**20CEXXO6 –WATER RESOURCES MANAGEMENT**

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| **Course Category** | Open Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0- 0 |
| **Prerequisite** | None | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Understand the nature of groundwater and its role in the water cycle. |
| CO2 | Apply the concept of Darcy’s law for estimating discharge and understand their characteristics and classifications. |
| CO3 | Familiar with the technology of water wells and groundwater monitoring. |
| CO4 | Familiar with the technology to investigation the surface and subsurface water. |
| CO5 | Understand the importance of artificial recharge and employ the artificial ground water recharge techniques. |
| CO6 | Identify the saline water intrusion locations. |
| **Course**  **Content** | **UNIT – I**  **INTRODUCTION:** Ground water utilization and historical background – Ground water in hydrologic cycle. Ground water budget and ground water level fluctuations and environmental influence.  **UNIT – II**  **OCCURRENCE AND MOVEMENT OF GROUND WATER**: Origin & age of ground water – Rock properties affecting groundwater– Groundwater column, zones of aeration & saturation, aquifers and their characteristics and classification –Groundwater basins & springs – Darcy’s Law – Permeability & its determination –Dupuit’s assumptions.  **UNIT – III**  **ADVANCED WELL HYDRAULICS:** Steady and unsteady uniformradial flow to a well in a confined, unconfinedand leaky aquifer – Well flow near aquifer boundaries for special conditions, partially penetrating.  **UNIT – IV**  **SURFACE SUB-SURFACE INVESTIGATION OF GROUND WATER:** Geological – Geophysical Exploration– Remote Sensing – Electric Resistivity –Seismic refraction based methods for surface investigation of ground water– Test drilling & ground water level measurement– Sub-surface ground water investigation through geophysical – Resistivity.  **UNIT – V**  **ARTIFICIAL GROUND WATER RECHARGE:** Concept and methods of artificial ground water recharge– Recharge mounds and induced recharge – Wastewater recharge for reuse – Water spreading.  **UNIT – VI**  **SALINE WATER INTRUSION IN AQUIFERS:** Ghyben-Herzberg relation between fresh & saline waters – Shape & structure of the fresh and saline water interface – Upcoming of saline water – Fresh-saline water relations on oceanic islands – Seawater intrusion in karst terrains – Saline water intrusion control. | |
| **Textbooks**  **and**  **References** | **TEXTBOOKS:**   1. David K. Todd, Larry W. Mays,*Groundwater hydrology*, Wiley India Pvt Ltd., 3rd edition, 2011. 2. H. M. Raghunath, *Ground Water*, Newage publishers, 3rd edition, 2007. 3. R. N. Saxena and D.C. Gupta, *Elements of Hydrology and Groundwater*, PHI Learning, 3rd edition, 2017.   **REFERENCE BOOKS:**   1. K.Subramanya, *Engineering Hydrology*, Tata McGraw Hill Publishing Company, 4th edition, 2019. 2. K. Karanth, Ground Water Assessment, Development and Management, McGraw Hill Education, 2nd edition, 2017. 3. Bhagu R. Chahar, *Groundwater Hydrology*, McGraw Hill Education, 1st edition, 2017. | |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | - | 1 | 2 | - | - | 2 | - | - | - | - | 1 | - | - | - |
| **CO2** | - | 3 | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| **CO3** | - | - | 2 | - | - | - | 1 | - | - | 2 | - | 2 | - | 1 | - |
| **CO4** | 2 | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 1 | - |
| **CO6** | - | 2 | - | - | 1 | - | 2 | - | - | 2 | - | 1 | - | 1 | - |