



Course: Physiology and Pathophysiology III

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Department: Physiology,Immunology and Pathophysiology

Study program: University Integrated Undergraduate and Graduate Study of Dental Medicine
(in English)

Study year:second

Academic year: 2024./25.

SYLLABUS

Course description (a brief description of the course, general instructions, where and in what form the lessons are organized, necessary equipment, instructions for attendance and preparation for classes, student obligations, etc.):

The aim of the course is to enable student to know elementary life functions of whole organism, to define function of organs and tissues and to acquire basic knowledge about physiologic and pathophysiologic processes in organism which provoke illness.

For better definition course is divided in two parts, PHYSIOLOGY AND PATHOPHYSIOLOGY I which is performed on the first year of study and PHYSIOLOGY AND PATHOPHYSIOLOGY II and III which takes translation exam on second year of study.

The main purpose of this course is to enable student the knowledge about physiologic and pathophysiologic mechanisms of gastrointestinal tract, hepatobiliary tract, metabolism and regulation of body temperature, endocrine and nervous system. The aim of this course is to acquire the knowledge about basic and specific metabolic substances and their disturbances, endocrine disturbances and functions of central nervous system. By vertical and horizontal integration of knowledge student will be able to define etiology of factors which lead to the development of physiologic and pathophysiologic processes which lead to illness.

Course is performed in lectures, seminars. On seminars the student can discuss physiologic and pathophysiologic mechanisms at the molecular level and on the level of whole organism.

Students have to participate actively in all forms of the course and to learn in advance the material for seminars. Teacher is controlling the knowledge of student and seminars and lectures which comprise the knowledge about morphologic, ultrastructural, biochemical and functional factors and their disturbances which lead to the development of illness.



The knowledge of students is controlled by three partial tests on which students earn points. Course PHYSIOLOGY AND PATHOPHYSIOLOGY III has 30 hours of lectures and 30 hours of seminars. Course PHYSIOLOGY AND PATHOPHYSIOLOGY III has 6.5 ECTS points.

Assigned reading:

1. Guyton and Hall Textbook of Medical physiology, Elsevier, 13th edition, 2016.
2. Gamulin S, Marušić M, Kovač Z editors, Pathophysiology. Basic mechanisms of disease-Textbook. Book I-volume one. Medicinska naklada, Zagreb 2014.
3. Gamulin S, Marušić M, Kovač Z editors: Pathophysiology. Basic mechanism of disease. Book I-volume two. Medical edition. Medicinska naklada, Zagreb, 2014.

Optional/additional reading:

1. Kovač Z, Gamulin S i editors. Study guide algorithms-problem solver, Book two, Medical edition, Zagreb 2014

COURSE TEACHING PLAN:

The list of lectures (with topics and descriptions):

Lecture 1. Metabolism of carbohydrates and formation of adenosine triphosphate

Results of learning:

To explain physiology of carbohydrate metabolism and formation of adenosine triphosphate

To explain etiologic mechanisms and consequences of disturbed carbohydrate metabolism

To describe causes and effects of hyperglycemia.

To describe the causes and effects of hypoglycemia

To describe glycogen metabolism disturbances.

Lecture 2. Gastrointestinal tract-physiology

Results of learning:

To describe basic principles of structure of gastrointestinal wall

To describe electric activity of smooth gastrointestinal muscle.

To describe blood flow of digestive tract

To describe functional movement of digestive tract



To describe nervous control of gastrointestinal tract (enteric nervous system)
To describe food intake, chewing and swallowing
To describe gastric function, movement of small intestine and colon
To define general and local principles of secretion in digestive tract
To define digestion and absorption of different nutrients (carbohydrates, proteins and lipids)

Lecture 3. Gastrointestinal tract-pathophysiology

Results of learning:

To describe disturbed function of pharynx, esophagus and stomach
To describe disorder of exocrine pancreas
To describe disorder of small intestine and colon
To describe pathophysiological forms and consequences of diarrhea
To describe mechanisms and consequences of vomit
To describe causes and consequences of ileus

Lecture 4. Physiologic functions of liver

Results of learning:

