



# SUBJECT OUTLINE

Subject Name:

**Nutritional Biochemistry**

Subject Code:

**NMDF211**

## SECTION 1 – GENERAL INFORMATION

Award/s:	Total Course Credit Points:	Level:
Bachelor of Health Science (Naturopathy)	128	2 <sup>nd</sup> Year
Bachelor of Health Science (Nutritional and Dietetic Medicine)	96	2 <sup>nd</sup> Year
<b>Duration:</b> 1 Semester		
<b>Subject Coordinator:</b> Dr Mansi Dass Singh (Adelaide Campus)		
<b>Subject is:</b> Core	<b>Subject Credit Points:</b> 2	

### Student Workload:

No. timetabled hours per week:	No. personal study hours per week:	Total hours per week:
<b>3</b>	<b>2</b>	<b>5</b>

### Delivery Mode:

e-Learning (Online)	Narrated PowerPoint presentations Tutorials: Asynchronous tutor moderated discussion forum and activities Student handouts, web-based resources	
Blended Learning (Online and Live Streaming)	1 x 2 hour lecture live streamed	1 x 1 hour tutorial activities / workshops as indicated
Intensive Delivery (Summer School)	Live streaming contact hours are delivered over 4 weeks with 1 x 6.5 hour days delivered per week; online contact hours are delivered over 4 weeks with activities due before and after relevant lectures as indicated below. Content: Combination lecture and tutorial activities Assessment: Report - Week 2; Integrative Biochemical Analysis - Week 4; Final Exam - Week 5 Full Time Part Time	
<b>Pre-requisites:</b>	BIOH122, NMDF121	
<b>Co-requisites:</b>	Nil	



## SECTION 2 – ACADEMIC DETAILS

### Subject Rationale

This subject draws on students' understanding of biochemistry and explores the biochemical activity of nutrients and food constituents in the human body. Students gain an appreciation of the clinical relevance of nutritional biochemistry and the influence of dietary modification and nutritional intervention on physiology and physiological dysfunction. Essential biochemical pathways are explored in relation to the nutritional influences that moderate those pathways. Students further develop their understanding of the role that biological oxidation and the metabolic release of energy plays in disease processes. Students learn about the influence of nutritional biochemistry in liver detoxification, neurotransmitter synthesis, antioxidant pathways and immune function. This subject deepens students' understanding of nutrition and diet therapy while developing their investigative skills in a way that will augment later nutritional medicine and clinical practicum subjects.

### Learning Outcomes

1. Investigate the biochemical absorption, storage and metabolic function of macro- and micro- nutrients.
2. Illustrate an understanding of the major metabolic pathways including the role of nutrient cofactors, substrates, enzymes and coenzymes in dysfunction when compared with normal metabolic function within the body.
3. Demonstrate an understanding of the inter-relationship between the nutrients and their metabolites involved in metabolic and detoxification pathways.
4. Examine and explain the links between inflammation, oxidation and antioxidants and the impact these can have developing physiological dysfunctions.
5. Understand the microbiome and its modulation through diet with the strategic aim to prevent dysfunction.
6. Describe the role of the nutrients in the synthesis of hormones and neurotransmitters and their action on metabolic dysfunction.

### Assessment Tasks

Type	Learning Outcomes Assessed	Session Content Delivered	Due	Weighting
<b>Report</b> (750 words)	1 - 3	1 - 4	Week 6	25%
<b>Integrative Biochemical Analysis</b> (1000 words)	3 - 6	5 - 10	Week 12	35%
<b>Final Written Exam</b> multiple choice, short answer and case study questions	1 - 6	1 - 13	Final Examination Period	40%



(1.5 hours)

All written assessments and online quizzes are due at 11:55 p.m. Sunday and submitted through the LMS

### Prescribed Readings:

1. Gropper, S. S., & Smith, J. L. (2017). *Advanced nutrition and human metabolism* (7th ed.). Wadsworth; Cengage Learning. [eBook available]

