## Appendix 3: Content and detailed description of the courses

## Appendix 3.1. Content of the EM3E Master programme per semester.

Semester 1: UM2	+UPS France (30	ECTS)	
Module 1	I.A.1 - 24 ECTS		
Course	Туре	ECTS	Responsibility
Characterization of porous materials	Mandatory	3	UM2-UPS
Colloid and surface engineering	Optional	3	UPS
Structural characterization of solids	Optional	3	UM2
Speciality 1 - Material	s Science	(4)	UM2
Inorganic materials	Mandatory	3	UM2
Polymer materials	Mandatory	3	UM2
Hybrid and composite Materials	Mandatory	3	UM2
Materials for chemical reactions/ heterogeneous catalysis	Mandatory	3	UM2
Speciality 2 - Chemical	Engineering		UPS
Transport phenomena	Mandatory	3	UPS
Thermodynamics, kinetics and reactivity	Mandatory	3	UPS
General chemistry and physico-chemical analytical methods	Mandatory	3	UPS
Separation science	Mandatory	3	UPS
Individual project (bibliographic and experimental study)	Mandatory	6	UM2-UPS
Module	1.A.2 - 6 ECTS		
Course	Туре	ECTS	Responsibility
Safety, Security, Health and Environmental Law	Mandatory	2	UM2-UPS
Quality Assurance and Laboratory Practice	Mandatory	2	UM2-UPS
International and European Working Law	Mandatory	2	UM2-UPS
French language and culture	Mandatory*	4	UM2-UPS

<sup>(\*)</sup> Mandatory for at least one of first three semesters and associated with an oral presentation of the individual project in the corresponding national language.

Semester 2: IC	TP, Czech Republic (3	30 ECTS)	- 50 YE WALES
Mo	dule 2.1 – 24 ECTS		
Course	Туре	ECTS	Responsibility
Membrane processes	Mandatory	4	ICTP
Process design	Mandatory	5	ICTP
Applied reaction kinetics	Mandatory	4	ICTP
Separation Technology	Mandatory	5	ICTP
Individual project (bibliographic and experimental study)	Mandatory	6	ICTP
Mc	odule 2.2 – 6 ECTS		
Course	Туре	ECTS	Responsibility
Czech language and culture	Mandatory*	<u> </u>	ICTP
Intellectual capital management	Mandatory	3	ICTP
Valorisation, commercialisation and enterpreneurship	Mandatory	3	ICTP/UTwente

Semes	ter 3: UNL, Portugal (	30 ECTS)	Beis - He
	Module 3.A.1 - 30 EC	TS	#
Course	Туре	ECTS	Responsibility
Membrane contactors and bioreactors	Mandatory	6	UNL
Membranes in downstream processing	Mandatory	6	UNL
Barrier membranes for food applications	s Mandatory	6	UNL
Membranes in regenerative medicine	Mandatory	6	UNL
Individual project (bibliographic and experimental study)	Mandatory	6	UNL
	Module 3.A.2 ECT	S	
Course	Туре	ECTS	Responsibility
Portuguese language and culture	Mandatory*	· ·	UNL

Semeste	er 3: UNIZAR, Spain	(30 ECTS)	
	Module 3.B.1- 30 EC	TS	
Course	Туре	ECTS	Responsibility
Fundamental properties of nanostructured materials	Mandatory	6	UNIZAR
Preparation of nanostructured materials	Mandatory	6	UNIZAR
Assembly and fabrication of nanostructures	Mandatory	6	UNIZAR
Case studies of industrial applications	Mandatory	6	UNIZAR
Individual project (bibliographic and experimental study)	Mandatory	6	UNIZAR
	Module 3.B.2 EC	TS	
Course	Туре	ECTS	Responsibility
Spanish language and culture	Mandatory*		UNIZAR

Semester 3: U	Twente, The Nether	lands (30 ECTS	)
M	lodule 3.C.1 – 30 E0	CTS	
Course	Туре	ECTS	Responsibility
Batteries, fuel cells and electrolysers	Mandatory	5	UTwente
Gas separation membranes and gas treatment	Mandatory	5	UTwente
Water treatment	Mandatory	5	UTwente
Membrane process plant design	Mandatory	5	UTwente
Microdevices and sensors	Mandatory	4	UTwente
Individual project (bibliographic and experimental study)	Mandatory	6	UTwente
	Module 3.C.2 EC	TS	
Course	Туре	ECTS	Responsibility
Dutch language and culture	Mandatory*	-	UTwente

	Semester 4: 30 ECTS
100	Module 4 - 24 weeks, research assignment in industry or university

Appendix 3.2. Detailed description of the contents of the scientific courses

	of porc	us materia	IS				
ECTS Credits	3	Semes	ter	S1	Туре	Mandator	/
Used sources		2. Slid 3. Met mat Men Tecl (Am	erials" A nbrane Sci nnology Se sterdam,	ne characterisation JULBE, J.D.F. RA JENCE and Technologies 4, Ed. A.J. E NL), Chapter 4,	MSAY, in "Fur ology", Membe Burggraaf and 1996, pp: 67		orane organic
Short description of course contents		Description of porous materials- Definitions     Static characterisation techniques     2.1. Stereology     2.2. Intrusive methods     2.3. Non intrusive methods     3. Dynamic characterisation techniques     3.1. Rejection measurements     3.2. Liquid displacement techniques					
Competencies acquired by th student	e	1. To k 2. To h chai 3. To h	nave a ger racterization oe able to	ral concepts aboreral knowledge a on of porosity	about the mai	terials and porosi n techniques for and analytical m	the
		4. Comproject 5. To pinfo 6. Abil	work perform bil rmation	on skills. Preparat		ay of 'posters' repocess the acquire	d
Activity	/		(h) S=25h	Method	lology	Relationship competen	
Lectures Seminars		0,6	(15) (5)	Presentations to professionals a researchers	by external	1, 2, 3	
Laboratory cour	ses	0,4	(10)	Lab coursed in Characterization different types materials	on of	2, 3	
Tutorials		0,4	(10)	Solving exercises Solving question presented by the Direction of the learning of the Orientation in the assignments.	he students. e self- student.	1, 2, 3	
	oject	0,4	(10)	Discussion and the results obtained laboratory.		2, 3, 4, 5, 6	
Collaborative pr	Self-study, working		0,8 (20) Preparation of Personal study			1, 2, 3, 4, 5, 6	
individually	ting		(5)			1 2 2 1 5 6	
Self-study, work	king	0,2	(5)	Oral presentati Examinations		1, 2, 3, 4, 5, 6	00011000

Colloid and su	rface engi	neering						
ECTS Credits	3	Semester	S1	Туре	Mandatory			
Used sources	S	5. Hiemenz, Pri	auoud, Claudine E.	nd surface ch	emistry, Deker, 1986			
Short description of course contents		1. Intermolecular and surface forces and their consequences in term of surface interaction 2. Electro-kinetics phenomena (electrophoresis, electro-osmosis) 3. Colloidal properties (stability, coagulation,) 4. Practice of product formulation						
Competencie acquired by student		7. To be able to 8. To be able to 9. To know the dispersed pa 10. To know the	eral concepts about a concept about a concept and restimate electroses estimate the state effect of the suspendictes practice of productions.	nanoparticles kinetics pheno ility of colloid endant fluid of t formulation	properties omena s n the properties of			
			form team-work					
Activ	rity	Credits ECTS	inage operators	ology	Relationship with competences			
	rity	Credits ECTS (h) 1ECTS=25h	nage operators  Method		competences			
Activ Lectures Laboratory co		Credits ECTS	inage operators	ching staff groups. illation,				
Lectures	urses	Credits ECTS (h) 1ECTS=25h 1 (25)	Method  Lectures by tea  Lab coursed in Examples: Dist Absorption, Re	aching staff groups. illation, actor, nanages a e students The team he whole	1, 2, 3, 4			
Lectures Laboratory co Collaborative "Lab course d Self-study, we	urses project irector"	Credits ECTS (h) 1ECTS=25h 1 (25) 0,6 (15)	Method  Lectures by tea Lab coursed in Examples: Dist Absorption, Re Extraction A team-work m process and the working on it. work analyse ti data obtained of	aching staff groups. illation, actor, ananages a e students The team he whole on the assignments	competences  1, 2, 3, 4  2, 3, 4, 5  5, 6, 7, 8  1, 2, 3, 4, 5, 6, 7			
Lectures Laboratory co Collaborative "Lab course d	urses project irector"	Credits ECTS (h) 1ECTS=25h 1 (25) 0,6 (15)  0,6 (15)	Method  Lectures by tea Lab coursed in Examples: Dist Absorption, Re Extraction A team-work m process and th working on it. work analyse t data obtained o process. Preparation of	aching staff groups. illation, actor, ananages a e students The team he whole on the assignments ons of the	competences 1, 2, 3, 4 2, 3, 4, 5 5, 6, 7, 8			
Lectures Laboratory co Collaborative "Lab course d  Self-study, we individually	urses project irector"	Credits ECTS (h) 1ECTS=25h  1 (25) 0,6 (15)  0,6 (15)  0,6 (15)  0,7 (15)	Method  Lectures by tea Lab coursed in Examples: Dist Absorption, Rei Extraction A team-work in process and the working on it. work analyse te data obtained of process. Preparation of Personal study Oral presentati "Lab course directions"	aching staff groups. illation, actor, ananages a e students The team the whole on the assignments ons of the ector"	competences  1, 2, 3, 4  2, 3, 4, 5  5, 6, 7, 8  1, 2, 3, 4, 5, 6, 7  1, 2, 3, 4, 5, 6, 7			