To describe macro and micro anatomy of liver
To describe basic functional unit of the liver-liver lobule
To explain blood flow through the liver and system of liver macrophages.
To explain lymphatic system in the liver.
To describe liver metabolism of carbohydrates, amino acids and ammonia
To explain syntheses and degradation of proteins (glycoproteins, angiotensin, coagulation factors, hematopoietic factors, acute phase proteins).
To describe mechanisms of detoxification (drugs, toxic substances)
To describe metabolism of hormones, lipids and cholesterol
To describe metabolism of bilirubin
To describe bile tree and forming, excretion and role of bile in digestion and lipid absorption
To describe storage of iron and vitamins in the liver

Disorders of liver function

Results of learning:

To describe general etiopathogenesis of liver disorders
To describe disorders of liver metabolic function
To describe disturbances of composition, excretion and bile function
To describe protective function of the liver (neutralisation of toxin)
To describe disturbances of salt and water transport
To describe pathogenesis of ascites
To describe disturbances of liver blood flow
To describe pathogenesis of portal hypertension
To describe the effect of liver disturbances on other organs and organic systems

Lecture 5. Physiologic functions of pancreas and its disturbances



Results of learning:

- To describe physiologic structure of exocrine pancreas
- To describe secretion of water and electrolytes
- To describe secretion of pancreatic digestive enzymes
- To describe the control over pancreatic secretion
- To describe etiopathogenetic factors, flow and complications of acute pancreatitis
- To describe etiopathogenetic factors of chronic pancreatitis

Lecture 6. Overview of endocrine system function

Results of learning:

Hypophysis and their disturbances

- To explain structure of endocrine system and to explain the mechanisms of hormonal action
- To explain the mechanisms hormonal creation and of action and their control by hypothalamus
- To understand the consequences of hormonal hypersecretion and hyposecretion
- To understand the consequences of hormonal disturbances in target tissues
- To describe the disturbances of hormonal metabolism and disturbances of hormonal regulation
- To explain disturbances of anterior and posterior lobe of hypophysis.

Lecture 7. Thyroid hormones and its disturbances

Results of learning:

- To explain creation, secretion and physiologic functions of thyroid gland
- To understand thyroid gland disturbances (thyrotoxicosis, hyperthyroidism, hypothyroidism and goiter)

Lecture 8. Insulin, glucagon and their disturbances

Results of learning:

- To understand mechanisms of creation, secretion and metabolic effects of insulin, glucagon and somatostatin
- To explain the causes and consequences of disturbed action of insulin, glucagon and somatostatin
- To understand etiopathogenesis of different types of diabetes mellitus .
- To explain the course of acute and chronic consequences of diabetes mellitus

Lecture 9. Parathyroid hormone, calcitonin, calcium and phosphate metabolism

Results of learning:

- To understand creation and secretion of parathyroid hormone and calcitonin
- To understand mechanism of calcium and phosphate concentration maintenance
- To explain disturbances of calcium, magnesium and phosphate traffic
- To explain disturbances with hypoproduction and hyperproduction of parathyroid hormone
- To explain disturbances with hypoproduction and hyperproduction of calcitonin



Lecture 10 . Organisation of central nervous system, synapse, neurotransmitters

Results of learning

To define the organisation of central nervous system, basic functions of synapse and neurotransmitters

To define main levels in central nervous system function

To define central nervous system synapse

Lecture 11. Sensory system and its disturbances

Results of learning:

To define sensory system and its disturbances

Lecture 12. Motoric system and its disorders

Results of learning

To define motoric system and its disturbances

Lecture 13. Autonomus system and its disorders

Results of learning

To describe device of autonomus system

To describe disturbances of autonomous system

Lecture 14. Mechanisms of pain origin and its disorder

Results of learning

To describe mechanisms of pain origin and its disturbances

Lecture 15. Blood flow in the brain, cerebrospinal liquid and brain metabolism

Results of learning

To describe brain blood flow

To describe composition of cerebrospinal fluid

To describe brain metabolism

The list of seminars with descriptions:

Seminar 1. Carbohydrate metabolism

Results of learning:

To explain the physiology of carbohydrate metabolism and formation of adenosin triphosphate

To explain etiologic mechanism and consequences of disturbed carbohydrate metabolism .

To describe causes and effects of hyperglycemia.

