

PHARMACEUTICAL HYDROLOGY

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Optional	Pharmaceutical Hydrology	4º, 5º	1º	6	Optional
LECTURER(S)			Postal address, telephone nº, e-mail address		
<ul style="list-style-type: none"> Rafael Delgado Calvo-Flores Gabriel Delgado Calvo-Flores Juan Manuel Martín García 			Dpto. Edafología y Química Agrícola Facultad de Farmacia Campus Universitario de Cartuja s/n 18071, Granada, Spain Telephones: 0034 958 24 38 35; 0034 958 24 38 33; 0034 958 24 63 80 Emails: rdelgado@ugr.es; gdelgado@ugr.es; jmmartingarcia@ugr.es		
DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT					
Degree in Pharmacy					
PREREQUISITES and/or RECOMMENDATIONS (if necessary)					
Have adequate knowledge of: General Chemistry; Inorganic Chemistry; Physics; Physical Chemistry; Geology Applied to Pharmacy; Pharmacology; Pharmaceutical Legislation; Pharmaceutical Technology.					
BRIEF ACCOUNT OF THE SUBJECT PROGRAMME (ACCORDING TO THE DEGREE IN PHARMACY)					
Concept of Pharmaceutical Hydrology. The hydrologic cycle: environmental and health implications. Concept, origin and properties of mineral-medicinal waters. Hydrothermal treatments (hydropinic cure and balneotherapy), Thalassotherapy and Pelotherapy. Spanish and European Spas.					
GENERAL AND PARTICULAR ABILITIES					
Learn about the concept of mineral-medicinal water. Understand that water can be an agent with therapeutic purpose. Know the different origins in the nature of the mineral-medicinal waters and properties that are derived. Learn about the different mechanisms of action of mineral waters and its relationship with its properties					



(chemical, physical and physic-chemical, among others).

Acquire knowledge on the different modalities of health application of mineral-medicinal waters: hydrothermal cures (hydropinic cure and balneotherapy), Thalassotherapy and pelotherapy.

Know the location and characteristics of mineral water, peloids and treatments of the main spas of Spain and Europe.

Know the types of water that exist in nature through the hydrological cycle and its key elements. Relationship between the characteristics of natural waters and their origin.

Evaluate the quality of the waters, and classify them by means of physical, chemical and physic-chemical analysis.

Understand water as a natural resource valuable and scarce, with important health implications.

OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

Understand the concept of Pharmaceutical Hydrology and concept, origin and properties of mineral-medicinal waters.

Understand the different ways, mechanisms of action and application techniques: hydrothermal cures (hydropinic cure and balneotherapy), Thalassotherapy and Pelotherapy; as well as the mechanisms of protection of these waters and the various quality controls that are applied to them.

Spas.

The hydrological cycle.

Water in nature: origin, properties and importance for the human being.

DETAILED SUBJECT SYLLABUS

THEORETICAL ISSUES:

FIRST PART. BASIC PRINCIPLES

Lesson 1 - Concept. 1.1. Concept of Hydrology. 1.2. Pharmaceutical Hydrology. 1.3. Medical Hydrology. 1.4. Historical development. 1.5 Water as a constituent of the Earth and of broad uses for mankind. 1.6. Study skills. 1.7. Bibliographic sources in Hydrology and Pharmaceutical Hydrology.

Lesson 2 – The water cycle. 2.1 Approach and concept. 2.2. Main Hydrological Elements. 2.3 Precipitation. 2.4 Origin and types of precipitation. 2.5 Measurement of precipitation. 2.6. Importance of precipitation on the Environment and the Health Sciences.

Lesson 3 - Soil and cycle of water. 3.1 Concept of Soil. 3.2. The Soil like fractionator of waters of the Hydrological Cycle. 3.3 Runoff-erosion. 3.4 Evaporation-transpiration. 3.5 Importance of Soil use in Environmental and Health Sciences.

Lesson 4 - Aquifers. 4.1 Infiltration of water into the subsoil. 4.2. Groundwater. 4.3 Aquifers. 4.4 Hydrological parameters of rocks (physical). 4.5 Piezometric surface. 4.6 Types of aquifers. 4.7 Downloading and recharging 4.8. Pollution of aquifers. Importance in Health Sciences.

Lesson 5 - Properties of the Natural Waters. 5.1. Introduction. 5.2. Synopsis of the main properties of Natural Waters. 5.3 Physical properties. 5.4 Chemical properties: Marine Waters and other Natural Waters. 5.5



Processes that control the properties of the waters. 5.6. The Natural Waters and biogeochemical cycles.

Lesson 6 – Natural Waters, Environment and Health. 6.1 Approach 6.2. Outline of selected examples. 6.3. Effect of the hardness of the water. 6.4 Effect of the fluoride content. 6.5. Effect of the content of selenium. 6.6 Effect of the content of iodide. 6.7. Other cases.

SECOND PART: MINERAL-MEDICINAL WATERS AND OTHER APPLICATIONS

Lesson 7 - Concept and origin of Mineral-Medicinal Waters. 7.1. Definition of Mineral-Medicinal Waters. Thermalism. 7.2. Disputes about the origin of the Mineral-Medicinal Waters. 7.3 Meteoric origin. 7.4. Endogenous origin. 7.5. Mixed origin. 7.6 Hydrominerals basins. 7.7. Mineralization of the water. 7.8 Examples of origin of deposits of Mineral-Medicinal Waters: Lanjarón, Alhama, Vichy (France) 7.9. Main springs and spas of Mineral-Medicinal Waters in Spain and Europe.

