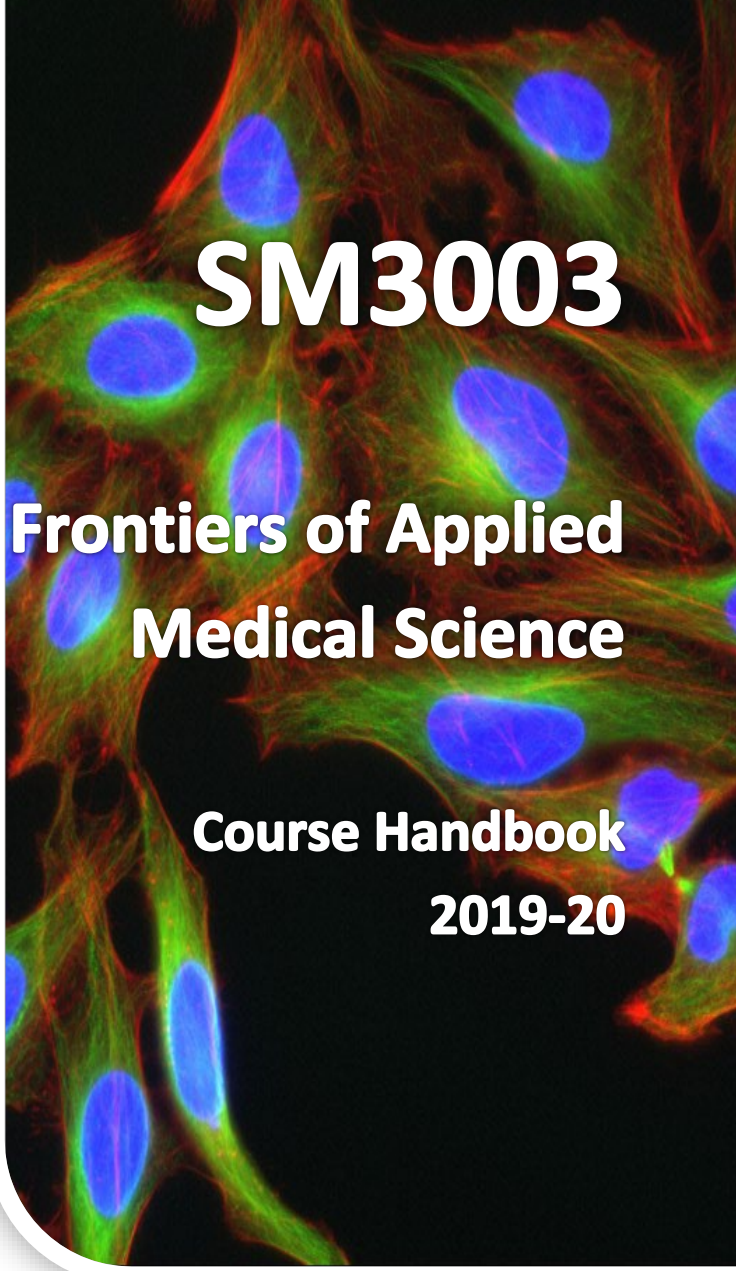
School of Medicine, Medical Sciences & Nutrition



SM3003

Frontiers of Applied Medical Science

Course Handbook

2019-20

1495 UNIVERSITY OF ABERDEEN

Contents

Cover image:

Confocal micrograph of fluorescently labelled HeLa cells.

Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:

Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology

Course Summary

This course provides core material regarding the physiological responses to acute exercise and the adaptations that occur in response to repeated bouts of exercise. It deals with the measurement of energy, work and power, the structure and function of skeletal muscle, respiration and control of acid-base status, cardiovascular function, and temperature regulation during exercise, the adaptation to training, and mechanisms of fatigue.