To describe the causes and effects of hypoglycemia

To explain disturbances of glycogen metabolism

Seminar 2. Movements in gastrointestinal tract

Results of learning:

To describe repression and mixing of food in gastrointestinal tract



To explain general principle of structure of gastrointestinal wall, blood circulation and motility of gastrointestinal tract

To explain nervous control of gastrointestinal function

To explain functional movements, reposition and mixing of food in gastrointestinal tract

Seminar 3. Secretory functions of gastrointestinal tract

To define general and local principles of secretion in gastrointestinal tract

To describe secretion in gastrointestinal tract

To describe the salivation

To describe secretion in stomach

To describe pancreatic secretion

To describe bile secretion

To describe small intestine and colon secretion

Seminar 4. Pathophysiology of gastrointestinal tract

Results of learning:

To describe disturbances of pharynx, esophagus, stomach, exocrine pancreas, small intestine and colon

To explain pathophysiological forms of diarrhea and mechanism of vomit

To explain causes and consequences of ileus

Seminar 5. Liver and liver disorders

Results of learning:

To explain liver function and its disorder

Seminar 6. General endocrinology. Pituitary hormones

Results of learning:

To explain mechanism of creation and action of hormones of anterior and posterior lobe of pituitary gland and its control by hypothalamus

To understand physiologic function of growth hormone

To explain disorder of function of anterior and posterior lobe of pituitary gland

Seminar 7: Thyroid gland

To explain creation and secretion of thyroid gland

To explain thyroid gland disorders

Seminar 8. Insulin, glucagon and diabetes mellitus

Results of learning:

To understand mechanisms of creation, secretion and metabolic effects of insulin, glucagon and somatostatin

To explain causes and consequences of disturbed insulin, glucagon and somatostatin

To understand different types of diabetes mellitus

To explain acute and chronic consequences of diabetes mellitus



Seminar 9. Parathyroid hormon, calcitonin, calcium and phosphate metabolism, Vitamin D, bones and teeth

Results of learning

- To explain creation, secretion and action of parathyroid hormon and calcitonin
- To understand calcium and phosphate metabolism
- To understand disturbed traffic of calcium, phosphate and manganese
- To explain disturbances with increases and decreased secretion of parathyroid hormon
- To explain disturbances with increased and decreased creation of calcitonin
- To explain the teeth physiology

Seminar 10. Organisation of central nervous system, synapse and neurotransmitters

Results of learning

- To define organisation of central nervous system, basic synapse function and neurotransmitters
- To describe main levels in the organisation of central nervous system
- To define central nervous system synapse

Seminar 11. Sensory system and its disorders

Results of learning

- To define sensory system and its disorders

Seminar 12. Motoric system and its disorders

Results of learning

- To define motoric system and its disorders

Seminar 13. Autonomous system and its disorders

Results of learning

- To describe device of autonomous system
- To describe disorders of autonomous system

Seminar 14. Mechanism of pain appearance and its disorders

Results of learning

- To define mechanisms of pain origin and its disorders

Seminar 15. Blood flow in brain, cerebrospinal fluid and brain metabolism

Results of learning

- To describe blood flow in brain
- To describe composition of cerebrospinal liquid
- To describe brain metabolism

The list of practicals with descriptions:

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Students' obligations:

Students have obligations to attend lectures and seminars. Students have to prepare course material for seminars in advance.

Assessment (exams, description of written / oral / practical exam, the scoring criteria):

Evaluation during the course

The students work will be evaluated and scored during performing of course and on final exam. From hundred points in total, during the course student can earn **70 points** and **30 points** on final exam

I. During the course the score of 70 points can be earned by the following:

1) 70 points student can earn on three partial exams (partial exam I, partial exam II and partial exam III) which will be held at the end of every course whole. At each partial exam student can earn maximally 23,33 points.

The points scale is the following:

Right answers	Number of points
49, 50	23,33
46,47, 48	22
43, 44, 45	20
40, 41, 42	18
3, 38, 39	16
31,32,33,34 35, 36	14
25,26,27,28,29,30,	12

II Final exam (till 30 points)

On final written exam the key and specific competences for each course part are tested

Who can approach to the final exam:

The students which are during the course earn 35-70 points obligatory approach to the final *multiple choice question (MCQ)* test-on which they can earn additional points.



- Students which during the course earned 35 and more points have a right to attend the written exam. In the final test they have to earn minimally 50% of the test.
- Students which earned less of 35 points and students which were absent more than 30% of course do not have the right to attend final exam (unsuccessful E)
- Passed partial exams are not the condition for attendance of final exam.