Lesson 8 - Properties of the Mineral-Medicinal Waters. 8.1 Classification of their properties: physical, chemical, physico-chemical and therapeutic. 8.2 Main physical properties. 8.3 Main chemical properties. 8.4 Main physicochemical properties.

Lesson 9 - Classification of the Mineral-Medicinal Waters. 9.1. Approach. 9.2. Classifications based on physical properties. 9.3. Classifications based on chemical properties. 9.4. Types of graphical representations.

Lesson 10 - Protection and quality control of the Mineral-Medicinal Waters. 10.1. Protection of Mineral-Medicinal Waters. 10.2. Sources of pollution. 10.3. Parameters of protection. Validity. 10.4. Intrinsic and extrinsic contamination. 10.5 Quality control plan for the Mineral-Medicinal Waters.

Lesson 11 - Therapeutic properties of the Mineral-Medicinal Waters. 11.1. Hydrothermal cures. Definition and approach. 11.2. Specific and non-specific actions. 11.3 Routes and management techniques. 11.4 Applications orally (Hydropinic Cures). 11.5 Description of actions taken by mouth: gastric, intestinal, liver (biliary) kidney, urinary and other actions.

Lesson 12 - Topically therapeutic action of Mineral-Medicinal Waters (balneotherapy). 12.1. Approach. 12.2. Mechanisms of action. 12.3. Scheme of the main applications. 12.4 Rheumatology. 12.5 Dermatology.

Lesson 13 - Thalassotherapy. 13.1. Approach. 13.2. Actions on the human organism of the baths with sea water. 13.3. Therapeutic indications. 13.4. Techniques of Thalassotherapy. 13.5. Examples: Dead Sea, Mar Menor, etc.

Lesson 14 - Pelotherapy. 14.1. Approach. Definition. 14.2. Stages of the peloids. 14.3. Types of peloids. 14.4. Preparation. 14.5 Maturation. 14.6 Properties. Quality control. 14.7 The peloids actions.

PRACTICE ISSUES:

Practice 1. Classification of Mineral-Medicinal Waters by their chemical composition. Major ions.

Practice 2. Preparation of peloids. Determination of main properties. Quality control.

Field practice: Guided visit to resorts, properties of its waters, description and demonstration of the various types of therapeutic treatments used.

READING

- AENOR (1997). Calidad del Agua. (Recopilación Normas UNE) Medio Ambiente, Tomo 1. AENOR.
- Albu, M., Banks, D. Nash, H. (1997). Mineral and Thermal Groundwater Resources. Chapman and Hall. Londres.
- Armijo, M. y S. Martín, J. (1994). Curas balnearias y climáticas. Talasoterapia y Helioterapia. Edit,



Complutense. Madrid.

- Castillo Martín, A. (2008). Manantiales de Andalucía. Agencia Andaluza del Agua, Consejería de Medio Ambiente.
- Ceballos, A. (2001). Glosario de Hidrología Médica. Universidad Europea-CEES Ediciones, Madrid.
- Custodio, E. y Llamas, M. R. (Eds.) (2001). Hidrología subterránea, Tomo I y II, 2ª edición. Edic. Omega, S.A., Barcelona.
- Domenico, P.A. Y Schwartz F.W. (1998). Physical and Chemical Hydrogeology (2 edition). Wiley & Sons, New York.
- Fetter C.W. (2001). Applied Hydrogeology (4 Edition). Prentice Hall, New Jersey,
- Gámiz, E., Martín-García J.M., Fernández-González, M.V., Delgado, G. and Delgado, R. Influence of water type and maturation time on the properties of kaolinite-saponite peloids, 2009. Applied Clay Science, vol. 46, p. 117-123.
- Instituto de Salud Carlos III (2003). Vademécum de aguas mineromedicinales españolas.
- Llamas, J (1993). Hidrología General. Servicio Editorial de la Universidad del País Vasco, Bilbao
- Martínez, E. (2001). Hidrología Práctica. Servicio de Publicaciones de Colegio de Ingenieros de Caminos, Canales y Puertos, Madrid.
- Millero, F.J. (2001). The Physical Chemistry of Natural Waters. Wiley & Sons, New York.
- Pérez Fernández, M.R. (2005). Principios de Hidroterapia y Balneoterapia. Edición Mc Graw Hill Interamericana, Madrid.
- Pulido Bosch, A. (2007). Nociones de Hidrogeología para Ambientólogos. Editorial Universidad de Almería.
- Rodier, J. (1990). Análisis de las aguas. Ediciones Omega S.A., Barcelona.
- Rubio J.C., Beas, J., López, J.A. y Alcaín, G. (2006). Guía de Manantiales de la Provincia de Granada, una Visión sobre su Origen y Naturaleza. Diputación de Granada e Instituto Geológico y Minero de España, Granada.
- San José, C. (2001). Hidrología médica y terapias complementarias. Univ. De Sevilla. P. 139-143.
- SEA (Sociedad Española de Arcillas). (2000). Integración Ciencia-Tecnología de las Arcillas en el Contexto Tecnológico-Social del Nuevo Milenio. Sociedad Española de Arcillas, Málaga.
- Snoeyink V.L. y Jenkins, D. (2000). Química del Agua. Limusa. México.
- Stumm, W. y Morgan, J.M. (1996). Aquatic Chemistry. Willey & Sons, New York.
- Van der Leeden, F., Troise, F.L. y Todd, D.K. (1990). The Water Encyclopedia (2 Edition). Lewis Publishers. Boca Raton, Florida.

RECOMMENDED INTERNET LINKS

-Sociedad Española de Hidrología Médica: <http://www.hidromed.com/>

-La Société Française d'Hydrologie et de Climatologie Médicales: http://www.soc-hydrologie.org/gb_index.php