Course name	Name of						
Structural chara	acterizati	on of solids					
ECTS Credits	3	Semeste	r	S1	Туре	М	andatory
Used sources		7. Lectur 8. Slide	0.00				1 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Short description of course contents		6. X-ray 7. Solid 8. Vibra 9. X-ray	absorp -state National sp scatter	tion spectroso MR		XANES)	er
Competencies acquired by th student		12. To ha struct 13. To be	ow gene ve a gen ural cha able to	ral concepts a eral knowledgracterization of	nalytical strategy	in technic	ques for the
		project w 15. To pe inform 16. Ability	nunication ork or form bil nation of to perform security to perform security to perform the security that security the security the security the security that security the security the sec	on skills. Prepa bliographic se orm team-wo		rocess the	
Activit	y	(h 1ECTS	i) =25h	Methodology		competences	
Lectures		0,6	(15)		teaching staff	1, 2, 3	
Seminars		0,2	(5)	Presentation		1, 2, 3	
Laboratory cou	rses	0,4	(10)	Lab coursed Sample cros programs o characteriza	d in groups. ss-testing f	2, 3	
Tutorials		0,4	(10)	Solving exe Solving que presented to Direction of learning of	ercises estions by the students. the self- the student. in the personal	1, 2, 3	
Collaborative p	roject	0,4	(10)	Discussion the results laboratory.	and analysis of obtained in the	2, 3, 4, 5, 6	
Self-study, wor individually	king	0,8	(20)	Preparation Personal st	of assignments	1, 2, 3,	4, 5, 6
Evaluation		0,2	(5)	Oral presen	itations	1, 2, 3,	, 4, 5, 6
System for assessment a evaluation	nd		onal ass	ignments	on in class and la	aboratory	

Inorganic materi	als						
ECTS Credits	3	Semest	er	S1	Туре		Homologation
Used sources		9. Lecti 10. Slide	ure notes				
Short descripticourse content  Competencies acquired by the student	S	2. Metal 2.1. E 2.2. S 2.3. T 3. Glass 3.1. G 3.2. G 3.3. G 4. Cerar 4.1. P 4.2. D 5. Hydra 6. Films 6.1. L 6.2. V 7. Differ  Specific 17. To g 18. To g prep 19. To g men  Generic 20. Com project 21. To p	s and alloxtractive olidification hermal trues and vitilities and vitilities and vitilities propriet satisfies propriet satisfies propriet satisfies and coatinguid phase competed basic ket basic k	metallurgical on and precipi eatments and treous state sition positions erties  cking and rhectages of the colors, cements, ings se deposition as deposition as deposition as for inorganic recies enowledge about tencies enowledge about overview on the tences on skills. Preparet	methods membranes out the main ty out the deposit atings and thin he different ty	re and a solution wes wes when trated is concretes when the solution method is films pes of in splay of	suspensions norganic materials nods for the organic
Activity	,		ts ECTS (h) 'S=25h	Meth	nodology	Re	elationship with competences
Lectures	er sail	0,2	(25) (5)		teaching staff ns by external		
Seminars			71 (0)	professiona	ls		
Laboratory cours	ses	0,4	(10)	Preparation membranes	of ceramic	1, 2,	
Tutorials		0,4	(10)	Solving exe Solving que presented to Direction of learning of	rcises stions by the students the self- the student. in the persona	N.	, 3
Self-study, work individually	king	0,8	(20)		of assignmen	ts 1, 2	, 3, 4, 5
THE THAT HE PARTY		0,2	(5)	Oral presen	tations	1, 2	, 3, 4, 5
Evaluation					-		

	Is							
ECTS Credits	3	Semest	er	S1	Туре		Homologation	
Used sources			ure notes				A IL CHANNE	
oseu sources		12. Slide shows						
Short description of course contents		11. Introduction, Definitions & Nomenclature 12. Classification of Polymers & Basic Morphology 13. Polymer processing and synthesis 14. Mechanical and Thermal properties 15. Copolymers & Advanced Morphology 16. Smart polymers and polymeric materials 17. The world market of plastic industry 18. Polymers in membrane technologies 19. Current trends in polymer membranes						
acquired by the student	e	23. To pri 24. To be ( eg. 25. To ur prop 26. To kr Generic 10. Com	repare and e able to membra nderstanderties now the vector of the competer of	ne application) I the ties between vorld plastic ma	the main polyn nt polymer in fu een chemical st arket and the fo	ners. unction of tructure, uture tre		
		11. To point	ect work erform bi mation	bliographic sea	rches and to pr			
Activity	,	11. To poinfor 12. Abilit	ect work erform bi mation ty to perf ts ECTS h)	bliographic sea	rches and to pr	rocess th	ne acquired	
	,	11. To point information infor	ect work erform bi mation ty to perf  ts ECTS (h) S=25h	bliographic sea orm team-work Metho	rches and to proceed t	Rela	ne acquired nationship with	
	,	11. To poinfor 12. Abilit	ect work erform bi mation ty to perf ts ECTS h)	Metho  Lectures by t	odology teaching staff s by external	rocess th	ationship with	
Lectures		11. To prinfor 12. Abilit	ect work erform bi mation ty to perform the sects (h) S=25h (15)	Metho  Lectures by t  Presentations professionals Lab coursed Polymer synt	podology teaching staff s by external in groups. theses and	Rela	ationship with ompetences	
Lectures Seminars Laboratory cours		11. To prinfor 12. Abiliti  Credit  (1ECT 0,6 0,2	ect work erform bit mation ty to perform the sects (h) S=25h (15) (5)	Metho  Lectures by t Presentations professionals Lab coursed Polymer synt chaaracterize Solving exere Solving ques presented by Direction of t learning of th Orientation in	rches and to proceed t	Rela co	ationship with ompetences	
Lectures Seminars Laboratory cours	ses	11. To prinfor 12. Abiliti  Crediti (1ECT 0,6 0,2 0,4	ts ECTS  (h)  S=25h  (15)  (5)	Metho  Lectures by t Presentations professionals Lab coursed Polymer synt chaaracterize Solving exert Solving ques presented by Direction of t learning of th Orientation is assignments Discussion as the results of	rches and to proceed t	Relacco 1, 2, 3 1, 3, 4 2, 3, 4	ationship with ompetences	
Lectures Seminars Laboratory cours Tutorials  Collaborative pro	ses	11. To prinfor 12. Abiliti  Credit  (1ECT)  0,6  0,2  0,4  0,4	ect work erform bi mation ty to perform to the ECTS (h) (S=25h (15) (5) (10)	Metho  Lectures by t Presentations professionals Lab coursed Polymer synt chaaracterize Solving exerc Solving ques presented by Direction of t learning of th Orientation is assignments Discussion as the results of laboratory. Preparation of	rches and to prodology  teaching staff s by external in groups. theses and ation cises tions the students. the self- the student. In the personal and analysis of btained in the of assignments	Relacco 1, 2, 3 1, 3, 4 2, 3, 4 2, 3, 4	ationship with ompetences 3, 4, 5 4, 5 4, 5 4, 5	
Lectures Seminars Laboratory cours Tutorials Collaborative pro	ses	11. To prinfor 12. Abiliti  Credit  (1ECT	ts ECTS h) S=25h (15) (10) (10)	Metho  Lectures by t Presentations professionals Lab coursed Polymer synt chaaracterize Solving exert Solving ques presented by Direction of t learning of th Orientation is assignments Discussion as the results of laboratory.	rches and to proceed t	Relactor 1, 2, 3 1, 3, 4 2, 3, 4 1, 2, 3	ationship with ompetences 3, 4, 5 4, 5 4, 5	

Hybrid and co							
nybrid and co	mposite m	aterials					
ECTS Credits	3	Semest	er	S1	Туре	Mandato	ry
Used source	ıs	14. Slide					
Short description of course contents  20. General defi a. Hybrid b. Compo 21. Surface graf 22. Preparation, 23. Industrial ap 24. Hybrid and composite to the course contents are contents.		Hybrid r Compos face graft paration, ustrial app	naterials: defin ite materials: d ing shaping of hybi plications of hy	ition and prope lefinition and m rid and compos brid and compo	erties nain properties ite materials		
Competenci acquired by student		27. To k surfa 28. To b	ace grafting e able to	ral concepts ab ng prepare hybrid		composite mate materials and a technology	
		29. Comproject 30. To pinfor 31. Abili	work perform bi rmation ty to perform ts ECTS	on skills. Prepar bliographic sea orm team-work	rches and to pr	ay of 'posters' recess the acquire	red
Activ	vity		(h) S=25h			compete	nces
Lectures		0,6	(15)	Lectures by t	eaching staff	1, 2	
Seminars		0,2	(5)	professionals	s by external	1, 2	
Laboratory courses		0,4	(10)	The second secon			
Laboratory co	ourses	3,1	(10)	Preparation of composite m	in groups. of hybrid and aterials	2	
Laboratory co		0,4	(10)	Preparation of composite m Solving exem Solving question of the composite	of hybrid and aterials cises tions the students. The students of the students of the students of the personal cites and the personal cite	1, 2	
			98-24-36	Preparation of composite m Solving exem Solving questo presented by Direction of learning of the Orientation is assignments Discussion a	of hybrid and aterials cises tions the students. The students of the students of the students of the personal cites and the personal cite	1, 2	
Tutorials  Collaborative Self-study, w	e project	0,4	(10)	Preparation of composite m Solving exem Solving questo presented by Direction of learning of the Orientation is assignments.  Discussion at the results of laboratory.  Preparation of the composite presented by Direction of the learning of	of hybrid and aterials cises tions the students. The students of the personal and analysis of btained in the personents of assignments	1, 2	
Tutorials  Collaborative	e project	0,4	(10)	Preparation of composite m Solving exemples of the presented by Direction of the learning of the composite of the presented by Direction in assignments biscussion at the results of laboratory.	of hybrid and aterials cises tions the students. The students of the personal analysis of btained in the personal the coff assignments dy ations	1, 2	