Course Co-ordinators: Dr Michael Scholz (ext 8022) m.e.scholz@abdn.ac.uk

Course Aims & Learning Outcomes

To provide students with core knowledge appropriate to the study of the physiological responses and adaptations to physical exercise. Specifically, to:

1. Provide a basic understanding of the concepts of energy, work and power as applied to the exercising human.
2. Give an overview of the factors that determine muscle strength in man, the adaptations of skeletal muscle to strength training, and the contractile and metabolic properties of different muscle fibre types.
3. Explain the control of ventilation and the ventilatory response to exercise: considering both gas transport and acid-base roles of the lungs.
4. Present the function of the cardiovascular system at rest and during exercise, and discuss possible sites of limitation to the transport of oxygen and the adaptations that occur with training.
5. Explain thermal balance of man during exercise in different environments.
6. Introduce the theory of training and the adaptations that occur in response to different types of training.

Course Teaching Staff

Course Co-ordinator(s):

Dr Michael Scholz (MES), Medical Sciences & Prof Alison Jenkinson (AMJ), Medical Sciences

Other Staff:

Dr Guy Bewick (GB), Medical Sciences

Dr Derek Ball (DB), Medical Science

Prof Stephen Davies (SND), Medical Sciences

Dr Arimantas Lionikas (AL), Medical Sciences

Susan McCourt (SM), Library & Information Services

Assessments & Examinations

Students are expected to attend all lectures, laboratory classes, and tutorials, and to complete all class exercises by stated deadlines. The minimum performance acceptable for the granting of a class certificate is attendance at 75% of the practical classes, and 100% attendance at the presentation of all set course work, written and oral.

The continuous assessment (CA) accounts for 30% of the total assessment. The continuous assessment is based on the course essay (12.5%), the oral presentation (7.5%) and the data analysis and blood pressure practicals (5% each).

Written Examination: 70% of the total assessment is based on one three hour written paper. The student has to answer four questions of equal weighting selected from a choice of six questions.

Common grading scale (CGS) grade: The overall performance of the student is expressed as a grade awarded on the common spine marking scale. See attached sheet.

The degree examination is held in December, with the re-sit examination in July/August.

Class Representatives

We value students' opinions in regard to enhancing the quality of teaching and its delivery; therefore in conjunction with the Students' Association we support the Class Representative system.

In the School of Medicine, Medical Sciences and Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the class representative system visit **www.ausa.org.uk** or email the VP Education & Employability **vped@abdn.ac.uk**. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: **www.abdn.ac.uk/careers**.

Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with, alone they should notify the course coordinator immediately. If the problem relates to the subject matter general, advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (**medsci@abdn.ac.uk**) on the ground floor of the Polwarth Building in Foresterhill, or Mrs Sheila Jones (**s.jones@abdn.ac.uk**) in the Old Aberdeen office associated with the teaching laboratories, to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e. work from second semester during the summer vacation), coursework will be kept until the end of Fresher's Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

Astrand, P.O., Rodahl, K, Dahl, M.A & Stromme, S.B. Textbook of Work Physiology (Physiological Bases of Exercise), 2004, ISBN 0-7360-0140-9, Human Kinetics.

McArdle, W. D., Katch, F. I. & Katch, V. L. Exercise Physiology. Energy, Nutrition, and Human Performance . 2007, ISBN 0-7817-4990-5 Lippincott Williams & Wilkins.

Powers, S.K, Howley E.T Exercise Physiology - Theory and Application to Fitness and Performance, Ninths edition, 2015 ISBM 978-1-259-09500-9, McGraw-Hill

Lecture Synopsis

Lecture 1: Applied Medical Sciences: an overview - Dr Michael Scholz & Prof Alison Jenkinson

Description of the content of Course SM3003 and introduction to the physiology of exercise. Expectations with regard to continuous assessment (essay & presentation).

Lecture 2-3: Energy, work and power - Dr Michael Scholz

Lecture 2: Units of measurement. Energy, work and power defined. Laboratory measurement of work and power. Measurement of energy expenditure.

Lecture 3: Laboratory measures of aerobic and anaerobic power and capacity. Absolute and relative power output: maximum oxygen uptake. Limitations to predictive methods. Calculation of mechanical efficiency. Laboratory tests of performance.

