**E-COURSE:**

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| --- | --- |
| Institution | Khovd State University of Mongolia |
| Course name | Biochemistry of plant |
| Credits | 2 ECTS (optional course) |
| Course type | Specific course (Required course)  |
| Lecturers | Auyrzana Amarjargal  |
| Level | MSc and PhD courses |
| Course duration | 16 weeks |
| Type | General skill |

**Summary (main concept and understanding)**

The course includes background knowledge, data analysis, individual and group exercises, field work, seminar presentation and report writing.

1. Acquire theoretical knowledge on the classification, properties and methods of separation of turpentine compounds from plants and learn the methods of separation of essential oils from plants.

 2. Study the environmental effects of aromatic plants and study the disinfecting properties of the air.

3. Acquire theoretical knowledge about the physical and chemical properties of coumarin

 4. Determine the coumarin in a plant sample by qualitative reaction and determine the quantity of the component

5. Determination of condensation and hydrolysis tannins in samples of medicinal plants

6. Knowledge of the classification and properties of alkaloids

7. Detection of alkaloids in plant samples by qualitative reaction and study of the environmental impact of alkaloid-containing plants

**Key word (5-8 words).** Flavnoids, tannins, terpenoids, diterpenoids, sesquiterpene

**Target audience**

MSc and Ph.D. students in environmental science, chemisrty

**Required courses (or equivalents):**

- Environmental science

- Environmental impact assessment

-Technology of herbal raw materials processing

**Aims and objectives**

1. To gain theoretical knowledge about the classification and properties of turpentine compounds, flavonoids, tannins, coumarins and alkaloids.

2. Be able to determine the quantity and quality of biologically active low-molecular compounds in plants

3. To be able to detect the biosynthesis and mutual transfer patterns of turpentine compounds in plants, to develop a scheme of biogenesis and to evaluate and evaluate.

**General learning outcomes:**

By the end of the course, successful students will:

1.The method of determining the properties of these substances in plants is the theoretical knowledge of the organic, aggregate, calcium, calcium, flavonoid, tannin, saponin, alkaloid classification, properties, plants, and plant biosynthesis in plants.

2. Determine the concentration of catechines and flavonoids contained in the plates and give them an assessment and conclusion.

3. Identify and explain the patterns of accumulation of turpentine compounds in plants

4. To determine the general patterns of coumarin biosynthesis in plants and to determine their role in plants

 5.Determine the accumulation of constituents of agglomerates in Artemisia and Dracocephalum.

 6. Determine quartz, flavonoids and concentrations in the flask, and learn about the determination of hydrolysis and catechins in soap and tea samples.

 **Applicable learning outcomes:**

1.Ability to determine the content of low molecular weight compounds in plants and compare them with medicinal plant standards.

2. Evaluate the amount of alkaloid-containing plants against the standard and determine the requirements for the preparation of drugs

3. Determine the content of saponins in plants and learn how to make tissue soap.

4.-Study the chemical composition and antibacterial activity of aromatic vegetable essential oils.

5.Write a report, group discussion, conduct interview

**Course workload**

|  |  |  |  |
| --- | --- | --- | --- |
| Activities/үйл ажил/ | Learning outcomes | Assessment | Workload(hours) |
| **In-class activities** |
| Lectures | Understanding theories, concepts,methodology and tools. | Class participation | 20 |
| Moderatedin-class discussions |  Learn how to separate turpentine and coumarin from plant raw materials. | Class participationand preparednessfor discussions | 20 |
| In-class assignments | To understand the various policy and management contexts and problems in communication in medicinal plant | Class participationand preparednessfor discussions | 20 |
| **Independent work** |
| Paper reviewand discussion | Familiarity with an ability to critically andcreatively discuss key concepts, tools, andmethods as presented in the literature | Class participationcreative and activecontribution todiscussion | 20 |
| Basic Concepts &Definitions | To understand basic concepts and itsapplication, components. This will include the collection of data,calculations, report writing and make the presentation | Groupdiscussion andself-workIndividual reportand presentations | 20 |
| Surveys &Assessment | Mastering the method of extracting essential oils from plants, separation of essential oils by water vapor. Determination of coumarin content in medicinal plants. Identify endogenous and exogenous essential oil plants | Going to field research and conducting experimental research | 30 |
| Fieldwork | Familiarity with the real situation, communicate with field experts, photo taken, collect relevant data and information | Participationand preparednessfor discussions | 20 |
| **Total** |  |  | **150** |

**Grading**

The students’ performance will be evaluated based on the following criteria:

* Level of preparedness for participation in class discussions and seminars (30% from 100% for active

participation and demonstrated familiarity with the course readings to 0% for completely ignoring in-class discussions);

