UNIVERSIDAD AUTÓNOMA DE BAJA CALIFORNIA

COORDINACIÓN GENERAL DE FORMACIÓN BÁSICA
COORDINACIÓN GENERAL DE FORMACIÓN PROFESIONAL Y VINCULACIÓN UNIVERSITARIA
PROGRAMA DE UNIDAD DE APRENDIZAJE

I. IDENTIFICATION INFORMATION

1. **Academy unit:** Facultad de Ingeniería, Mexicali; Facultad de Ingeniería, Arquitectura y Diseño, Ensenada; y Facultad de Ciencias de la Ingeniería y Tecnología, Valle de las Palmas

2. **Study program:** Civil Engineering

3. **Plan duration:** 2020-1

4. **Name of the learning unit:** Hydrology

5. **Code:** 36029

6. **HC:** 01 **HL:** 00 **HT:** 02 **HPC:** 00 **HCL:** 00 **HE:** 01 **CR:** 04

7. **Learning stage to which it belongs:** Disciplinary

8. **Character of learning unit:** Obligatory

9. **Requirements for enrollment to learning unit:** None

PUA formuled by
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II. GENERAL PROPOSE OF THE COURSE

The study of Hydrology is fundamental in Civil Engineering and Environmental Engineering, since it is the natural science that studies water, its occurrence, circulation and distribution on the earth's surface, as well as its chemical and physical properties and its relationship with the environment, including living beings. Hydrology studies various physical variables that directly influence the design, management, control, evaluation and optimization of hydraulic infrastructure. Its usefulness lies on allow the student to apply calculations and analysis to obtain these variables.
The learning unit is taught at the disciplinary training stage and is mandatory. It belongs to the knowledge area Water Resources and Environment.

III. COURSE COMPETENCIES

Design and model sustainable infrastructure projects, using standards, techniques, specialized software and addressing the behavior of materials, for urban and rural development, with respect for the environment and proactive attitude.

IV. EVIDENCES OF PERFORMANCE

1. Prepares and presents a sustainable design project for a hydrology and environmental system, where the fundamentals of hydrological engineering are applied, analyzing their behavior through the use of software that meets the demand of the social sector and care for the environment.
2. Reports of the workshops held for each unit, which include: objective, theoretical framework, development, results and conclusions.

V. DEVELOPMENT BY UNITS

UNIT I. Introduction to hydrology

Competence:
Identify and understand the basic concepts of hydrology and a watershed, its study base and applications in civil engineering, calculating the variables and the physiographic characteristics of a watershed for a hydrological analysis, to solve problems of water resources, with a willingness to collaborative and cooperative work.

Content : **Duration:** 4 hours

1.1 Hydrologic cycle.
1.2 Water balance.
1.3 Engineering approach to hydrological problems.
1.4 Watershed.
1.5 Physiographic characteristics of a watershed.
- 1.5.1 Area.
- 1.5.2 Elevation.
- 1.5.3 Slope.
- 1.5.4 Drainage network.
- 1.5.5 Main stream slope.
- 1.5.6 Time of concentration.
- 1.5.7 Runoff coefficient.
- 1.5.8 Physical parameters of the drainage.

UNIT II. Precipitation and evapotranspiration

Competence:
Understand and relate the hydrological phenomena of precipitation and evapotranspiration, as well as their spatial and temporal distribution, using hydrological data measurement and adjustment methods, for the design, analysis and control of hydraulic infrastructure, with empathy to collaborative work and a proactive attitude.

Content : **Duration:** 4 hours

2.1 Meteorology.
2.2 Methods and techniques for the measurement of hydrometeorological variables.
    2.2.1 Climate Stations.
2.3 Precipitation.
    2.3.1 Measuring and presenting precipitation data.
    2.3.2 Spatial and temporal analysis of precipitation.
    2.3.3 Estimation of missing data and methods of data adjustment.
2.4 Intensity duration and frequency curves design.
2.5 Evaporation and transpiration.
    2.5.1 Evaporation measurements.
    2.5.2 Transpiration measurements.
    2.5.3 Evapotranspiration estimation methods.

UNIT III. Runoff and infiltration

Competence:
Analyze and apply the methods, techniques and protocols for measuring runoff, the role of the infiltration process in the rain-runoff relationship as well as understand the differences between the volume of water entering and leaving the watershed, applying the fundamental equations of hydraulics and the experimental coefficients of the measurement of flow parameters, to solve hydrological problems considering the components of infiltration, runoff and precipitation, with a willingness to collaborative and cooperative work.

Content : **Duration:** 4 hours

3.1 Sources and processes of runoff.
3.2 Precipitation/Runoff relationship.
3.3 Hydrographs.
    3.3.1 Analysis.
    3.3.2 Types.
3.4 Empirical methods for runoff estimation.
3.5 Methods and techniques of direct and indirect measurement of runoff.
3.6 Infiltration.
    3.6.1 General characteristics of the infiltration process.
    3.6.2 Factors that affect the infiltration process.
    3.6.3 Methods for the estimation of infiltration.