The work of students is evaluated during the course (70%) and on final exam (30%). The students work and attainment are expressed in achieved points on which the final evaluation is formed.

Final exam is consisted from the written exam and the oral exam. On the written part of the exam students can earn 7,5 - 15 points. On oral exam students can earn 7,5 - 15 points divided in 4 categories (7,5, 9, 12, 15).

To pass the final exam it is necessary that students earn minimally 7,5 points on written exam and minimally 7,5 points on oral part of final exam. The points earned on written exam and oral exam are summed.

- **The number of earned points on final test of 80 questions are the following:**

Correct answers	Grade points
76,77,78,79,80	15
71,72,73,74,75	14
66,67,68,69,70	13
61,62,63,64,65	12
56,57,58,59,60	11
50,51,52,53,54,55	10
46,47,48,49	9
43,44,45	8
40,41,42	7,5

A student may access the oral part of the final exam if they obtained a minimum of 7.5 grade points at the written part of the final exam. At the oral part of the final exam, a student may obtain grade points as shown in the table:

The grade on oral exam	The number of points
Excellent (5)	15



Very good (4)	12
Good (3)	9
Sufficient (2)	7,5
Insufficient (1)	0

In order to pass the final exam, a student must achieve a minimum of 7,5 grade points at the written part and the minimum of 7,5 grade points at the oral part of the exam. The final exam is an integral part, therefore if the student does not achieve a positive assesment of the oral part of the final exam, the results of the written part of the final exam are invalid in the following final exam terms.

The final grade represents a sum of all grade points (ECTS credits) obtained during classes and at the final exam:

A (90-100 points)	Excellnt (5)
B (75-89,99 points)	Very good (4)
C (60-74,99 points)	Good (3)
D (50-59,99 points)	Sufficient (2)
E student which has not passed final test (less than 50% of test)	Insufficient (1)

Other important information regarding to the course:

There is possibility of performing the course on english language.

COURSE SCHEDULE (for the academic year 2024/2025)

Date	Lectures (time and place)	Seminars (time and place)	Practicals (time and place)	Instructor
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07.01.2025	L1 (08,15-10,00), Lecture room 9			D. Muhvić, MD,PhD, Full Professor.
07.01.2025	L2 (10,15-12,00), MS teams			D. Muhvić, MD,PhD, Full Professor
07.01.2025		S1 (12.15-13.45) MS teams		M. Marcelić, PhD, mag. pharm. in v, post doctoral Research assistant
08.01.2025.	L3 (8,15-10,00), MS teams			D. Muhvić, MD,PhD, Full Professor
08.01.2025	L4 (10,15-12,00), MS teams			.H. Jakovac, MD,PhD, Associate professor
08.01.2025		S2(12.15-13.45) MS teams		B. Ćurko Cofek, MD,PhD, Assistant Professor
09.01.2025	L5 (8,15-10,00), MS teams			D. Muhvić, MD,PhD, Full Professor
09.01.2025		S3(10,15-11,45) MS teams		V. Barac Latas, MD,PhD, Full Professor
10.01.2025.	L6 (8,15-10,00), MS teams			D. Muhvić, MD,PhD, Full Professor
10.01.2025		S4(10.15-11.30) Lecture room 6		D. Muhvić, MD,PhD, Full Professor
13.01.2025	L7 (8,15-10,00) Lecture room 7			T. Gulić, PhD, Assistant Professor
13.01.2025		S5(10.15-11,45) MS teams		.Z.Trobonjača, MD,PhD, Full Professor
14.01.2025.	L8 (08,15-10,00) Lecture room 7			B. Ćurko Cofek, MD,PhD, Assistant Professor
14.01.2025.		S6(10.15-11.00) Lecture room 7		D. Muhvić, MD,PhD, Full Professor
14.01.2025	Midterm exam I (14,15-15,15), MS teams (P7)			
15.01.2025	L9 (8,15-10,00) MS teams			T. Gulić, PhD, Assistant Professor