Course name			LOVINGE OF					
Materials for ch	emical re	actions - h	neterogen	eous catalys	is			
ECTS Credits	3	Semest	er	S1	Туре	Mandatory		
Used sources		15. Lecti 16. Slide	ure notes shows					
Short descript course conten		1. Catalysis et catalytic processes 1.1. Basic principles of heterogeneous catalysis 1.2. Preparation and characterisation of catalytic materials 1.3. Redox catalysis 1.4. Acid-base catalysis 1.5. Industrial processes based on heterogeneous catalysis 2. Membrane reactors using inorganic membranes 2.1. Basic concepts 2.2. Membrane materials 2.3. Studies of cases						
Competencies acquired by th student		32. To k mate 33. To b reac 34. To p  Generic 35. Com	erials and e able to tors and o repare an c Compet imunicatio	ral concepts membrane rapply previous catalytically and to apply catalytically catalyt	reactors us knowledge acq active membrane atalytically active	eous catalysis, catalyticuired in membranes with membranes membranes		
Activit		infor				ocess the acquired  Relationship wit		
ACTIVI		1ECT	S=25h	Methodology		competences		
Lectures Seminars		0,2	(25) (5)	Presentation	y teaching staff ons by external	1, 2, 3		
Laboratory cou	rses	0,4 (10) Lab coursed in groups. Preparation and application catalytic membranes		ed in groups. n and application	1, 2, 3			
Tutorials		0,4 (10) Solving exe Solving que presented but Direction of learning of		ercises estions by the students. of the self- f the student. n in the personal	1, 2, 3			
Self-study, wor individually	rking	0,8	(20)		n of assignments	1, 2, 3, 4, 5		
Evaluation		0,2	(5)	Oral prese Examination	ntations	1, 2, 3, 4, 5		
System for assessment a evaluation	ind	26. Per 27. Ora	sistance a sonal ass al Presenta amination	ignments	ion in class and la	boratory		

Transport pheno	mena					
ECTS Credits	3	Semester	S1	Туре	Homologation	1
Used sources		17. R.Byron E	Bird, Warren St na, John Wiley	ewart, et E.N. Light & Sons Ltd, 2007	foot, Transport	
Short descripti course content		25. Fluid dyr 26. Mass tra 27. Heat trai 28. Coupled 29. Macrosco	um transfer) mena in processes neat balance in pro	cesses		
acquired by the	e	analogy b 38. To be abled determine 39. To be abled transfer of 40. To know in main p	etween mome e to develop me e velocity, conc e to use adime or heat transfer the consequent rocesses e to evaluate t	ntum, mass and he omentum, mass an entration or tempe nsional corelation to coefficient at inter	d heat balances to rature variation of estimate friction, maked of transport phenoment the phenomena in a	
		Generic Cor 13. To perfor informati	<b>npetences</b> m bibliographic	searches and to p	rocess the acquired	
		Generic Cor 13. To perfor informati 14. Ability to	mpetences m bibliographic on perform team-	searches and to powerk	rocess the acquired  Relationship w	
Activit	y	Generic Cor 13. To perfor informati 14. Ability to Credits EC (h) 1ECTS=2	mpetences m bibliographic on perform team-	e searches and to powerk	Relationship w	
Activity Lectures Laboratory cour		Generic Cor 13. To perfor informati 14. Ability to Credits EC (h)	mpetences m bibliographic on perform team- crs  M 5h 5) Lectures 6) Lab coul Example Mass tra	work  lethodology  by teaching staff reed in groups. es: Fluid dynamics, insfer coefficient,	rocess the acquired  Relationship w	
Lectures Laboratory cour	rses	Generic Cor 13. To perfor informati 14. Ability to Credits EC (h) 1ECTS=2!	mpetences m bibliographic on perform team- crs  M 5h 5) Lectures K Mass tra Heat cou descript problem	work  lethodology  by teaching staff red in groups. es: Fluid dynamics, insfer coefficient, inductivity ork on the ion of transfer in a process	Relationship w competences  1, 2, 3, 4,5  2, 3, 4, 5	
Lectures Laboratory cour Collaborative pr Self-study, worl	rses	Generic Cor 13. To perfor informati 14. Ability to Credits EC (h) 1ECTS=2! 1 (25 0,6 (15	mpetences m bibliographic on perform team-  CTS  M  Sh  Si) Lectures Mass tra Heat coi Mass tra Heat coi D) Team-w descript problem D) Prepara Persona	work  lethodology  by teaching staff red in groups. ses: Fluid dynamics, insfer coefficient, inductivity ork on the ion of transfer in a process tion of assignments I study	Relationship w competences  1, 2, 3, 4, 5  2, 3, 4, 5, 6, 7  1, 2, 3, 4, 5, 6, 7	
Lectures	rses	Generic Cor 13. To perfor informati 14. Ability to  Credits EC (h) 1ECTS=2! 0,6 (15	mpetences m bibliographic on perform team-  CTS  M  5h  5)	estarches and to provide the searches and to provide the searches and to provide the search of the s	Relationship w competences  1, 2, 3, 4,5  2, 3, 4, 5	
Lectures Laboratory cour  Collaborative pr  Self-study, worl individually	rses	Generic Cor 13. To performation information informati	mpetences m bibliographic on perform team- crs  M 5h 5) Lectures Example Mass tra Heat col O) Team-w descript problem O) Prepara Persona Oral pre project Examina	estarches and to provide the searches and to provide the searches and to provide the search of the s	Relationship w competences  1, 2, 3, 4, 5  2, 3, 4, 5  1, 2, 3, 4, 5, 6, 7  1, 2, 3, 4, 5, 6, 7	

Thermodynam	ic, kinetic	s and react	tivity				
ECTS Credits	3	Semest	ter	S1	Туре	Mand	datory
		18 D W	Atkins I	Ovsical Chemis	try, Oxford, 199	2	
Used sources		19. 20.		*5-010-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-			
Short description of course contents		31. Kin	etics of coalysis)	omplex reaction	nd non ideal phasens (chain reaction) (adsorption, cata	n, polymeri	
Competencie acquired by t student		43. To b 44. To b hete 45. To k	e be able to be able to erogeneou know how	calculate equi estimate reac is conditions) to describe no	about thermodyn librium in solids tion rates (in hor on ideal solution surface reactivty	or fluids mogeneous	and
		15. To p info 16. Abili 17. Abili	rmation ity to per ity to exp			ocess the a	cquired
Activ	ity	15. To pinfor 16. Abili 17. Abili Credi	perform b rmation ity to perf ity to exp its ECTS (h)	ibliographic se form team-wor lain a concept	rk	Relatio	nship with
Activ	ity	15. To pinfor 16. Abili 17. Abili Credi	perform b rmation ity to per ity to exp	form team-worlain a concept  Methodology	nodology teaching staff	Relatio comp	nship with
		15. To pinfo 16. Abili 17. Abili Credi	erform b rmation ity to per ity to exp its ECTS (h) IS=25h (25) (15)	Meti  Lectures by Lab coursed Examples: Absorption, Extraction	teaching staff d in groups. Distillation, Reactor,	Relatio comp 1, 2, 3, 4, 2, 3, 4, 5	nship with
Lectures	urses	15. To pinfo 16. Abili 17. Abili Credi	perform bermation ity to perform be rmation ity to perform to experiment	Meti  Lectures by Lab coursed Examples: Absorption, Extraction A team-wor	nodology teaching staff d in groups. Distillation, Reactor,	Relatio comp 1, 2, 3, 4, 2, 3, 4, 5	nship with petences
Lectures Laboratory col  Collaborative "Physico-chem course" Self-study, wo	urses project nical	15. To p info 16. Abili 17. Abili 17	erform b rmation ity to per ity to exp its ECTS (h) IS=25h (25) (15)	Meti  Lectures by Lab coursed Examples: Absorption, Extraction A team-wor course to exin physical	teaching staff d in groups. Distillation, Reactor, rk will prepare a xplain a concept chemistry. T of assignments	Relatio comp  1, 2, 3, 4, 2, 3, 4, 5  6, 7, 8  1, 2, 3, 4,	nship with betences 5
Lectures Laboratory con Collaborative "Physico-chemicourse"	urses project nical	15. To p info 16. Abili 17. Abili 17	erform bermation ity to perfit to experiment ity ity to experiment ity ity to experiment ity ity ity ity ity ity ity ity ity it	Meti  Lectures by Lab courses Examples: Absorption, Extraction A team-wor course to e in physical Preparation Personal str	teaching staff d in groups. Distillation, Reactor, k will prepare a explain a concept chemistry. Tof assignments addy attations of the gemical course"	Relatio comp 1, 2, 3, 4, 2, 3, 4, 5	nship with betences 5
Lectures Laboratory con Collaborative "Physico-chem course" Self-study, wo individually	urses project nical	15. To pinfor 16. Abili 17. Abili 17	perform bermation ity to perform bermation ity to perform bermation ity to experit to ex	Meti  Lectures by Lab coursed Examples: Absorption, Extraction A team-wor course to exin physical Preparation Personal str Oral presen "Physico-ch Examinatio	teaching staff d in groups. Distillation, Reactor, k will prepare a explain a concept chemistry. Tof assignments addy attations of the gemical course"	Relatio comp  1, 2, 3, 4, 2, 3, 4, 5  6, 7, 8  1, 2, 3, 4, 1, 2, 3, 4, 5	nship with betences 5