UNIT IV. Frequency Analysis

Competence:
Analyze and relate the magnitude of a hydrological event (flood or drought) with its probability of occurrence, using statistical methods and probabilistic models, as well as the graphic representation of these, to determine intervals of recurrence for the various events that may occur, with a provision to collaborative and cooperative work.

Content : **Duration:** 2 hours

4.1 Probability.
4.2 Random variables and probability distributions.
4.3 Return period or recurrence interval.
4.4 Common probabilistic models.
4.5 Graphical representation of data**.**

UNIT V. Hydrological modeling and simulation tools

Competence:
Identify and apply hydrological simulation models, using advance tools in the resolution of problems related to complex systems of water resources and watershed management, with a willingness to collaborative and cooperative work, as well as a proactive, responsible and creative attitude.

Content : **Duration:** 2 hours

5.1 Introduction to hydrological modeling.
5.2 GIS applications for hydrology.
5.3 Modeling procedure of surface hydrological watershed.
5.4 Application of hydrological models.

VI. STRUCTURE OF WORKSHOP PRACTICES				
Practice No.	**Competence**	**Description**	**Support material**	**Time**
UNIT I				
1	Analyze the behavior of the water cycle and its relationship with the water balance in a watershed, by performing various exercises, with objectivity and commitment.	The components of the water cycle will be identified and their importance will be evaluated as part of the water balance in different regions of the world, writing a report as evidence.	Bibliography. Problems Calculator.	2 hours
2	Apply the concepts and physiographic characteristics of a watershed, through the use of topographic charts and specialized software, in order to obtain a watershed delimitation as well as its main components, with a willingness to collaborative and cooperative work.	A watershed will be delimited through the use of topographic charts in paper and digital using tools and specialized GIS software. A report of the processes will be delivered as evidence.	Topographic charts of INEGI in paper format. Topographic charts of INEGI in digital format. Digital Elevation Model. Specialized software - GIS. Bibliography.	2 hours
3	Apply the concepts of the main stream slope, as part of the physiographic characteristics of a watershed, applying different methods, for their later use in the runoff calculations, with a willingness to collaborative and cooperative work.	The slope of a main stream will be estimated using the average, compensated and Taylor-Schwartz slope methods. A spreadsheet will be provided as evidence of the activity.	Topographic charts of INEGI in paper format. Topographic charts of INEGI in digital format. Digital Elevation Model. Specialized software - GIS. Bibliography.	4 hours
UNIT II				
4	Identify and describe the main types of precipitation and their relation to orography as well as the effect of climate change on precipitation regimes, through the analysis of data from weather stations, for later use in statistical	Identify in three points of the world the occurrence of advective, orographic and cyclonic precipitation in recent years, indicating its occurrence, extent, intensity and damage to hydraulic structures (if applicable). Make a	Bibliography.	2 hours

	and hydrological calculations, with provision to collaborative and cooperative work.	report including photos of the events that serves as evidence.		
5	Perform an analysis of the spatial distribution of precipitation, using Thiessen polygons and isohyets, to calculate the average rainfall, with a willingness to collaborative and cooperative work.	Select several climatological stations with precipitation data for spatial analysis applying the Thiessen polygons method and the isohyets method, calculating areas and average precipitation. A report with the procedure and results will be delivered.	Topographic charts of INEGI in paper format. Topographic charts of INEGI in digital format. Digital Elevation Model. Specialized software - GIS. Precipitation data. Bibliography.	4 hours
UNIT III				
6	Assess different methods of infiltration measurement and flow measurement, through a bibliographical investigation, to determine the most appropriate method for different scenarios, with a willingness to collaborative and cooperative work.	Elaborate an extensive investigation detailing the most used methods to measure infiltration and runoff, considering the published official norms. Evaluate the application of different methods for different scenarios. A report will be delivered digitally.	Bibliography.	2 hours
7	Obtain the unit hydrograph of a watershed, based on streamflow data and average rainfall, using the technique of total precipitated volume and S-hydrograph method, to evaluate the runoff in other precipitation events, with a willingness to collaborative and cooperative work.	From streamflow data and average precipitation, the unit hydrograph will be estimated considering that the total precipitated volume is a fraction of the drained volume and this is the area under the curve of the hydrograph. It will include the S-Hydrograph technique to change the hasty period and present it digitally.	Streamflow data. Precipitation data. Bibliography.	2 hours
8	Obtain the instant hydrograph, from a series of average precipitation in the watershed and a streamflow data, to evaluate the runoff in other precipitation events, with collaborative and cooperative	By using tools for solving simultaneous algebraic equations, estimate the instant runoff derived from a series of precipitation and streamflow measurements in a hydrological watershed. The	Streamflow data. Precipitation data. Bibliography.	2 hours