15.01.2025.		S7(10.15-11,45) MS teams		K. Grabušić, PhD,AssociateProfessor
16.01.2025.	L10 (8,15-10,00), MS teams			D. Muhvić, MD,PhD, Full Professor
16.01.2025.		S8 (10.15-11.45) MS teams		K. Grabušić, PhD,Associate Professor
17.01.2025.	L11 (8,15-10,00), Lecture room 8			N. Kučić, MD,PhD,Full Professor.
17.01.2025		S9 (10.15-11,45) Lecture room 8		T. Gulić, PhD, Assistant Professor
20.01.2025	L12 (08,15-10,00), Lecture room 5			D. Muhvić, MD,PhD, Full Professor
20.01.2025		S10 (10.15-11.45) Lecture room 5		N.Kučić, MD,PhD,Full Professor
21.01.2025	L13 (8,15-10,00) MS teams			D. Muhvić, MD,PhD, Full Professor
21.01.2025		S11(10.15-11,00) Lecture room 4 S11 11.00.11.45 Lecture room 2		N. Kučić, MD,PhD,Full Professor
21.01.2025	Midterm exam II (15.-15.50) online (P1)			D. Muhvić, MD,PhD, Full Professor
22.01.2025	L14 (8,15-10,00) Lecture room 6			I. Mrakovčić-.Šutić,MD, PhD,Full Professor
22.01.2025		S12(10,15-11.45) Lecture room 6		D. Muhvić, MD,PhD, Full Professor
23.01.2025	L15 (08,15-10,00), Lecture room 6			D.Muhvić, MD,PhD,Full Professor
23.01.2025		S13(10.30-12,00) Lecture room 6		D. Muhvić, MD,PhD, Full Professor
24.01.2025		S14(08.15-09,45) Lecture room 7		I. Mrakovčić-.Šutić,MD, PhD,Full Professor
24.01.2025		S15(10.15-11,45) Lecture room 7		D. Muhvić, MD,PhD, Full Professor
24.01.2025	Midterm exam III			



	(12,30-13,30), Lecture hall P 1			
27.01.2025	Exam first term (10-11.20) P4			
04.02.2025	Midterm exam repair 10.00-12.00 P5			
10.02. 2025.	Exam second term (10-12) P8			
24.02. 2025.	Exam third term (10-12) P8			
04.09.2025	Exam fourth term (10-12) P8			
18.09- 2025.	Exam fifth term (12,00-14,00) P8			

List of lectures, seminars and practicals:

	LECTURES (Topics)	Teaching hours	Location/Lecture room
L1	Metabolism of carbohydrates metabolism and creation of adenosine triphosphate	2	Lecture room 5
L2	Gastrointestinal tract physiology	2	MS teams
L3	Pathophysiology of gastrointestinal tract	2	MS teams
L4	Physiological function of the liver and disorders of the liver function	2	Lecture room 5
L5	Physiological functions of the pancreas and its disorders	2	Lecture room 6
L6	Overview of endocrine system functions Pituitary gland and its disorders	2	Lecture room 8
L7	Thyroid hormones and its disorders	2	Lecture room 7
L8	Insulin, glukagon,dijabetes mellitus	2	MS teams
L9	Parathyroid hormones, calcitonin,calcium and phosphate metabolism and its disorders	2	Lecture room 5
L10	Organisation of nervous system, synapse and neurotransmitters	2	Lecture room 9
L11	Sensory system and its disorders	2	MS teams
L12	Motoric system and its disturbances	2	Lecture room 5
L13	Autonomus system and its disorders	2	Lecture room 1



L14	Mechanism of pain appearance and its disorders	2	MS teams
L15	Blood flow in the brain, cerebrospinal liquid and brain metabolism	2	Lecture room P8

	SEMINARS (Topics)	Teaching hours	Location/Lecture room
S1	Carbohydrate metabolism and its disorder	2	Lecture room 15
S2	Movements in gastrointestinal tract	2	MS teams
S3	Secretory functions of gastrointestinal tract	2	Lecture room 5
S4	Patophysiology of gastrointestinal tract	2	Lecture room 2
S5	Liver and liver disorders	2	Lecture room 7
S6	General endocrinology. Pituitary hormones	2	Lecture room 2
S7	Thyroid gland and its disorders	2	Lecture room 15
S8	Insulin, glucagon and diabetes mellitus	2	Lecture room 5
S9	Parathyroid hormone, calcitonin, calcium and phosphate metabolism, Vitamin D, bones and teeth	2	Lecture room 7
S10	Organisation of central nervous system, synapse and neurotransmitters	2	Lecture room 6
S11	Sensory system and its disorders	2	Lecture room 7
S12	Motoric system and its disorders	2	Lecture room 9
S13	Autonomous system and its disorder	2	Lecture room 5
S14	Mechanism of pain appearance and its disorders	2	Lecture room 7
S15	Blood flow in brain, cerebrospinal fluid and brain metabolism	2	Lecture room 7
TOTAL TEACHING HOURS		60	