Course nam	ie		will					
General chen	nistry and p	ohysico-cher	nical ana	lytical metho	ods			
ECTS Credits	3	Semeste	er	S1	Туре		Mandatory	
Used source	es	21. Danie Ltd,2		ris, Quantitat	ive Chemical And	alysis, W	.H.Freeman & C	
Short descr course cont		33. Gene 34. Fund chen 35. Instr 36. Deve	lamental nical mea rumentat elopment	physical and asurements tion for chem and applica	d chemical theori lical and physical tion of analytical	measur	ements	
Competenci acquired by student		deter 48. To kr 49. To be 50. To be meas 51. To kr  Generic 18. To pe inforr 19. Abilit	ow generation generated to the perform bin mation y to perform principle of the perform the performance of t	eral concepts emical compo possible appli choose the c use an instru good practice tences bliographic s form team-we	about chemistry position and physication of the Good Labora	cal propersion of the call and propersion of the	erties emical methods or an analysis hysical ne acquired	
	TOT BUILDING						SHOWS	
Acti	vity	(1	s <b>ECTS</b> n) S=25h	Met	thodology		ationship with ompetences	
Lectures		1	(25)		y teaching staff	1, 2, 3		
Lectures Laboratory courses Collaborative project "An analysis for a problem"		0,6 (15) 0,6 (15)		A team-wo	Lab coursed in groups.  A team-work has to find the instrumentation to use, the operating conditions, and the procedure for a fixed arother.		2, 4, 5, 7, 8 6, 7, 8	
	vorking	0,6	(15)		n of assignments	1, 2,	3, 4, 5, 6, 7	
Self-study, v individually		1000000	(5)		ntations of the	1. 2.		
Self-study, v individually Evaluation		0,2	(3)		sis for a problem		3, 4, 5, 6, 7	
individually				"An analys Examination	sis for a problem			

ocparación de	ience					
ECTS Credits	3	Semeste	er	S1	Туре	Mandatory
		122 6	notion On	agas Enginee	ring, Phillip C. W	ankat 2006
Used source	S	24. Sepai 1997 25. Chem Proce	ration Pro nical Engl	ocess Technolo ineering: Parti	ogy, Jimmy Hum cle Technology a	phrey, George Keller,
Short descri course conte	The second secon	37. Role 38. Phys 39. Sepa 40. Effic	of separ sico-chen arating a iency and nents for	gents and asso d capacity of s process select	s involved in sep ociated technology eparation proces	gies
Competencie acquired by student		in ind 53. To be techn 54. To kr 55. To be separ	lustry able to lology how the seable to	associate a se scientific funda estimate the e ocess (the mo	parating agent to ments of separa efficiency and the delling aspects o	tion processes e capacity of a f the processes will b
		56. To kr Generic 21. To pe inform 22. Abilit	Competerform bit mation y to perf	tences	hoose a separati	ocess the acquired
Activ	vity	56. To kr Generic 21. To pe inform 22. Abilit 23. Abilit Credit	Competerform bit mation y to perfy to com	tences bliographic sectorm team-work municate	hoose a separati	on processes
Activ	vity	56. To kr Generic 21. To pe inform 22. Abilit 23. Abilit Credit	Competerform bit mation y to perfy to com	tences bliographic sectorm team-work municate  Meth	hoose a separation arches and to proceed to	Relationship wit competences  1, 2, 3, 4, 5
		56. To kr Generic 21. To pe inform 22. Abilit 23. Abilit Credit (I	Competerform bit mation y to perfy to compete sects h) S=25h	tences bliographic ser form team-work municate  Meth Lectures by Lab coursed Examples: I	arches and to proceed to the procedure of the procedure o	Relationship wit
Lectures	ourses	S6. To kr  Generic 21. To pe inform 22. Abilit 23. Abilit  Credit () 1ECTS	Competerform bit mation by to perfy to compete sects h) S=25h (25)	Meth  Lectures by Lab coursed Examples: I Absorption, A team-wor project to p processes in	arches and to proceed and to proceed and to procedure and to a separation  The will work on a propose an regard to a	Relationship wit competences  1, 2, 3, 4, 5
Lectures Laboratory co Collaborative "Physico-cher course" Self-study, w	ourses project mical	Generic 21. To perinform 22. Abilit 23. Abilit  Credit (1 1 0,6	Competerform bit mation by to perfy to compete sects h) S=25h (25) (15)	Meth  Lectures by Lab coursed Examples: I Absorption, A team-wor project to p processes ir "separation Preparation Personal sto	arches and to proceed to a separation of assignments and to proceed to a separation of assignments and to a separation.	Relationship wit competences  1, 2, 3, 4, 5 1, 2, 4  1, 5, 6, 7, 8
Lectures Laboratory co Collaborative "Physico-cher course"	ourses project mical	S6. To kr  Generic 21. To perinform 22. Abilit 23. Abilit  Credit (1 1 0,6  0,6	Competerform bit mation by to perfy to compete by the compet	Meth  Lectures by Lab coursed Examples: I Absorption, A team-wor project to p processes ir "separation Preparation Personal sto	arches and to proceed and to a problem.  It will work on a problem.  It of assignments ady tations of the problem.	Relationship wit competences  1, 2, 3, 4, 5 1, 2, 4
Lectures Laboratory co Collaborative "Physico-cher course" Self-study, w individually	ourses project mical	56. To kr  Generic 21. To perinform 22. Abilit 23. Abilit  Credit  1 0,6  0,6  0,6  0,2	Competerform bit mation by to perfey to compete sects (25) (15) (15) (15)	Methodological contents of the	arches and to proceed and to a problem.  It will work on a problem.  It of assignments ady tations of the problem.	Relationship wit competences  1, 2, 3, 4, 5 1, 2, 4  1, 5, 6, 7, 8  1, 2, 3, 4, 5, 6  1, 2, 3, 4, 5, 7, 8

Course name		LO LA PERIO			
Individual projec	t				
ECTS Credits	6	Semester	S1-S3	Туре	Mandatory
Used sources		26. Data bases ( I 27. Documents (p 28. Laboratory	apers, theses	, books, patents	)
Short descripti course content		experimental stude consultation with project and the project a	dy. The project a supervisor. roject present prited for motons. tudy tudy a written repetus	at is formulated at A report is present is present and distribution of the programment of the programment is a second of the	a bibliographic and/or and carried out in ented at the end of the scussed publicly. Externa ress and/or attendance
Competencies acquired by th student	e	Generic Compet 2. The ability to (bibliographic acquired info	deal with and vious knowled tences manage and/c search and/rmation.	ge acquired. or conduct an incor experimental s	dividual project study), and to process d group discussions.
Activit	<b>y</b>	Credits ECTS (h) 1ECTS=25h	Met	hodology	Relationship with competences
Self-study, work	king	5(125)	Preparation Personal st	of assignment udv	1
Evaluation	305	1(25)	report Oral preser		2, 3
System for assessment are evaluation	nd	45. Written repo 46. Oral Present	rt ation and def	ense	

Course nam	ie						
Membrane pr	rocesses						
ECTS Credits	4	Semeste	er	S2	Туре	Man	datory
Used source	es	Wiley 30. T. Sa Modif 31. D. Ple Editio 32. S.P.N Indus 33. J.G. S	& Sons ta, Ion I fication a etcher, F on,Spring lunes, K stry, Wild Sanchéz tors	, Ltd., 2004 Exchange Mer and Application F.C. Walsh, Ir ger, 1990. V. Peinema ey-VCH Verla Marcano and	mbranes: Preparation, RSC, 2004. Idustrial Electrochem Inn, Membrane Tech Ig GmbH, 2001 IT.T. Tsotsis, Catal	on, Charac mistry – S nology in t	econd
Short descr course cont Competenc acquired by student	ies	b. Chara c. Meml force d. Meml osmo e. Press micro f. Electi g. Ion e electi h. Utiliz i. Micro j. Med k. Utiliz l. Mem m. Mem n. Mem 59. To be and t 60. To ut 61. To ki react 62. To ki  Generic 24. Com work 25. To po	acteristical brane sees so brane sees so sis, dial sure mer of iltration romembers ation of the brane romembers ation of the brane romembers are able to transport and the transport sees so sees at the transport sees at t	eparation procession and transport reparation procession exchange lesoporous more mass transferences and general core apply previous them and transport remain applicaration procession skills. Presibiliographic specification of the procession skills. Presibiliographic specification procession skills.	es – electrodialysis, as a solid electroly emembranes in fue embranes for gas afer in membranes in separation technomogeneous reaction the embranes in separation technomogeneous cataly in chemical industry encepts of membranes knowledge acquin the separation in membranes of membranes and new applicane preparation and displasearches and to prosecution of membranes and new applicant paration and displasearches and to prosecution of membranes and to prosecution and displasearches and to prosecution of membranes and membranes and membranes and new applicant paration and displasearches and to prosecution of membranes and to prosecution and displasearches and to prosecution of the prosecution of the prosecution and displasearches and to prosecution of the prosecution o	on according concentrations, ultra electrode te e "zero el cells and liquid s' nologies, in ons' tic reaction, direction et echnologied in separations of to character y of 'poste electrode el concentration de technologies in separations of to character	ng to the driving ation gradient - ifiltration, cionization -gap" membrane separation industrial applications as of development ogy paration processes with membranes ation processes, echnological interest
Acti	ivity	Credit (	s ECTS h) S=25h	n team-work	Methodology		Relationship with competences
Lectures		1	(25)		y teaching staff		1, 2, 3, 4, 5
Seminars		1,2	(30)	Exercises	by teaching staff		1, 3, 4, 5
Laboratory of Tutorials	courses	0,4 (10) Solving questions presented by the students. Direction of the student self-learning. Orientation in the personal assignments.					
Collaborative	e project	0,4	(10)	Discussion	n and analysis of the within the project.	e results	2, 3, 4, 5, 6, 7, 8
Self-study, v	working	0,8	(20)		on of assignments		1, 2, 3, 4, 5, 6, 7, 8
Evaluation		0,2	(5)	Oral prese	entations ons		1, 2, 3, 4, 5, 6
System for assessmen evaluation	t and		sonal as I Presen	signments tation	tion in class and lab	ooratory	