### Recommended Readings:

1. Lord, R. S., & Bralley, J. A. (Eds.). (2008). *Laboratory evaluations for integrative and functional medicine* (2nd ed.). Metamatrix Institute.
2. Nelson, D. L., & Cox, M. M. (2016). *Lehninger principles of biochemistry* (7th ed., international ed.). W.H. Freeman.
3. Pagana, K. D., & Pagana, T. J. (2018). *Mosby's manual of diagnostic and laboratory tests* (6th ed.). Elsevier. [eBook available 5th ed.]
4. Stipanuk, M. H., & Caudill, M. A. (2019). *Biochemical, physiological, and molecular aspects of human nutrition* (4th ed.). Elsevier.

## Subject Content

Week	Lectures	Tutorials
1.	<p><b>Introduction</b> (Subject Outline / Subject Aims / Assessment / Teaching Resources)</p> <p>Stimulation and Hormonal Regulation of the Digestive System</p> <p><b>Macronutrient Pharmacokinetics</b></p> <ul style="list-style-type: none"> <li>➤ Biochemical mechanisms of digestion, absorption and metabolism</li> <li>➤ Transport and storage physiology</li> <li>➤ Agonists and antagonists</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch a video on Sodium potassium pump</li> <li>➤ Revise the previous knowledge through <i>H5P</i> activity of 'flip the card' on Stimulation and Hormonal Regulation of the Digestive System</li> </ul> <p>In-class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Watch a video by Khan academy on lipid absorption and transport</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ <i>H5P</i> activity on LMS- Match the GLUT transporters to their location</li> <li>➤ Group discussion on <i>flip grid</i> on the impact of gastric surgery and the lack of stomach and intestinal enzymes (causes and effects).</li> </ul>
2.	<p><b>Water Soluble Vitamin Pharmacokinetics</b></p> <ul style="list-style-type: none"> <li>➤ Biochemical mechanisms of digestion, absorption and metabolism</li> <li>➤ Transport and storage physiology</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Revision activity through a reading on LMS on the food sources, deficiency symptoms and excess of vitamin Bs</li> </ul>



	<ul style="list-style-type: none"> <li>➤ Agonists and antagonists</li> </ul>	<p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Watch a video on Vitamin B12 absorption and transport.</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ H5P activity: 'Drag and place' to revise the concepts of absorption and transport of vitamins through the epithelial layer</li> <li>➤ Fill the summary sheet for each vitamin-self fill</li> <li>➤ Revision questions-self complete</li> </ul>
<p>3.</p>	<p><b>Fat Soluble Vitamin and Macromineral Pharmacokinetics</b></p> <ul style="list-style-type: none"> <li>➤ Biochemical mechanisms of digestion, absorption and metabolism</li> <li>➤ Transport and storage physiology</li> <li>➤ Agonists and antagonists</li> </ul>	<p>Pre-lecture:</p> <ul style="list-style-type: none"> <li>➤ Revision activity through a reading on LMS on the food sources, deficiency symptoms and excess of fat soluble vitamins and macrominerals</li> </ul> <p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Watch animated video on absorption and transport of Vitamin D.</li> </ul> <p>Post-lecture:</p> <ul style="list-style-type: none"> <li>➤ H5P activity: 'Drag and match' - to revise concepts of Vitamin A absorption and transport.</li> <li>➤ H5P activity: Flip the card to revise concept of vitamin D activation</li> <li>➤ Fill the summary sheet for each vitamin-self fill</li> <li>➤ Revision questions-self complete</li> </ul>
<p>4.</p>	<p><b>Micromineral Pharmacokinetics</b></p> <ul style="list-style-type: none"> <li>➤ Biochemical mechanisms of digestion, absorption and metabolism</li> <li>➤ Transport and storage physiology</li> <li>➤ Agonists and antagonists</li> </ul>	<p>Pre-lecture:</p> <ul style="list-style-type: none"> <li>➤ Revision activity through a reading on LMS on the food sources, deficiency symptoms and excess of microminerals</li> </ul> <p>In-class blended activity:</p> <ul style="list-style-type: none"> <li>➤ H5P activity on absorption, storage and transport of Iron</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Reading of research paper on clinical importance of Zinc-posting key points on <i>padlet</i>.</li> <li>➤ Revision questions-<i>kahoot</i></li> </ul>