* Contribution to group assignments and demonstration of individual work (30% from 100% for

clearly demonstrated input to 0% for non-participation);

* Quality of the approach application and reporting and presenting (40% from 100% for clearly shown

the report and presentation to 0% for non-participation);

o correct application of the approach +20%

o write report +10%

o make presentation +10%

**Сourse schedule**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| № | In classHours | Topics | Content Class | Type | lecturer |
| 1 | 2 | Properties of monoterpenes and monoterpenoids  | Myrzen, cimen, allocymen. Acyclic monoteric penoids. Properties of monoterpenes and monoterpenoids Geraniol, nerol, linalool, citronellol, jasmine properties, separation from natural raw materials, environmental effects Properties of limonene, α-terpine, terpinolene, and plant forms. Acyclic monoteric penoids. Aromatic monoterpene and its traditional compounds. Properties and significance of p-cymol, 1,8 cineole, carvacrol. | LectureSeminar, experimental research methods | A.Amarjargal |
| 2 | 2 | Bicycle monoterpen, bicycle monoterpenoid | Characteristics of terpene in the group of karen and pinene.Plants containing karene and pinene. Camphenes and sabines terpenes. Camphene and sabine-containing plants and their effects on the environment. Properties of borneol, myrthenol, isoborneol, camphor, and methods of plant separation. | LectureSeminar, experimental research methods | A.Amarjargal |
| 3 | 2 | Sesquiterpene, diterpene, polyter terpene  | Sesquiterpene and its traditional compounds. The role of terpenoids in plants and their effects on the environment.Properties of farnesene, nerolidol, farnesol, amount and importance in plants. Bicycle sesquiterpene and its traditional compounds. α-kadinine, γ-kadinene, ε-kadinene, δ-kadinene properties and forms in plants Gutta, latex properties and uses | LectureSeminar | A.Amarjargal |
| 4 | 2 | The pattern of accumulation of turpentine compounds in plants | Biogenesis of coniferous essential oils. Biogenetic stages of monoterpene formation in pine plants | Lecture | A.Amarjargal |
| 5,6 | 4 | Classification and properties of flavonoids | Effects of flavnoids on living organisms. Physical and chemical properties and classification of flavnoids. Flavones and flavonol compounds. Flavonone compounds and anthocyanins. Effects of flavonoids on animals and plants | LectureSeminar, experimental research methods | A.Amarjargal |
| 7,8 | 4 | Classification, properties and formation of coumarins in plants | Classification, properties and formation of coumarins in plants Physicochemical properties and structural features of coumarin. Path of biosynthesis in plants. Kumarin classification and properties. Coumarin biosynthesis in plants (Shikim road, acetate malon road).  | LectureSeminar, experimental research methods | A.Amarjargal |
| 9,10 | 4 | Classification and properties of tannins | Properties and biological role of the drug. Properties and significance of catechins and leukoanthocyanins. Condensation tannins, properties of hydrolyzed tannins, plant accumulation patterns. Properties and biological role of hexaoxydiphenic acid, ellaic acid. | LectureSeminar, experimental research methods | A.Amarjargal |
| 11,12,13 | 6 | Classification and properties of saponins | Physical and chemical properties of saponins. Diosgenin, α-amirin, lupeol, damarin properties and role in plants. Properties of triterpene saponins. Features of Asian acids, oleic acids, barringtogenol-C, their content in plants | LectureSeminar | A.Amarjargal |
| 14,15,16 | 6 | Classification and properties of alkaloids | Physical and chemical properties of alkaloids, their effects on plants and organisms. Classification of alkaloids. Steroids cyclopen alkaloids of the tanperhydrophenanthrene group. Adverse effects of alkaloids on the body.  | LectureSeminar, experimental research methods | A.Amarjargal |

**Course assignments**

Course assignments will constitute a multi-part project:

 Assignment #1 – Introduction: 2 pages of review note in 1 class

 Assignment #2 – Basic Concepts & Definitions: includes 2-4 classes

 Assignment #3 – Surveys & Assessment: includes 5-9 classes

 Assignment #5 – Presenting: Full report 16 class

**Literature-compulsory**

 1. Ж.Баярмаа, Д.Пүрэв Экологийн биохими УБ., 2002

 2. Березовский Т.П, Амельченко В.П, Красноборов И.М, Серых Е.А Полыни Сибири /систематика, экология, химия, хемоситематика, перспективы использования/ Новосибирск., 1991

 3.Гаммерман А.Ф. Курс фармакогнозий Ленинград., 1977

 4. Георгиевский Г.П, Казаринов Н.А, Каррыев М.О. Физико-химические методы анализа биологически активных веществ растительногопроисхождения Ашхабад., 1976