Process design					
Process design					
ECTS 5 Credits	Semester	S2	Туре	Mandatory	
Used sources	35. Perry's Cen	Chemical Process: Dinical Engineers' Har	ndbook		02
Short description of course contents	b. Selection of c. Technologic d. Application e. Chemical ref. Pumps – ch g. Compression h. Filtration of i. Energy exc j. Simulation k. Rectification l. Simulation m. Process con n. Examples of c.	tess view of chemical reactions' pathway all schema, mass a of design software eactors, membrane earacteristics and expensions, characteristics, characteristic	y, economical and energy bala reactors and to the complex of selecteristics, exhaus and the complex and the fundam pervaporation of cycle, chara	criterions, environrance.  heir models. ection. lsters. lters and filtration in characteristics. cimal exchanger. hentals, characteristics. cteristics of regulat	membranes. stics of columns.
Competencies acquired by the student	64. To be able applied phy 65. To understaminimization 66. Application 67. Communication 67. Communica	and general concepto apply previous kestical chemistry and and synthesis of pron, construction may of simulation softworth settences ation skills. Prepara	nowledge acquid separation processes from the serial and equivare in solution and displation and displation and displation.	uired in chemical er rocesses to the pro- he energy saving, pment selection po- n of process design ay of 'posters' repo	cess design waste bint of view. problems.
		bibliographic searc erform team-work	thes and to pro	ocess the acquired	information
Activity	69. Ability to p  Credits ECT (h)	erform team-work  Method		Relationship wi	information
	69. Ability to p  Credits ECT (h) 1ECTS=25h	erform team-work  S  Method	dology	Relationship wi	information
Activity Lectures Seminars	69. Ability to p  Credits ECT (h)	Method  Lectures by te  Industrial production by	dology aching staff	ocess the acquired	information
Lectures	69. Ability to p  Credits ECT (h) 1ECTS=25h 1.6 (40)	Lectures by te Industrial professionals Lab courses - flowsheeting s solving of typi technology pre	dology aching staff cess by external Application of software for cal bblems	Relationship wi  1, 2, 3, 4  1, 2, 3, 4,  2, 3, 4, 5	information
Lectures Seminars Laboratory courses	69. Ability to p  Credits ECT (h)  1ECTS=25h  1.6 (40) 0.2 (5)	Lectures by te Industrial professionals Lab courses - flowsheeting s solving of typi	aching staff cess by external  Application of coftware for cal boblems problems the students.	Relationship wi	information
Lectures Seminars Laboratory courses Tutorials	69. Ability to p  Credits ECT (h) 1ECTS=25h  1.6 (40) 0.2 (5)  0.8 (20)	Lectures by te Industrial proof presentation to professionals Lab courses - flowsheeting solving of typi technology profession of presented by Leadership of self-learning. Orientation in assignments. Discussion and the results ob	aching staff cess by external  Application of coftware for cal boblems problems the students. the student the personal d analysis of tained in	Relationship wi  1, 2, 3, 4  1, 2, 3, 4,  2, 3, 4, 5	information
Lectures Seminars	69. Ability to p  Credits ECT (h) 1ECTS=25h 1.6 (40) 0.2 (5)  0.8 (20)  0.8 (20)	Lectures by te Industrial proof presentation by professionals Lab courses - flowsheeting signification of typi technology profinesented by Leadership of self-learning. Orientation in assignments. Discussion and	dology  aching staff cess by external  Application of coftware for cal bollems problems the students. the student the personal d analysis of tained in ject	Relationship wi  1, 2, 3, 4  1, 2, 3, 4,  2, 3, 4, 5  1, 2, 3, 4, 5  2, 3, 4, 5, 6, 7	th competence:
Lectures Seminars  Laboratory courses  Tutorials  Collaborative project  Self-study, working	69. Ability to p  Credits ECT (h) 1ECTS=25h 1.6 (40) 0.2 (5)  0.8 (20)  0.8 (20)  0.6 (15)	Lectures by te Industrial proc presentation to professionals Lab courses - flowsheeting si solving of typi technology pro Discussion of presented by Leadership of self-learning. Orientation in assignments. Discussion and the results ob individual pro- Preparation of assignments.	dology  aching staff cess by external  Application of coftware for cal boblems problems the students. the student the personal d analysis of tained in ject	Relationship wi  1, 2, 3, 4  1, 2, 3, 4,  2, 3, 4, 5  1, 2, 3, 4, 5	th competence

Course name								
Applied reactio	n kinetics							
ECTS Credits	4	Semester		S2	Туре	Ma	ndatory	
Used sources		1998. 37. H.S.Fog 1992 38. J.G. San Reactors	ler,Ele ichéz s age of	ments of Chen Marcano and T	ng of Chemical Finical Rection Englished  T. Tsotsis, Cata  Fogler: http://w nentary reaction	gineering, llytic Mem	2nd Edition,Problems and Months.edu/~c	entice Hall, embrane cre/
Competencie acquired by t	nts	2. Balance 3. Basic m 4. Kinetic 5. Energy reactors 6. Dynami 7. Heterog 8. Mass ar 9. Fixed b 10. Simulta 11. Catalyti 12. Pervapo 13. Membra 14. Industr  Specific Co 70. To unde the kno 71. To be a physica 72. To unde of react 74. To know and nev  Generic Co 26. Commu 27. To perfe	is in is lodels param balands. It is being	othermal react of chemical react of chemical react of chemical reacters estimation in reacting service in reacting service of non is as catalytic react transfer in poctor. It is separations an inbrane separation membrane represents of general concept to experiment apply previous of transport med transport med reacting systistems with memain application ications of techtences on skills. Preparations of constitutions of techtences on skills.	ing systems. Stactors for homogon from isothern ystems. Models sothermal homocotions in a gas porous catalyst.  Ind reactions. ion processes a actors  The processes a actors  The processes a actors in catalyst.  The processes a actor in catalyst.  The	oichiomet geneous s nal kinetic of homog geneous r ohase.  Ind reactor  system de sing.  uired in cla a in the reallytic system aneous section proces es in reactor  st	ry, conversion by stems. data. geneous non is reactors.  rs.  escription and hemical engine eacting system enems eparation and esses. tor/separation	transfer of eering, ns. combination processes
Activ	ita	Credits I		form team-wor	odology	Relatio	nship with c	ompetence
ACCIV	ity	1ECTS=						
Lectures			25)		teaching staff teaching staff	1, 2, 3,		
Seminars			15) 10)	Practice in e	xperimental or data treatment	1, 2, 3,		
Laboratory co Tutorials	urses	0.6 (15) Solving questions presented by the students. Direction of the self-learning of the student. Orientation in the personal assignments.						
Collaborative	project	0,4 (	10)	Discussion a	and analysis of ental results.		5, 6, 7, 8	
Self-study, wo	orking	0.8 (	20)		of assignments		4, 5, 6, 7, 8	
Evaluation		1	5)	Oral present Examination	tations is	1, 2, 3,	4, 5, 6	
System for assessment evaluation	and	55. Assista 56. Person 57. Oral P 58. Exami	nal ass resent	nd participatio signments tation	n in class and la	aboratory		

