic development on river floodplains

c. Polluted water due to both industrial and household discharges

(2) Degradation of aquatic and riparian systems due to river training and reclamation of floodplains for urban and industrial development, poor water quality due to discharges of pesticides, fertilizers and wastewater effluents etc.

(3) While port development requires deeper rivers, narrowing the river for shipping purposes will increase the flood level.

(4) River bank erosion and degradation of river bed upstream of the reservoirs may increase the flooding risks

(5) Sediment accumulation in the reservoir due to poor water quality Considering all these factors, the identification and evaluation of alternative measures that may increase the quantitative and qualitative system performance is the primary goal of planning and management policies.

Q.2. In a month a lake received an average infiltration of **$8m^3/s$** from surface runoff sources. Outflow from the basin is **$8.5\ m^3/s$**. The basin receives an average rainfall of 150mm and incurs an evaporation loss of 6.1 cm from Lake Surface. The lake surface area is 5000 Ha. Calculate the increase in water level in lake over a period of one month.

Solution:

Q.4. A watershed has an area of 800Ha. Due to a 20 cm rainfall event over the watershed, a stream flow is generated and at the outlet of the watershed it lasts for 10 hours. Assuming runoff/Rainfall ratio of 0.3 for this the average stream flow rate at the outlet in this period of 10 hours. Calculate average stream flow rate at the outlet for this period.

Solution:

Que. 4

Soln^{b} –

Given $A = 800$ Ha

$P = 20$ cm

$t = 10$ Hours, Runoff coeff. $= 0.3$

Average stream flow = ?

(in Runoff = ?)

$$\text{Runoff coeff.} = \frac{\text{Runoff}}{\text{Precipitation}}$$

Total precipitation = 20 cm

Runoff = Runoff coeff $\times P$

$= 0.3 \times 20 = 6$ cm.

∴ Corresponding stream flow Rate =

$$= \frac{6 \times 10^{-2} \times 800 \times 10^{4}}{10 \times 60 \times 60} = \underline{13.33 \text{ m}^3/\text{sec}}$$

Q.2. solution

Given— Inflow = $8 m^3/sec$.

outflow = $8.5 m^3/sec$

P = 150mm

E = 6.1 cm.

A = 5000 Ha.

↑se in water Level in a Lake over one month

Net inflow — Net out flow = change in storage

Net inflow = $8 m^3/sec$ + flow due to 150 mm precipitation

$$= \frac{8 + (150 \times 10^{-3} m) \times (5000 \times 10^4)\ m^2}{30 \times 60 \times 60 \times 24^2}$$

$$= 10.89 m^3/s. \rightarrow \left[\frac{P \times A}{E}\right]$$

Net out flow = 8.5 + out flow due to 6.1 cm evap.

$$8.5 + \frac{0.061 \times 5000 \times 10^4}{(30 \times 24 \times 60^2)}$$

$$= 9.68 m^3/sec$$

change in storage = Net inflow − Net outflow.

$10.89 - 9.68 = 1.21 m^3/sec$

↑se in water Level = ↑se in Discharge × time / Area

$$= \frac{1.21 \times 30 \times 24 \times 60^2}{5000 \times 10^4} = 0.0627 m.$$

62.7 mm

Ans.