BCH 476 (Chemistry of Antibiotics)

This course covers an introduction to secondary metabolites and their chemical structure, properties and function. It also covers the classification of antibiotics, usage, isolation and purification, characterization, structural and functional properties, mode of action and resistance from the chemical and biochemical point of view.

Main Objective

This course aims to deliver a fundamental understanding of the biology and chemistry of antibiotics. It provides an insight into industrial and clinical aspects of antibiotics and about the mechanisms of antimicrobial resistance.

Course Learning Outcomes

1.0 Knowledge and understanding

1.1 Analyze properties and structure-function relationship of antibiotics

1.2 Demonstrate different mode of actions of antibiotics and to determine their effect on the metabolism of different biomolecules

2.0 Skills

2.1 Identify the main effect of antibiotics on microbes.

2.2 Discuss applications of antibiotics as a part of a team

3.0 Values, autonomy, and responsibility

3.1 Improve communication with and between students

Course Content

No	List of Topics	Contact Hours
1.	Introduction, definition of antibiotics and its sources.	1
2.	Usage of antibiotics in: medicine, veterinary and animal feed, and agriculture and the food industry.	1
3.	When & why antibiotics are produced from microorganisms. The concept of idiophase and trophophase. Primary and secondary metabolism in relation to antibiotic production. Ecological role of antibiotics in nature. Antibiotics in regulation of metabolism. Role of antibiotics in differentiation of producing microorganisms.	2
4.	Choice and administration of antibiotics to humans.	2

	Isolation of antibiotics: Isolation of the microorganisms. Classical tests and modern methods in primary and secondary screening techniques. Fractionation of antibiotics. Chromatography and electrophoresis. Characterization techniques, Hamill's scheme and Bostian computer system. Quantitative determination of antibiotics: Diffusion methods, turbidimetric methods, respirometric method, and antibiotic sensitivity tests.	
5.	Classification of antibiotics on the basis of biological effect. Classification of antibiotics according to chemical structure. The code system of Berdy. Carbohydrate antibiotic structure and characteristics (e.g. streptomycin and neomycins).	1
6.	Macrocyclic lactone antibiotics- characteristics and mode of action (e.g erythromycin A, nystatin, amphtericin B, etc).	2
7.	Quinine & similar antibiotics. General structural properties (e.g. tetracyclines and mitomycins).	2
8.	Amino acid, peptides antibiotics. Site of action (e.g. penicillin, cephalosporin, gramicidins A, gramicidins S, and actiomycins). Nitrogen containing antibiotics. Condensed and non-condensed heterocycles; structure and function. Oxygen-containing antibiotics. Sources, structural and functional properties of each.	1
9.	Alicyclic antibiotics (e.g. cycloheximide). Aromatic antibiotic (e.g. chloramphenicol). Aliphatic antibiotics (e.g. phosphonomycin). Sources, structural and functional properties of each.	2
10.	Mechanism of action of antibiotics, biochemical targets or sites of action of antibiotics: Inhibitors of cell wall synthesis (e.g. penicillin, cephalosporin, cycloserine, phosphonomycin).	2
11.	Antibiotics affecting membrane structure and function (e.g. valinomycin, gramicidin A, polymyxins, and polyene antibiotics). Ionophosphorous antibiotics.	2
12.	Antibiotics affecting purine and pyrimidine synthesis. Inhibitors of de novo purine & pyrimidine synthesis (e.g. azaserine and DON). Inhibitors of nucleotide interconversion (e.g. hadacidin). Inhibitor of nucleotide utilization (eg. Showdomycin).	2
13.	Antibiotics inhibiting ribonucleic acid metabolism: Directly (e.g. azaserine, DON, formycin, and rifamicin) and indirectly (inhibitors of RNA synthesis).	2
14.	Antibiotics that inhibit DNA metabolism by: a- cross-linking covalently with DNA (e.g. anthramycin). b- intercalation with DNA (e.g. actinomycin D and daunomycin). non-covalently interacting with DNA (e.g. chromomycin and distamycin A).	2
15.	Protein biosynthesis-inhibition by antibiotics a- Inhibitors of the initiation stage (e.g. streptomycin and tetracycline).	2

	b- Inhibitors of the elongation stage (e.g. chloramphenicol, cycloheximide, and erythromycin). c- Inhibitors of the termination stage (e.g. puromycin).	
16.	Oxidative phosphorylation and respiratory chain inhibitors (e.g. antimycin A, oligomycin, gramicidin A, and valinomycin)	2
17.	Penetration of antibiotics into the cell. Factors that influence transmembrane movement of antibiotics. **Modes of resistance to antibiotics:** a- modification of the target enzyme b- reduction of the physiological importance of the target c- prevention of access of the inhibitor synthesis of an enzyme capable of inactivating the inhibitor.	2
Total		**30**

Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Written exams	7 and 13	50
2.	Presentation, weekly quizzes and homework assignments	Weekly	10
3.	Final exam	17	40

Required Textbooks	**Chemistry and Biology of Antibiotics. By Vladimir Betina, (1983)**