ECTS 5						
Credits	Semester	S2	Туре		Mandatory	
Used sources	41. Separation 42. Perry's C	on Process Princip Themical Engineer	oles, 2 <sup>nd</sup> edition, Si rs' handbook	eader, J	nn Wiley & Sons, NY (200 I.D., and Henley E.J.,.	02).
Short description of course contents	a. Material ab. Basic nur c. Fluid med turbulent d. Heat and exchange e. Separatic f. Adsorptic g. Membrar h. Ionic exci i. Selection Membrar j. Gas pern k. Ultrafiltra l. Electrodi m. Crystallis	and energy balar merical methods chanics for chem t flows in the pipe I mass transfer for ers, mass and he on processes, pho on and ion exchance separation pro- change and electron and arrangemen in e processes des meation, reverse ation, dialysis. alysis, pervapora sation - basic prir	inces in chemical er in chemical engine ical engineers, mo es, equipment and undamentals, heat at transfer on phases equilibria, rate inge – linear and nicesses - fundamentals of separation mign.	eering mentun porous and ma se inter proces onlinear ntals n metho ethods,	n balances, laminar and media. ass transfer coefficients, faces. ses. sorption. ads. criteria for selection.	
Competencies acquired by the student	75. To under 76. To be ab and trans 77. To under	le to apply previous sport phenomena rstand chemical of	a engineering princip	quired in oles of p	applied physical chemis rocesses	
	material 79. To be ab Generic Co 29. Commun 30. To performance	and energy bala le to solve indivi- mpetences nication skills. Pre	nces dually chemical en eparation and repo searches and to pr	gineerir		1:
	material 79. To be ab Generic Co 29. Commun 30. To performance	and energy bala ble to solve indivi- mpetences nication skills. Pre rm bibliographic	nces dually chemical en eparation and repo searches and to pr	gineerir	ng problems	1
Activity	material 79. To be ab Generic Con 29. Commun 30. To perfor 31. Ability to Credits Ed (h)	and energy bala ble to solve indivi- mpetences nication skills. Pre rm bibliographic perform team-v  CTS	nces dually chemical en eparation and repo searches and to pr	gineerir orting pr rocess t	ng problems	
	material 79. To be ab  Generic Co 29. Commun 30. To perfor 31. Ability to  Credits Ec (h) 1ECTS=2	mpetences nication skills. Pre rm bibliographic perform team-v  CTS  Me  25h  5) Lectures	eparation and reposearches and to provork	gineering process t	oject work he acquired information tionship with compete	
Lectures Seminars	material 79. To be ab  Generic Co 29. Commun 30. To perfor 31. Ability to  Credits Ec (h) 1ECTS=2	mpetences nication skills. Pre rm bibliographic perform team-v  CTS  Me  5) Lectures 5) Exercises Fractise i	eparation and reposearches and to provork  ethodology  by teaching staff n solving mass gy balances	Relating process t	oject work he acquired information tionship with compete	
Lectures Seminars Laboratory courses	material 79. To be ab  Generic Co 29. Commun 30. To perfor 31. Ability to  Credits Ec (h) 1ECTS=2  1 (2) 0,6 (1)	mpetences nication skills. Pre rm bibliographic perform team-v  CTS  Me  Sh  S) Lectures practise i and energe equations  Solving q presented Direction learning of	eparation and reposearches and to provork  ethodology  by teaching staff by teaching staff n solving mass gy balances d by the students. of the self- of the student. on in the personal	Relation 1, 2, 1, 2, 1, 2, 1	oject work he acquired information tionship with compete	
Lectures Seminars Laboratory courses Tutorials	material 79. To be ab Generic Cor 29. Commun 30. To perfor 31. Ability to Credits Et (h) 1ECTS=2 1 (2: 0,6 (1: 0.6 (1:	mpetences nication skills. Pre rm bibliographic perform team-v  CTS  Me  Sh  S) Lectures practise i and energe equations  Solving q presented Direction learning of contentation assignme  O) Discussion	exparation and repose searches and to provork  exthodology  by teaching staff by teaching staff by teaching staff as solving mass gy balances d by the students. of the self- of the student. on in the personal ents. In and analysis of the solvined in the	Relation 1, 2, 1, 2, 1, 2, 3, 2, 3,	oject work he acquired information  tionship with compete 3, 4, 5 4, 5 3, 4, 5 3, 4, 5	
Activity Lectures Seminars Laboratory courses Tutorials  Collaborative project Self-study, working individually	material 79. To be ab Generic Cor 29. Commun 30. To perfor 31. Ability to Credits Et (h) 1ECTS=2 1 (2! 0,6 (1! 0.6 (1! 1/25)	mpetences nication skills. Pre rm bibliographic perform team-v  CTS  Me  25h  5) Lectures 5) Exercises and energe equations  Solving q presented Direction learning orientation assignme  0) Discussion the result laborator	exparation and repo searches and to provork  ethodology  by teaching staff by teaching staff in solving mass gy balances diby the students of the self- of the student. on in the personal ents. In and analysis of its obtained in the y. on of assignments	Relation 1, 2, 1, 2, 1, 2, 3, 2, 3,	ng problems  oject work the acquired information  tionship with compete 3, 4, 5 4, 5 3, 4, 5 3, 4, 5	

Course nam	ne				
Individual pr	oject				
ECTS Credits	6	Semester	S1-S3	Туре	Mandatory
Used source	es	44. Documents 45. Laboratory	(papers, theses,	books, patents	~· 
Short descr course con		experimental st consultation with project and the experts may be of oral presental 1. Bibliographic 2. Experimental 3. Preparation of	tudy. The project the supervisor. It project presente invited for monitations.	is formulated at a report is present or all present of the program	a bibliographic and/or and carried out in ented at the end of the scussed publicly. Externa ress and/or attendance
Competence acquired by student		integrate pr Generic Comp 2. The ability t (bibliograpl acquired in	to deal with and revious knowledge tences to manage and/or formation.	r conduct an increase experimental s	dividual project study), and to process d group discussions.
Act	ivity	Credits ECTS (h) 1ECTS=25h	Meth	odology	Relationship with competences
Self-study, individually	working	5(125)		of assignment dy	1
Evaluation		1(25)	report Oral present		2, 3
System for assessmen evaluation	t and	63. Written rep 64. Oral Prese	port ntation and defe	nse	

Course name						
Membrane con	tactors ar	nd bioreacto	rs			
ECTS Credits	6	Semeste	r	S3	Туре	Mandatory
		i i i i i i i i i i i i i i i i i i i		Maria Mala		
Used sources		specialize	a scien	tific journals		
Short descrip course conte		43. Cell I 44. Enzy 45. Multi 46. Mom 47. Selec Mem Cont 48. Hybr 49. Proce	Membra matic M phasic I entum, cted cas brane C actors, id proce ess mor	e-studies of contactors, memulsification esses and pro- litoring and o	oreactors oreactors eat transport in Mem Membrane Contactor membrane distillation on with Membrane Cocess integration	ors: liquid extraction, gas-liquid or, crystallization in Membrane
Competencie: acquired by t student		82. To be 83. To be 84. To ac proce 85. Under Generic 86. Devel 87. Devel 88. Ability 89. Ability	quire ge able to able to quire kr ss contr stand h Compe opment opment to per to per	eneral conception design Mem design procession procession design p	brane Bioreactors a ess integration sche out emerging proces c problem may be a cation skills solving competence mous work ining	s monitoring tools and their use for
Activi	ty	Credits (h 1ECTS	)		Methodology	Relationship with competences
Lectures		1.20	(30)	Lectures b	by teaching staff	1, 2, 3, 4
Seminars		0.24	(6)	academic	ions by external lecturers, industrial nals and students	1, 2, 3, 4, 5
Tutorials		0.68	(17)	discussion Direction the studer Orientatio assignment Students assignment Support o	of the self-learning ont. on of individual onts. recitation of individu	ual
Self-study, wo individually	rking	3.24	(81)	Preparatio	on of assignments on of individual semi study	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Evaluation		0.64	(16)	Students Written Ex Individual the stude	Recitations xamination oral presentations nts eports of selected	1, 2, 3, 4, 5, 6, 7, 8, 9, 10 by
System for assessment a evaluation	and	66. Write 67. Indiv	ten repo vidual se vidual a	orts of semina eminar ssignments		ion sessions and in the seminars

Course name	е				
Membranes in	downstrea	am processing			
ECTS Credits	6	Semester	53	Туре	Mandatory
Used source	s	specialized scien	itific journals		
Short descri course conte		52. Product reco 53. Product pur 54. Hybrid proc 55. Process mo	of biological covery and fra fraction and esses and pro- nitoring and o	omplex media and ctionation polishing ocess integration	media /membrane interactions
Competencie acquired by student		92. To be able to transport ph 93. To be able to 94. To acquire k for process of 95. Understand  Generic Compe 96. Developmen 97. Developmen 98. Ability to pe 99. Ability to pe 99. Ability to pe	eneral concept of apply previous enomena, in the design procured about the control of problem-from autonor data m	the processing of bess integration school emerging process problem may be a carried school expression skills. It is solving competence mous work	uired in separation processes and iological media emes ss monitoring tools and their use approached by the Industry
Activ	vity	Credits ECTS (h) 1ECTS=25h		Methodology	Relationship with competences
Lectures		1.20 (30)	Lectures	by teaching staff	1, 2, 3, 4
Seminars		0.24 (6)	academic	ions by external lecturers, industria nals and students	1, 2, 3, 4, 5
Tutorials		0.68 (17)	discussion Direction the stude Orientation assignme Students assignme Support of	of the self-learning ent. on of individual ents. recitation of individ	dual
Self-study, w individually	orking	3.24 (81)	Preparati	on of assignments on of individual sen Il study	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Evaluation		0.64 (16)	Students Written E Individua the stude	Recitations examination oral presentations ents eports of selected	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
System for assessment evaluation	and	70. Assistance 71. Written rep 72. Individual s 73. Individual s 74. Examinatio	oorts of semir seminar assignments	tion in class, Recita	ation sessions and in the seminars