	FINAL EXAM DATES
29.01.2024.	Final exam first term (10-11.20) P4
06.02.2024.	Midterm exam repair 10.00-12.00 P4
13.02. 2024.	Exam second term (10-12) P8
26.02. 2024.	Exam third term (10-12) P8
05.09.2024	Exam fourth term (10-12) P8
19..09-2024.	Exam fifth term (12,00-14,00) P8

Course syllabus by teaching units

Teaching material
L1: Metabolism of carbohydrates and formation of ATP
L2: Gastrointestinal tract-physiology
L3: Gastrointestinal tract-pathophysiology
L4: Liver physiology and pathophysiology
L5: : Physiology and pathophysiology of pancreas
L6 Overview of endocrine system function
LP7: Thyroid hormones and its disturbances
L8: Insulin, glucagon and their disturbances
L9 P Parathyroid hormones, calcitonin, calcium and phosphate metabolism and its disorders
L10: Organisation of central nervous system, synapse, neurotransmitters
L11: . Sensory system and its disorders
L12: Motoric system and its disorders
L13: Autonomus system and its disorders
L14: Mechanisms of pain origin and its disorder
L15: Blood flow in the brain, cerebrospinal liquid and brain metabolism

Seminar schedule



S1 Guyton Chapter 68. Metabolism of carbohydrates and formation of adenosine triphosphate pp 853-862 Gamulin 6.1 Disorders of carbohydrate metabolism pages 250-265
S2: Guyton Chapter 64. Propulsion and mixing of food in the alimentary tract pp 807-816;
S3: Guyton Chapter 65. Secretory functions of the alimentary tract pp 817-832
S4: Gamulin Chapter 31.Pathophysiology of gastrointestinal system pp 1453-1491
S5: Guyton Chapter 71.The liver as an organ pp.881-886 Gamulin Chapter 32. Disorders of hepatobiliary system1493-1537
S6:Guyton Chapter 75.Introduction to endocrinology pp 925-937 Guyton Chapter 76. Pituitary hormones and their control by the hypothalamus pp 939-950
S7: Guyton Chapter 77.Thyroid metabolic hormones pp 951-963 Gamulin 10.7 Thyroid gland disorders p 517-526
S8: Guyton Chapter 79.Insulin, glucagon and diabetes mellitus pp 983-999
S9: Guyton 79. Parathyroid hormone, calcitonin, calcium and phosphate Metabolism,vitamin D, bones and teeth i fosfata;str.1001-1019; Gamulin 10.10. Disorder of parathyroid gland functions p 536-539
S10: Guyton 46. Organisation of the nervous system, function of synapses and neurotransmitters pp 577-593;
S11: Guyton 47. Sensory receptors ,neuronal circuits for processing information Pp 595-606 Gamulin 34.5.Sensation nerve disorders 1578-1594
S12: Guyton 55.Motor functions of the spinal cord; the cord reflex pp 695-706 ; Guyton 56. Cortical and brain stem control of motor function pp 707-719 Guyton 57. Contributions of the cerebellum and basal ganglia to overall motor control pp.721-736 Gamulin 34.3 Motor nerve disorders 1569-1574
S13: Guyton 61. The autonomic nervous system and the adrenal medulla pp 773 -785 Gamulin 12 Disorders of neurovegetative regulation 614-635
S14: Guyton 48. Somatic sensations:II Pain,Headache and thermal sensations pp 621-632 Gamulin Chapter 13 Pathophysiological foundations of pain 638-659.
S15: Guyton 62 Cerebral blood flow, cerebrospinal fluid and brain metabolism pp787-794;



	Lectures	Seminars	Practicals	Total
Total number	15	15	0	30
On-line	5	1	0	6
Percentage	30	6.66	0	36,66