 5. Гребинский С.О Биохимия растении Львов,1978

 6.Гринкевич.Н.И, Сафронич.Л.Н. Химический анализ лекарственных растении М, Высшая школа. 1983

 7.Б.Дагвацэрэн, Г.Наранцэцэг, Л.Хишигжаргал, С.Зина, З.Оюун, Ө.Батчимэг Ургамлын эмийн зохистой хэрэглээний гарын авлага УБ., 2005

 8. Дэвис.Д, Джованелли Дж, Рис.Т. Биохимия растения М, Мир 1966

 9. Кретович В.Л Биохимия растении М., 1980

 10. Г.В. Лазурьевский, И.В Терентьва, А.А Шамшурин Практические работы по химии природных соединении М., 1964

 11.Пентагова.В.А.Терпенойды хвойных растении Новосибирск 1987

 12. Ц.Цэндээхүү Ургамлын физиологи УБ., 2018

 13. Шатар С. Эфирийн тос судлал Улаанбаатар., 1998

 14. Шатар. С Биологийн идэвхит бодис түүний эх сурвалж Улаанбаатар.,1978.

 15. Шатар. С Ойн ашигт ургамлын фармахими хими технологийн үндэс УБ., 2005

 16 .Шатар. С, А.Амаржаргал Монгол, Говь-Алтай нутгийн зарим ашигт ургамлын эфирийн тосны химийн судалгаа УБ., 2005

 17. Шатар.С, Алтанцэцэг .Ш Терпеноид хими-I УБ., 2011

 18. Шатар.С Терпеноид хими-II УБ., 2011

 19. Шатар.С Терпеноид хими-III УБ., 2011

 20.Шулов А.М. Справочник по душистых веществам и другим синтетическим продуктам парюмерно-косметический промышленности М., 1977

 21.Shatar Sanduin Chemical investigation of essential oil from Mongolian Flora Ulaanbaatar.,1998

**Электрон эх сурвалж.**

1.https://www.ted.com/talks/luca\_turin\_on\_the\_science\_of\_scent/transcript?language=ru

2.https://www.kommersant.ru/doc/4155368

3.http://www.dkv99.ru/glavnaya

4.https://www.youtube.com/watch?v=eybMbgotdR8-

5.https://www.google.com/search?q=%D1%84%D0%BB%D0%B0%D0%B2%D0%BE%D0%BD%D0%BE%D0%B8%D0%B4%D1%8B&client=firefox-b-.d&sxsrf=ALeKk01LdcRoBxCE4Y3gjkQUllhVNGw7rg:1619925060285&source=lnms&tbm=vid&sa=X&ved=2ahUKEwjroZ-Og6rwAhUJwZQKHRL6BM4Q\_AUoAnoECAEQBA&biw=1296&bih=580

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7.<https://voladm.ru/%D1%80%D0%B0%D0%B7%D0%BD%D0%BE%D0%B5/flavonoidy-yavlyayutsya-antioksidantami-flavonoidy-kak-antioksidanty-v-pishhevoj-promyshlennosti.html>

**Literature-recommended**

 1.Ж.Батхүү, Ч.Санчир, У.Лигаа, Ц.Жамсран, Suzuki Tsutomu, Oma Masaaki, Tsuruoka Tsutomu, Hamasaki Chise Монгол орны ашигт ургамлын зурагт лавлах-II Улаанбаатар 2005

 2.Беффа М.Т Лекарственные растения М., 2005

 3. Ж.Бадамханд Монгол орны зонхилох ургамлын лавлагаа УБ., 2014

 4. Володя. Ц Монгол орны эмийн ургамал УБ., 2008

 5. Володя. Ц Монгол орны эмийн ургамлыг эмнэлэгт хэрэглэх аргачлал УБ., 2014

 6.Горяев.М.И. Характеристика химических соединений входящих в состав эфирных масел М., 1953

 7. Д.Дорж, С.Даваасүрэн, Ц.Даржаа Хүрээлэн буй орчны химийн анализ УБ., 2005

 8. У.Лигаа. Монголын уламжлалт эмнэлэгт эмийн ургамлыг хэрэглэх арга ба жор УБ.,1996

 9. У.Лигаа, Б.Даваасүрэн, Н.Нинжил Монгол орны эмийн ургамлыг өрнө дорнын анагаах ухаанд хэрэглэхүй УБ., 2005

 10.Турова А.Д, СапожниковаЭ.Н. Лекарственные растения СССР и их применение М.,1984

 11.Хайдав.Ц, Алтанчимэг.Б, Варламова Т.С Лекарственные растения в монгольской медицине УБ., 1985

 12. Шатар.С. Монгол орны анхилуун ургамал Улаанбаатар., 1989