

COURSE CONTENT

Course

Course code: BCH 423
Course title: Metabolic Regulation (3 Units)
Course status: Compulsory

Course Duration

5 hours per week

Lecturer Data

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Course Content:

Integration of metabolic pathways: The relationship of Kreb's Cycle to protein, carbohydrate, lipid and nucleic acid metabolism. Turnover rates and metabolic pools. Levels of enzyme regulation: Feed-back inhibition versus enzyme synthesis. Catabolite repression, end product repression, the lactose operon and arabinose operon. Regulation of enzymes and metabolic pathways. Identification of different regulatory mechanisms in metabolic pathway.

Course Description:

The course reviews the integration of metabolic pathways, examining the relationship of Kreb's cycle to protein, carbohydrate, lipid and nucleic acid metabolism. It also reviews turnover rates, metabolic pools, levels of enzyme regulation, catabolite and end product repression. The lactose and arabinose operon, and regulation of enzymes and metabolic pathways would also be considered

Course Justification:

Metabolic processes are regulated in order to control flux of metabolites or materials for optimal use by cells. Regulation is essential for several reasons: (i) Maintenance of an ordered state: Regulation of each pathway results in the production of the substances required to maintain cell structure and function in a timely fashion and without wasting resources; (ii) Conservation of energy: Cells constantly control energy-generating reactions so that they consume just enough nutrients to meet their energy requirements; (iii) Responsiveness to environmental changes: Cells can make relatively rapid adjustments to changes in temperature, pH, ionic strength, and nutrient concentrations because they can increase or decrease the rates of specific reactions. From the foregoing, knowledge of Metabolic Regulation is imperative to understanding how living systems avoid futile cycle.

Course objectives: At the end of the course, students would be able to;

- i. Describe the central metabolic themes
- ii. Highlight major metabolic pathways
- iii. Describe the metabolic profile of different tissues and organs
- iv. Highlight and explain metabolic pool and intermediary metabolism
- v. Explain the integration of carbohydrate, protein, lipids and nucleic acid metabolism into Kreb's cycle
- vi. Describe metabolic fates of key metabolites
- vii. Explain impact of alcohol on tissue metabolism
- viii. Highlight and explain different metabolic states
- ix. Highlight and describe different regulatory mechanisms in metabolic pathways

Method of Grading:

S/N	Grading	Score (%)
1.	Test/Assignment	15
2.	Practical (laboratory work)	15
3.	Final Examination	70
	Total	100

Course Delivery Strategies:

Lectures will be given. Guided instructions for practical activities, and interactive classroom sessions will hold for adequate participation of the students. Assignments will be given periodically either individually or in groups

LECTURE CONTENT

Week 1-3: Integration of metabolic pathways: the relationship of Kreb's cycle to protein, carbohydrate, lipid and nucleic acid metabolism

Objective: The students at the end of the lectures for the week should be able to;

- (i) Describe the central themes of metabolism
- (ii) Highlight major metabolic pathways
- (iii) Review the metabolism of carbohydrates, lipids, proteins and nucleic acid
- (iv) Describe integration of carbohydrates, lipids, protein and nucleic acid metabolism into Kreb's cycle

Study Questions:

1. Mention the central themes of metabolism
2. Mention key metabolic pathways
3. Highlight relationship between the Kreb's cycle and metabolism of carbohydrates, lipids, protein and nucleic acid

Recommended reading:

- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
- Harper's Illustrated Biochemistry, (2003) twenty-sixth edition. McGraw-Hill companies limited. ISBN-0-07-121766-5
- Nelson, D. L. and Cox, M. M. (2004) Integration and Hormonal Regulation of Mammalian Metabolism. Lehninger Principles of Biochemistry. 4th edition. Worth Publishers, New York

Week 4: Turnover rates and metabolic pools

Objective: The students at the end of the lectures for the week should be able to

- (i) Explain the 'metabolic pool' and 'intermediary metabolism'
- (ii) Describe metabolic fates of key metabolites

Study Questions:

1. What is metabolic pool?
2. Explain intermediary metabolism
3. What is the metabolic fate of glucose?

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- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
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Week 5: Identification of different regulatory mechanisms in metabolic pathways

Objective: The students at the end of the lectures for the week should be able to

- (i) Highlight regulatory steps in different metabolic pathways
- (ii) Explain the mechanism of regulation in metabolic processes

Study Questions:

1. Highlight the regulatory steps in glycolysis, Kreb's cycle and gluconeogenesis
2. What is compartmentation?
3. With relevant examples, explain the role of hormones in regulating metabolic processes

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Week 6: Regulation of enzymes and metabolic pathways

Objective: The students at the end of the lectures for the week should be able to:
Give a general overview of factors that influence enzymatic activity

Study Question:

Describe the regulation of aspartate carbamoyltransferase, a key enzyme of pyrimidine biosynthesis as an example of allosteric regulation of enzyme activity.

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- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
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Week 7: Levels of enzyme regulations: feedback inhibition vs enzyme synthesis

Objective: The students at the end of the lectures for the week should be able to:

Describe how the TCA cycle is regulated

Study Question:

Describe the levels of enzyme regulation.

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- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
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Week 8: Catabolite repression and End product repression

Objective: The students at the end of the lectures for the week should be able to

- (i) Have a basic understanding of what differences exist between catabolite repression and end product repression

Study Question:

1. Describe the catabolite repression in the arabinose operon

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- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
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Week 9: The lactose operon

Objective: The students at the end of the lectures for the week should be able to

- (ii) Have a basic understanding of what is meant by gene expression
- (iii) Itemize the main players and actors of the lactose operon
- (iv) Describe the negative and positive control of the lactose operon

Study Question:

1. Discuss the negative and positive control of the lactose operon

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- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1

- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
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Week 10: The arabinose operon

Objective: The students at the end of the lectures for the week should

- (i) Have an understand of the details of *araBAD* operon

Study Question:

1. Discuss the role of Ara C protein in the regulation of the *araBAD* operon

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Week 11: Regulation of enzymes and metabolic pathways

Objective: The students at the end of the lectures for the week should be able to

- (i) Identify the factors that influence enzymatic activity
- (ii) Understand the fundamental mechanisms of metabolic regulation

Study Questions:

1. Explain the factors that influence enzymatic activity
2. Discuss the fundamental mechanisms of metabolic regulation

Recommended reading:

- Garrett Reginald H. and Grisham Charles M. (2007). Biochemistry. Updated Third Edition. Brooks/ Cole. ISBN 0-495-11912-1
- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
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Week 12: Identification of different regulatory mechanisms in metabolic pathway

Objective: The students at the end of the lectures for the week should be able to

- (i) Identify regulatory mechanisms in metabolic pathway

Study Questions:

1. Identify the regulatory mechanisms involved in the metabolism of carbohydrate
2. Identify the regulatory mechanisms involved in the β -oxidation of fatty acids

Recommended reading:

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- Biochemistry, Third edition (2005) by Voet and Voet, Wiley, ISBN: 978-0-471-19350-0.
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Week 13: Tutorial**Objective:** To enhance comprehension of all that has been taught**Week 14:** Revision**Objective:** To remind students of all that has been taught**Week 15:** Examination**Objective:** To examine students of all that has been taught