Lecture 4-6: Respiration and acid-base balance - Dr Derek Ball

Lecture 4: Mechanics & control of breathing. Lung structure and function. Physics of breathing. Transport of oxygen and carbon dioxide. Controls of breathing: central and peripheral chemoreception. Other control mechanisms.

Lecture 5: Ventilation during exercise. Energy for respiration. Effects of exercise intensity and duration. The lungs as a limiting factor in exercise.

Lecture 6: Acid-base balance in exercise. Metabolic acidosis. Respiratory compensation. Renal and non-renal mechanisms.

Lecture 7-11: Skeletal muscle structure and function. - Dr Alison Jenkinson

Lecture 8: Skeletal Muscle - an overview: muscle structure and mechanisms of contraction. Isometric, isotonic and isokinetic contraction. Neural control of movement.

Lecture 9: Determinants of muscle strength. Muscle size; anatomical and physiological cross section. Experimental models in man. Voluntary and evoked contractions.

Lecture 10: Muscle fibre types. Contractile and metabolic characteristics of different fibre types. Recruitment patterns in different activities. Implications for muscle strength.

Lecture 11: Effects of training on muscle strength. Hypertrophy vs hyperplasia. Limits to adaptation. Effects of disuse on muscle mass and function. Effects of ageing on strength.

Lecture 12-15: Cardiovascular function - Prof Stephen Davies

Lecture 12: The heart. Heart rate, stroke volume and cardiac output. Control of heart rate at rest and during exercise of varying intensities. Cardiac drift. Control of blood pressure. Cardiac output as a limitation to oxygen uptake. Adaptations to training. (SND)

Lecture 13: The peripheral circulation. Muscle capillarity. Fibre types and capillary density. Adaptations to endurance exercise. Implications of altered capillary density. (SND)

Lecture 14: Oxygen utilisation in the periphery. Muscle metabolic capacity as a limitation to maximum oxygen uptake. Integration of the metabolic and cardio-respiratory response to exercise. Adaptations to training. (SND)

Lecture 15-17: Training and Adaptation – Dr Arimantas Lionikas

Lecture 15: Principles of training. Classical and contemporary views of mechanisms that control adaptation to training.

Lecture 16: Strength training; training forms to increase muscle size and neural activations. Muscle protein synthesis response to resistance training. Neural adaptations.

Lecture 17: Endurance training; ACSM guidelines, programmes for athletes, introduction to mechanisms that regulate fibre phenotype, mitochondrial biogenesis and cardiac hypertrophy.

Lecture 18-20: Endocrinology – Dr Derek Ball

Lecture 18: Introduction and overview

Lecture 19/20: Endocrinology and Exercise

Lecture 21-24: The body in extreme environments –Dr Michael Scholz

Lecture 21: Principles of heat production and heat loss during exercise. Exercise in the heat: physiological impact and effect on performance.

Lecture 22: Exercise in the cold: heat conservation mechanisms, risks and tolerance.

Lecture 23: Exercise at altitude: atmospheric changes at altitude, physiological adjustments, impact on performances, acclimatization.

Lecture 24: Diving - water as surrounding media: buoyancy, density, viscosity, gasses under high pressure, nitrogen narcosis, oxygen toxicity, tissue saturation, decompression, SCUBA-diving, apnoea diving

Lecture 25-27: Fatigue and limitations to exercise performance. - Dr Derek Ball

Lecture 25: Performance measures and assessment of fatigue. Causes of fatigue in high intensity exercise. Depletion and accumulation hypotheses. Anaerobic capacity and oxygen deficit. Oxygen supply. Acid-base and manipulation of performance.

Lecture 26: Causes of fatigue in prolonged exercise. Substrate depletion. Cardiovascular function: maintenance of muscle perfusion and skin blood flow. Maintenance of central venous pressure.

Lecture 27: The central fatigue hypothesis. Serotonin and fatigue. Circumstantial evidence. Experimental interventions: pharmacological studies. Animal models. Training and serotonergic function.