Course name			Halle		
Barrier membranes for f	ood applications				
ECTS 6 Credits	Semester	S3	Туре		Mandatory
Used sources	specialized scient	ific journals			
Short description of course contents	56. Introduction 57. Development 58. Development 59. Transport me 60. Selected case 61. New challeng	of flakes (includi of Barrier Membi echanisms in Barrie e-studies of Barrie	ng reactive fl ranes er Membrane er Membranes	es s for Fo	
Competencies acquired by the student	102. To be ab 103. To acqui 104. To acqui 105. Understa Generic Compet 106. Developi 107. Developi 108. Ability to 109. Ability to	re general concep le to model mass re knowledge abo re knowledge abo and how a specific	transport in out emerging out emerging problem manation skills solving components work ning	comple materi applica y be a	ex Barrier Membrane systems ials for Barrier Membranes ations for Barrier Membranes pproached by the Industry
201-202-00-00	Credits ECTS			92019 2	
Activity	(h) 1ECTS=25h	Methodo	ology	Rela	tionship with competences
Lectures	1.20 (30)	Lectures by tea	ching staff	1, 2,	3, 4
Seminars	0.24 (6)	Presentations b academic lectur industrial profes students	ers,	1, 2,	3, 4, 5
Tutorials	0.68 (17)	Case-studies ar discussion. Direction of the learning of the Orientation of in assignments. Students recitar individual assig Support of students recitaring support of individual semination of the students recitaring support of students recitaring support suppo	self- student. ndividual tion of nments. ents for heir	1, 2,	3, 4, 5, 6, 7, 8, 9, 10
Self-study, working individually	3.24 (81)	Preparation of a Preparation of i seminar Individual study	ssignments ndividual	1, 2,	3, 4, 5, 6, 7, 8, 9, 10
Evaluation	0.64 (16)	Students Recita Written Examin Individual oral presentations b students Written reports external semina	tions ation y the of selected	1, 2,	3, 4, 5, 6, 7, 8, 9, 10
System for assessment and evaluation	75. Assistance at 76. Written report 77. Individual se 78. Individual as 79. Examination	rts of seminars minar	class, Recita	ition se	essions and in the seminars

Membranes in r	egenerat	ive medicine			
ECTS Credits	6	Semester	S3	Туре	Mandatory
		Lange in light scien	tific iournals		
Used sources		specialized scien	tilic journals		
Short descript course conten		64. Preparation 65. Transport pl 66. Selected cas 67. New challen	and character and character henomena in se-studies in ges in Tissue	rization of membrane	es for Artificial Organs rtificial Organs tificial Organs
Competencies acquired by th student		membranes 112. To be a Organs syste 113. To acqu Artificial Org 114. To acqu Artificial Org 115. Undersi Generic Compe 116. Develop 117. Develop 118. Ability 119. Ability	ire knowledg for Tissue Cu ble to model ems ire knowledg ans ire knowledg ans cand how a sp etences oment of com- coment of pro- to perform au to perform da	Iture and Artificial Org transport in complex e about emerging ma e about emerging app pecific problem may b munication skills plem-solving compete atonomous work	Tissue Culture and Artificial aterials for Tissue Culture and plications in Tissue Culture and the approached by the Industry
Supplied the second		Credits ECTS			
Activit	у	(h) 1ECTS=25h		Methodology	Relationship with competences
Lectures		1.20 (30)	Lectures I	by teaching staff	1, 2, 3, 4
Seminars		0.24 (6)	academic	ions by external lecturers, industrial nals and students	1, 2, 3, 4, 5
Tutorials		0.68 (17)	discussion Direction the stude Orientatic assignme Students assignme Support of	of the self-learning of nt. on of individual nts. recitation of individua	
Self-study, wor individually	king	3.24 (81)	Preparati	on of assignments on of individual semin I study	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Evaluation		0.64 (16)	Students Written E Individua the stude	Recitations xamination I oral presentations b nts eports of selected	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
System for assessment a evaluation	nd	80. Assistance 81. Written rep 82. Individual 8 83. Individual 8 84. Examinatio	orts of semin seminar assignments	tion in class, Recitation	on sessions and in the seminars

Course name					
Individual proj	ject				
ECTS Credits	6	Semester	S1-S3	Туре	Mandatory
Used sources		46. Data bases 47. Documents 48. Laboratory	( like SciFinder (papers, these	Scholar – CAS), s, books, patents	University library
Short descrip course conte		experimental st consultation wit project and the	tudy. The projeth a supervisor project present invited for moations.  study I study of a written rep	ct is formulated a . A report is prese ted orally and dis initoring the prog	a bibliographic and/or and carried out in ented at the end of the scussed publicly. Externa ress and/or attendance
Competencie acquired by student		integrate pr Generic Comp 2. The ability t (bibliograph acquired in	pility to deal with revious knowled petences to manage and/ hic search and/ formation.	dge acquired.  for conduct an income of the conduct	dividual project study), and to process d group discussions.
Activ	ity	Credits ECTS (h) 1ECTS=25h	Met	hodology	Relationship with competences
Self-study, wo	orking	5(125)		n of assignment tudy	1
Evaluation		1(25)	report Oral prese		2, 3
System for assessment evaluation	and	85. Written rep 86. Oral Prese		ense	

Fundamental pro	operties	of nanostructu	red Mate	erials			
randamental pro							
ECTS Credits	6	Semester		53	Туре		Mandatory
Used sources		Springe     Springe		ook of nano	technology / Bh	narat Bl	nushan (ed.) Ed.
		2. Nanoted Wilson. 3. The Che Müller 8	chnology et al. Ed emistry & A.K. Cl	d. Chapman Of Nanomat heetham. W	& Hall/CRC. Bo erials (Vols. 1 Y iley-VCH	ca Rato (2). C.	NR. Rao, A.
Short descript course content		vs. mac - Optical, nanoma electrica - Colloids - Meso ar - Nanobic - Applicat	eroscopio electrica aterials. al aspec s, tensoa and micro omateria tions of	c materials. c, magnetic, Physical Cho ts of surface actives, mon porous mat als. Biomacro nanoparticle	and mechanica emistry of Surfa chemistry and olayers, micelle erials, zeolites.	I prope aces: th interfa es, vesi	nermodynamic and ices.
Competencies acquired by th student	e	giving vectorisms giving vectorisms and sectorisms are sectorisms and sectorisms and sectorisms and sectorisms and sectorisms are sectorisms and sectorisms are sectorisms and sectorisms are sectorisms and sectorisms are sectorisms	the "stavalue to nic and lo rstand to s, acquirale. ify mate ale, eval rstand to at the nanosystire basic structur the legistability. Impeter e previous de such is the such is the such is the legistability.	ate of the ar its multidisc egal implicat he conceptu- ring the need erials and co- luating the a he important hanoscale as tems. It knowledge ared materials islation about luence on he materials islation about luence on he materials as knowledgas as nanoscier	ciplinary nature tions.  al differences be ded knowledge in the control of specific products of surface of surface of well as their in to evaluate process.  It nanostructure ealth issues, en	as well etween to appl ecial rel nd the p ffects a fluence perties ed mate vironme	evance in the problems to solve and the forces that in the properties of special interest erials, analyzing ent and
		Credits E	PX				lationship with
Activity	У	(h) 1ECTS=2	25h	Meth	odology		competences
Lectures			0)	Lectures, op by teaching	en discussions,	1, 2,	3, 4, 5, 6, 7, 8
Self-study, work individually		3,6 (9	0)	Preparation Personal stu	of assignments dy	74 0	3, 4, 5, 6, 7, 8
E-teaching and technologies	new			(e-teaching, testing).	technologies, e-learning, e-	8	
Evaluation		0,2 (5		Evaluation o Examination	of assignments,	1, 2,	3, 4, 5, 6, 7, 8
System for assessment are evaluation	nd		ion of a	participation ssignemnts	n in class		Santes en de locater

Course name	е						
Preparation of	f nanostruc	tured materi	als				
ECTS Credits	6	Semester		S3	Туре	Mand	atory
Used source	s	Microl 2. Nano Molec Sociel 3. Funda 4. Princi 5. Princi Micha 6. Mater Ohrin	fabrication and Micular Maty.  In mental ples of legister of legis	ion, Vols 1 Y croelectromed chines. David s of Microfab Lithography. Chemical Vapuraw (Eds.). I ence of Thin emic Press	iphy, Micromachin 2. P. Rai-Choudhu chanical Systems d. A. LaVan et al. M rication. Marc. J. I Harry J. Levinson for Deposition. Da Kluwer Academic Films: Deposition	ury. SPIE (NEMS and I Materials Res Madou. CRC . SPIE Press aniel M. Doble Publishers & Structur.	Press kin And Milton
Short descri course conte		Fabrication bottom-up Vacuum te Liquid Pha Electroche Optical lith	n metho o approa echnolouse Deplemical d mograph y. Ion t int, mic	ods of nanost aches. gy. PVD. CVD osition. leposition. ny. Fabrication peam lithogra ro-printing, s iques.	ructured material  one of MEMS/NEMS.  ophy. Scanning protection of the second s	. Electron be	am ohy.
Competencia acquired by student		Specific 1. To get chem 2. To be the p prope 3. To acculation devel convec 4Plant of na for do Generic 1. Organ	competed a general competed a general competed to reparative the competed c	tencies  ral conception the preparate correlate the ion technique the obtained an excessary so fabricate na tegies to solvolution in each isign and imputured materia  tences and design of	n of the different tion of nanostruct unique properties and the final chall nanostructure. Skills to recognize nostructured mate these difficulties the case. Ilementation of exals, assesing the part of an experimental ather information	ured materials of the raw iracteristics at the difficultiverials and to s and choose openiments for oblems and protocol	als. material, and es in the be able to the most or fabricatio d difficulties
Activ	vity	Credits (h 1ECTS	)	Met	hodology		nship with etences
Lectures	150	1,6	(40)		y teaching staff	1, 2, 3, 4,	
Self-study, w individually	orking		(75)	Personal s		1, 2, 3, 4,	5, 6
Laboratory		1,2	(30)	tutored by	n of materials, teaching staff	4,5	
Evaluation		0,2	(5)	Evaluation Examination	of assignments ons	1, 2, 3, 4,	5, 6
System for assessment evaluation	and	- Evalu		nd participati f assignemnt n			