		<ul style="list-style-type: none"> <li>➤ Fill the summary sheet for each mineral-self fill</li> <li>➤ Revision questions week 1-4 on LMS</li> </ul>
5.	<p><b>Microbiome Prebiotics and probiotics</b></p> <ul style="list-style-type: none"> <li>➤ SIBO / Gut dysiosis</li> <li>➤ Effects of gut microbiota in prevention of dysbiosis</li> <li>➤ Introduction to microbiome testing and use in prevention of dysfunctions</li> <li>➤ Role of pro and prebiotics in moderating food intolerance, immunity and malabsorption syndromes</li> </ul>	<p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Discussion on 'Dietary sources and recipes of prebiotic and probiotic foods'.</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch TED talk on Gut microbiome</li> <li>➤ Watch Catalyst video</li> <li>➤ Revision questions - on <i>Kahoot</i></li> <li>➤ Watch a video by 'microba' on Introduction to microbiome testing and use in prevention of dysfunctions</li> </ul>
6.	<p><b>Liver Detoxification</b></p> <ul style="list-style-type: none"> <li>➤ Liver Phase One Pathways</li> <li>➤ Liver Phase Two Pathways</li> </ul> <p><b>Alcohol Detoxification</b></p>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Read an article to revise the functions of Liver</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ <i>H5P</i> activity on on Phase 1 and II-Drug and Match</li> <li>➤ Researching Liver detox functional testing online for local or web-based tests such as-by NutriPath</li> <li>➤ Revision questions - self complete/kahoot</li> <li>➤ Read an article on 'Glutathione'</li> </ul>
7.	<p><b>Integration of Mind and Body</b></p> <ul style="list-style-type: none"> <li>➤ HPA axis and stress systems overview</li> <li>➤ Overview of Endocrine system</li> <li>➤ Relationship between liver and other organs</li> <li>➤ Cofactors and nutrients required</li> <li>➤ Hormonal regulation of biochemical pathways</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Reading to revise prelearned concepts- Endocrine systems and HPA axis</li> </ul> <p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Watch a video on 'effect of stress on body's biochemical pathways'.</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ <i>Flipgrid</i>: Research based reading on understanding effect of lifestyle modifications in prevention of metabolic dysregulation (e.g. meditation in HPA dysregulation and possible benefits for chronic diseases as well).</li> <li>➤ Mindfulness activity with music</li> </ul>
<p><b>NON-TEACHING WEEK</b> (note that make-up classes may be scheduled in this week)</p> <p><b>Semester 1</b> – This aligns with the week after Easter so it may fall between Weeks 6 to 8</p>		