Practical/Lab/Tutorial Work

Course Work

All students will complete a 1,500-word essay on a set subject. Your essay should include a list of cited references and these should be cited at appropriate places in the text. The essay must be submitted in word-processed format. The deadline for essay submission is Friday 2nd November at 13.00 and should be submitted using Turnitin. A link will be made available on MyAberdeen. The essay content and titles will be discussed during the Essay Topics tutorial.

In addition, you will have to complete a seminar based on the content of your course essay to the class. Each seminar will consist of a 10-minute PowerPoint presentation followed by a 5-minute discussion and a further 5 minutes to allow peer assessment. The criteria for assessing each presentation is given on a separate sheet.

Data analysis and blood pressure practical's

Details to follow.

Health and Safety

Before you start your laboratory work, you will have to attend a short course on Health and Safety. This is a legal requirement and you will have to complete and submit a short test to show that you have attended. You will not be allowed to continue with the rest of the course unless you have satisfactorily completed this test.

University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (**https://abdn.blackboard.com/bbcswebdav/institution/Policies**). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the **University's Infohub webpage** or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum

Medical Sciences Common Grading Scale

Grade	Grade Point	Category	Honours Class	Description
A1	22	Excellent	First	• Outstanding ability and critical thought • Evidence of extensive reading • Superior understanding • The best performance that can be expected from a student at this level
A2	21			
A3	20			
A4	19			
A5	18			
B1	17	Very Good	Upper Second	• Able to argue logically and organise answers well • Shows a thorough grasp of concepts • Good use of examples to illustrate points and justify arguments • Evidence of reading and wide appreciation of subject
B2	16			
B3	15			
C1	14	Good	Lower Second	• Repetition of lecture notes without evidence of further appreciation of subject • Lacking illustrative examples and originality • Basic level of understanding
C2	13			
C3	12			
D1	11	Pass	Third	• Limited ability to argue logically and organise answers • Failure to develop or illustrate points • The minimum level of performance required for a student to be awarded a pass
D2	10			
D3	9			
E1	8	Fail	Fail	• Weak presentation • Tendency to irrelevance • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts
E2	7			
E3	6			
F1	5	Clear Fail	Not used for Honours	• Contains major errors or misconceptions • Poor presentation
F2	4			
F3	3			
G1	2	Clear Fail/ Abysmal	-	• Token or no submission
G2	1			
G3	0			

Course Timetable SM3003: 2019-2020

Date	Time	Place	Subject	Session	Staff
Week 7					
Mon 9 Sep	12:00-13:00	NK14	Registration / Introduction	Lecture	MES/AMJ
Tue 10 Sep					
Wed 11 Sep	12:00-13:00	C11	Applied Medical Sciences: an overview	Lecture	MES/AMJ
Thu 12 Sep	14:00-15:00	*	Private study time	N/A	
Fri 13 Sep	12:00-13:00	C11	Energy, work & power 1	Lecture	MES
Week 8					
Mon 16 Sep	10:00-11:00	St Marys 105	Safety course - part 1 (with SM3002)	Lecture	GSB
	12:00-13:00	NK14	Mechanics & control of breathing	Lecture	DB
Tue 17 Sep					
Wed 18 Sep	11:00-12:00	MR051	Safety course - part 2 (with SM3002)	Lecture	GSB
	12:00-13:00	C11	Ventilation during exercise	Lecture	DB
Thu 19 Sep	15:00-18:00	Com MR106	Essay & Presentation Preparation - Introduction	Tutorial	MES
Fri 20 Sep	12:00-13:00	C11	Energy, work & power 2	Lecture	MES
Week 9					
Mon 23 Sep	12:00-13:00	NK14	Acid-base balance in exercise	Lecture	DB
Tue 24 Sep					
Wed 25 Sep	12:00-13:00	NL S2	Using Library Resources Lecture	Lecture	SMC
Thu 26 Sep	13:00-14:00	NL PC2	Using Library Resources Group 1	Practical	SMC
	14:00-15:00	NL PC2	Using Library Resources Group 2	Practical	SMC
Fri 27 Sep	12:00-13:00	C11	Practical skills: Blood pressure	Tutorial	MES
Week 10					
Mon 30 Sep	12:00-13:00	NK14	Skeletal muscle - 1	Lecture	AMJ
Tue 1 Oct					
Wed 2 Oct	12:00-13:00	*	Private study time	N/A	
Thu 3 Oct					
Fri 4 Oct	12:00-13:00	C11	Skeletal muscle - 2	Lecture	AMJ
Week 11					
Mon 7 Oct	12:00-13:00	NK14	Cardiovascular response to exercise 1	Lecture	SMD
Tue 8 Oct					
Wed 9 Oct	12:00-13:00	C11	Skeletal muscle - 3	Lecture	AMJ
Thu 10 Oct					
Fri 11 Oct	12:00-13:00	C11	Skeletal muscle - 4	Lecture	AMJ
Week 12					
Mon 14 Oct	12:00-13:00	NK14	Cardiovascular response to exercise 2	Lecture	SND
Tue 15 Oct					
Wed 16 Oct	12:00-13:00	C11	Training mechanisms	Lecture	AL
Thu 17 Oct	14:00-16:00	ZB06	Practical skills: Blood pressure	Practical	MES
Fri 18 Oct	12:00-13:00	C11	Limitations to cardiac performance	Lecture	SND
Week 13					
Mon 21 Oct	12:00-13:00	NK14	Private Study	Lecture	
Tue 22 Oct					
Wed 23 Oct	12:00-13:00	C11	Strength training	Lecture	AL