	work arrangements.	procedure and results will present them digitally.		
9	Calculate a design runoff from hydrological data of a watershed, to apply the results in the design of a hydraulic infrastructure, with a willingness to collaborative and cooperative work.	Based on the physiographic data of a watershed and precipitation analysis, runoff calculations should be carried out using different methods and taking into account the characteristics of the site. The procedure and the results will present them digitally.	National Commission of Water data. Topographic charts of INEGI in paper format. Topographic charts of INEGI in digital format. Digital Elevation Model. Specialized software - GIS. Precipitation data. Bibliography.	4 hours
UNIT IV				
10	Analyze series of precipitation data to calculate the precipitation associated with different return periods, using the probability functions most used for hydrology and its effect on the design of hydraulic works, with a willingness to collaborative and cooperative work.	Obtain from a 50 year time series data of maximum annual precipitation in 24 hours and apply 5 probability distributions, and analyze which of these distributions presents a better fit to obtain the associated rainfall of a 10, 50 and 100 years of return period. Discuss these results with respect to their influence on the design of hydraulic works	National Commission of Water data. Probabilistic functions software. Spread sheet.	4
UNIT V				
11	Understand the basic fundamentals of hydrological modeling and its application for civil engineering, through a research report and the creation of some basic example in a hydrological modeling software, to calculate the variables seen in the unit, with a willingness to collaborate and cooperative.	In a free distribution software, prepare a basic model to obtain some of the parameters seen in the course. In addition, a research report on hydrological modeling, the main tools and software most applicable to the field of civil engineering must be submitted	Bibliography. Hydrological software	4

VII. WORK METHOD

Framing: The first day of class the teacher must establish the form of work, evaluation criteria, quality of academic work, rights and obligations for teacher and students.

Teaching strategy (teacher)

- Through the exposition by the instructor in an orderly and consistent way of hydrology topics.
- In practical sessions, practical exercises will be developed on the blackboard platform.
- Use dynamics in work groups for the solution of exercises.
- Assigns exercises in individual and team modalities.
- Promotes the active participation of the student.

Learning strategy (student)

- Make previous research about the contents of the learning unit.
- Participates in work groups, workshop sessions and exercises to strengthen.
- The student applies the concepts in order to make the best decisions to solve the problems.
- Make reports and exhibitions, prepared in strict adherence to reflection and criticism
- Identify, formulate and solve specific problems of your locality so that through a project

VIII. EVALUATION CRITERIA

The evaluation will be carried out permanently during the development of the learning unit as follows:

Accreditation Criterion

- To be entitled to ordinary and extraordinary exam, the student must meet the attendance percentages established in the current School Statute.
- Scaled from 0 to 100, with a minimum approval of 60.

Evaluation criteria

- Test (3)……..….50%
- Assignments and team work…….……..…10%
- Performance evidence 1…….20%
  (Sustainable design project for a water and environmental system)
- Performance evidence 2……..…20%
  (workshop reports)

Total…....100%

IX. REFERENCES

Required

Aparicio, F. J. (1999). *Fundamentos de hidrología de superficie.* Limusa. [clásica]

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Linsley, R. E., y Franzini, J. B. (2015). *Ingeniería de los recursos hidráulicos*. México: Continental S.A de C.V. [clásica]

Linsley, R. K., Kohler, M. A., y Paulhus, J. L. (1977). *Hidrología para ingenieros*. México: McGraw-Hill. [clásica]

Viessman W., Lewis G. L., (1996). *Introduction to hydrology.* United States of America: HarperCollins College Publishers. [clásica]

Wanielista, M., Kersten, R., y Eaglin, R. (1997). *Hydrology: Water quantity and quality control.* Canada: John Wiley & Sons, Inc. [clásica]

Suggested

Evett J.B., Liu C. (1989). *Fluid Mechanics and Hydraulics.* United States of America: McGraw-Hill. [clásica]

Gat, J. (2010). *Isotope Hydrology: A Study of the Water Cycle.* London: Imperial College Press. Recuperado de http://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=340684&lang=es&site=ehost-live [clásica]

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Singh, V. P. (1992). *Elementary hydrology.* United States of America: Prentice Hall. Recuperado de: http://catalogocimarron.uabc.mx/cgi-bin/koha/opac-detail.pl?biblionumber=106259&query_desc=kw%2Cwrdl%3A%20Hidrology [clásica]

X. TEACHER PROFILE

The instructor who teaches this unit must have a Bachelor's degree in Civil Engineering, Physics or related area, preferably a Master or Doctorate in Science or Engineering. Have professional experience in the field of Civil Engineering and teaching experience as a minimum of two years in the area of water resources and environment. It is suggested to have carried out field investigations and hydrological analysis projects focused on hydraulic works.

Must communicate clearly and accurately with students, and be able to use technological tools to facilitate the delivery of the course. Be an analytical, proactive and responsible person, capable of proposing methodical solutions to a given problem, with vocation, respect and service to teaching.