Semester 2 & Online students – The non-teaching week falls between Weeks 7 and 8		
<b>8.</b>	<p><b>Nutrient Control of Gene Expression</b></p> <ul style="list-style-type: none"> <li>➤ Overview of DNA structure</li> <li>➤ One carbon metabolism</li> <li>➤ Epigenetics</li> <li>➤ Methylation</li> <li>➤ Homocysteine</li> <li>➤ Ethics relating to testing and challenges/ considerations for patients applying for health/life insurance</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch animated videos to revise the concept of DNA structure, functions and gene expression.</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Reading on 'Ethics relating to testing and challenges/ considerations for patients applying for health/life insurance'-discussion on <i>padlet</i></li> </ul>
<b>9.</b>	<p><b>Managing Oxidation</b></p> <ul style="list-style-type: none"> <li>➤ Overview of Free radical generation</li> <li>➤ Food based Antioxidants</li> <li>➤ Endogenous antioxidants</li> <li>➤ Regeneration / redox pathways</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch video on the effect of antioxidants on quenching free radicals in human body</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Developing of list of foods with highest antioxidant content on <i>padlet</i> and discuss ways to strengthen endogenous antioxidant system (nutrients and lifestyle factors)</li> <li>➤ Revision questions on <i>Kahoot</i></li> </ul>
<b>10.</b>	<p><b>Inflammation: Underlying Mechanisms of Origins of Diseases</b></p> <ul style="list-style-type: none"> <li>➤ Overview of Essential fatty acids and food sources</li> <li>➤ The role of prostaglandins, leukotrienes and cytokines</li> <li>➤ Overview of diseases with inflammation</li> <li>➤ Nutrients to address inflammation</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Reading on 'Disease prevention by modulating inflammation through an Anti-inflammatory diet'.</li> </ul> <p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Experiment - 24 hr self-dietary recall for list of anti-inflammatory foods/nutrients consumed.</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Discussion on 'Effect of Ketogenic diet vs Intermittent fasting on Inflammation and weight reduction' on <i>flipgrid</i></li> </ul>
<b>11.</b>	<p><b>Neurotransmitter</b></p> <ul style="list-style-type: none"> <li>➤ Synthesis of neurotransmitters</li> <li>➤ Types of neurotransmitters</li> <li>➤ Functions of neurotransmitters</li> <li>➤ Nutrient and cofactors required for optimal function</li> <li>➤ Relevance for mental health</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch a Khan academy video on classification of Neurotransmitters</li> </ul> <p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Develop a strategic dietary plan to balance neurotransmitters for a University student based on a research article.</li> </ul>



		<p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ <i>H5P</i> activity on the types of neurotransmitters</li> <li>➤ Revision questions on <i>kahoot</i></li> </ul>
12.	<p><b>Mitochondrial Dysfunction</b></p> <ul style="list-style-type: none"> <li>➤ Overview of mitochondria and CAC pathways</li> <li>➤ Nutrients and cofactors required</li> <li>➤ Role in chronic diseases</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Watch TED talk on Mitochondrial dysfunction</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Revision questions wk 5-13 on LOOP</li> </ul>
13.	<p><b>Homeostatic Maintenance</b></p> <ul style="list-style-type: none"> <li>➤ Overview of kidney functions</li> <li>➤ Body fluid, electrolytes and the role of the kidneys</li> <li>➤ Acid-base balance Role of diet in regulation of body pH</li> </ul>	<p>Pre lecture:</p> <ul style="list-style-type: none"> <li>➤ Revision of the functions of kidney through <i>H5P</i>-‘Flip the cards’</li> </ul> <p>In class blended activity:</p> <ul style="list-style-type: none"> <li>➤ Practice case study for the final exam</li> </ul> <p>Post lecture:</p> <ul style="list-style-type: none"> <li>➤ Reflect on the effect of low acid diet on metabolic conditions through a research paper reading-self completion</li> </ul>
14.	<p><b>Non-Teaching Week/Practical Examination Week 1</b></p> <p>Note that make-up classes may be scheduled in this week</p>	
15.	<p><b>Non-Teaching Week/Practical Examination Week 2</b></p> <p>Note that make-up classes may be scheduled in this week</p>	
16.	<p><b>Final Examination Week 1</b></p> <p>Students are required to sit examinations using the Respondus Lockdown Browser software per the <a href="#">Examination Policy – Higher Education</a>. Refer to your local campus calendar for exam opening and closing times.</p>	
17.	<p><b>Final Examination Week 2</b></p> <p>Students are required to sit examinations using the Respondus Lockdown Browser software per the <a href="#">Examination Policy – Higher Education</a>. Refer to your local campus calendar for exam opening and closing times.</p>	