Thu 24 Oct	13:00-17:00	F81	Data handling/analysis practical	Practical	AL
Fri 25 Oct	12:00-13:00	C11	Endurance training	Lecture	AL
Week 14					
Mon 28 Oct	12:00-13:00	NK14	Endocrinology I: Introduction and Overview	Lecture	DB
Tue 29 Oct					
Wed 30 Oct	12:00-13:00	C11	Endocrinology II: Endocrinology & Exercise	Lecture	DB
Thu 31 Oct	13:00-15:00	S81	Data handling/analysis practical	Practical	AL
Fri 1 Nov	12:00-13:00	C11	Private study		
	by 13:00		Deadline for essay submission		
Week 15					
Mon 4 Nov	12:00-13:00	NK14	Endocrinology III: Endocrinology & Exercise	Lecture	DB
Tue 5 Nov					
Wed 6 Nov	12:00-13:00	C11	Mock exam	Tutorial	MES
Thu 7 Nov	13:00-15:00	S81	How to make an effective presentation	Tutorial	MES
Fri 8 Nov	12:00-13:00	C11	Exercise in extreme environments I: Temperature regulation in the heat	Lecture	MES
Week 16					
Mon 11 Nov	12:00-13:00	NK14	Exercise in extreme environments II: Temperature regulation in the cold	Lecture	MES
Tue 12 Nov					
Wed 13 Nov	12:00-13:00	C11	Exercise in extreme environments III: High altitude	Lecture	MES
Thu 14 Nov	09:00-13:00	Auditorium	Presentations to all staff & students group 1	Seminar	MES/AMJ
Fri 15 Nov	12:00-13:00	C11	Exercise in extreme environments IV: Diving (Hyperbaric conditions)	Lecture	MES
Week 17					
Mon 18 Nov	12:00-13:00	NK14	Fatigue & exercise performance 1	Lecture	DB
Tue 19 Nov					
Wed 20 Nov	12:00-13:00	C11	Fatigue & exercise performance 2	Lecture	DB
Thu 21 Nov	09:00-13:00	1:143/144	Presentations to all staff & students' group 2	Seminar	MES/AMJ
Fri 22 Nov	12:00-13:00	C11	Fatigue & exercise performance 3	Lecture	DB

Staff

Dr Guy Bewick (GB) Biomedical Sciences
Dr Derek Ball (DB), Biomedical Sciences
Dr Stephen Davies (SND), Biomedical Sciences
Dr Alison Jenkinson (AMJ), Biomedical Science
Dr Arimantas Lionikas (AL) Biomedical Sciences
Susan McCourt (SM), Library & Information Services
Dr Michael Scholz (MES), Biomedical Sciences (Course Co-ordinator)