Course name							
Assembly and fa	bricatio	n of nanostr	uctures	112			
ECTS Credits	6	Semeste	er	S3	Туре		Mandatory
Used sources		2. Thre Orlan 3. Nano VCH 4. The Mülle	ishers. e-Dimen ndo et al oparticles . Chemistr	isional Nano I.Materials Ros. From Theory Ty Of Nanom I. Cheetham	ctures. Jin Zhang engineered Assem esearch Society ory To Application laterials (Vols. 1 Y Wiley-VCH	nblies. T .Günter (2). C.I	Chomas M. Schmid.Wiley- NR. Rao, A.
Short descripti course content		and micr Jera Quir cher Bioft	graphitic oporous rchical st ality in the nistry. Ir unctional demonst	structures. structures. tructures and he nanoscale ntercalation of lization of na trations	noparticles. Synth Nanocomposites. I molecular self-a s. Supramolecular chemistry. Inomaterials.	Mesopo	orous and
Competencies acquired by the student	e	2. To ac impl prob 3. To kr bott  Generic 4. Expe 5. Comi	retical krom-up (scraphy). Equire contempt to the contempt and competitions are competitional from the competitions are contempt and competitions are contempt and contempt and contempt are contempt and contempt and contempt are contempt and contempt and contempt are contempt and contempt and contempt are contempt are contempt and contempt are contempt are contempt and contempt are contemp	mowledge of self-assemble mpetences fi ion in the falsks and the requipments and top-down tences design	the preparation m y) and top down ( or the planification brication of nanon results. for the preparation techniques.	micro and designaterial	and nano- gn and s, evaluating the nostructures by
		0 - 14	FOTO		Carried State	18-11	
Activity	,	(1	s ECTS n) S=25h	Ме	thodology		lationship with competences
Lectures		1,6	(40)		y teaching staff	1, 2,	3, 4
Self-study, work individually	ing	2,8	(70)	Personal s		1, 2,	3, 4
Laboratory		1,2	(30)	tutored by	on of materials, teaching staff	2,4,5	
Evaluation		0,4	(10)	Examinati	n of assignments on n of experimental	Contract	3, 4, 5
240 250 250			11 12				
System for assessment an evaluation	d	- Eval		nd participat f assignemn n			

Course name			Lany (				
Case studies of i	ndustria	al application	ons				
ECTS Credits	6	Semest	er	S3	Туре		Mandatory
Used sources		Jack 50. Worl 51. Pate	son, M. J. d Wide W	, Ed.CRC Pre leb to look for se:, Europea	companies an	ıd produ	
Short descripti course content		Several detailed nanotec of the orits technical industry.  The stud of a new nanotec of a new nanotec.	case stud description hnology pportunity hological in ntative cacceutical, as as well a	here nanoted or for the device of industron of the man roduct will be to the design mplementation as estudies what the design of the fabrical team-work value on the membranes.	hnology has be elopment of a rail ial applications ket before the e performed, for of the product on and commen Il be analyzed extile, cosmetic ion of nanosen	een applinew productions will be introduced by the process of the	analyzed. A  ction of a certain by the identification ess together with on.  g the otechnology  or the developmen
Competencies acquired by the student		122. the instance of the insta	To evaluation and	estand the higological restand the higological restand the higological restand the distinct give to certary the difficulty directly from all experience. In the main oducts.	h potencial of is able to integ tive characteris in commercial ties for the imp to the comment the companies of factors in profeatures that no present and	nanotec rate in t stics tha product- olementarcial pra- s and the duct des nakes th	the fabrication  t the application a  s.  ation of the ctice. e "main actors"
Activity	n 10	(	ts ECTS (h) (S=25h		hodology		elationship with competences
Lectures Seminars		0,6	(15) (5)	Presentation professiona application	teaching staff ns by external ils of industrial of membrane	1, 3,	, <u>3, 4, 5</u> , 4, 5
Collaborative pro	oject	0,4	(10)		and analysis of obtained in the		
Evaluation		0,2	(5)	Oral preser Examination	tations	1, 2	, 3, 4, 5, 6
System for assessment an evaluation	d	88. Col	istance ar laborative		on in class		

Course nam	ie			- Justice of the little	
Individual pr	oject			W	
ECTS Credits	6	Semester	S1-S3	Туре	Mandatory
Used source	es	53. Documents (p	apers, theses	, books, patents	
Short descr course cont	Control of the Contro	experimental stude consultation with project and the p	dy. The project a supervisor. roject present ovited for moreons. tudy a written repetute.	at is formulated at A report is present is present is present in a report is present in a report in a	a bibliographic and/or and carried out in ented at the end of the scussed publicly. Externa ress and/or attendance
Competenc acquired by student		integrate prev Generic Compet 2. The ability to (bibliographic acquired info	ty to deal with vious knowled tences manage and/c search and/c rmation.	ge acquired.  or conduct an incor experimental s	dividual project study), and to process
Acti	vity	Credits ECTS (h) 1ECTS=25h	Met	nodology	Relationship with competences
Self-study, v	vorking	5(125)	Preparation Personal st	of assignment udy	1
Evaluation		1(25)	report Oral preser		2, 3
System for assessmen evaluation		90. Written repo 91. Oral Present	rt ation and defe	ense	

				· · · · · ·			
Batteries, fuel o	cells and	electrolyser	S				
ECTS Credits	5	Semeste	er	S3	Туре		Mandatory
Used sources		55. Lectu 56. Fuel o			Department of En	ergy, 20	004.
Short descript course conter		69. Ther 70. Elect 71. Elect 72. Diffe DMF 73. Minia	modynar trolyte m trode kind erent type C, BioFC, aturizatio	nics of electronics of electronics of batteries AFC, prima	ples and theory rochemical cells, nembrane electrons and fuel Cells; ry and secondary recent trends eceptance	sofc, s	mblies SAFC, PEMFC,
Competencies acquired by the student		art fu 130. and i 131. batte condi 132. batte Generic 5. Com 6. The a	rell cells a To under nterfacial The abilit ries, and itions, an To know ries, and Compet munication ability to cquired in	and batteries stand main kinetics. by to describ to mention d limitations major devel future trend ences on skills; Ora	e the different ty differences, appliances, opments in the files.  al presentation are ibliographic searces	pes of funcation a reld of funcation	lectrode reactions uel cells and reas, operation uel cells and o discussions.
Activi	ty	(1	s ECTS h) S=25h	Met	thodology		ationship with ompetences
Lectures		0,8	(20)		y teaching staff	1, 2,	
Seminars		0,4	(10)	Presentation external/ir profession		1, 2,	3, 4
Assignment		1,6	(40)		ignment focused elected fuel cell ent	4, 5,	6, 7
Laboratory cou	rse	0,2	(5)	Practice co	ourse organized testing of fuel	1,2	
Tutorials		0,8	(20)	Solving ex Solving qu the studer Offering so	estions raised by		
Self-study, wor individually	rking	0,8	(20)	Individual	preparations and e. Preparation of		3, 4, 6, 7
Evaluation		0,4	(10)		entation and s.	1, 2,	3, 4, 5, 6, 7
		92. Assi	anmont	Examinati	ON	Shine El	
System for							

Can accept							
Gas separation	membrar	nes and gas t	reatme	nt			
ECTS Credits	5	Semester		S3	Туре		Mandatory
	UES IX	57. Lecture	notes	slides	literate and		
Used sources		58. Y. Yam Wiley 8	ipolskii, & Sons, aker, M	I. Pinnau, B. Ltd. 2006.			science of Membranes, John
Short descript course conten		76. Metall 77. Carbo 78. Polym 79. Mixed 80. Comp distilla	ic mem n, zeoli er men conductive etitive ation, p	branes te and micro nbranes cting oxide m technologies ressure swing ance and acc	embranes for gas separation g adsorption, abso	and to	ceramic membranes reatment (cryogenic methods etc.)
acquired by th student	e	used for separa 134. To separa 135. To (cataly 136. To gas tre 137. To Generic Community To Community The all 10. Based plan 11. Based 11. Based 134. To separa 11. Based 134. To separa 14. Based 134. To separa 14. Based 135. To separa 14. Based 1	or gas so under tion me o know tic) me o know eatmen o prepa he abilicompeta funicationility to don a g	restand main to the more and character and character to interpretences on skills; Oraconduct a bit perform team peneral problemental pr	d gas treatment. ransport mechanistions of membran tors, and new apptechnologies for good cterize selected met experimental datal presentation and bliographic search memork.	es in solication as seponembra and digroup, and leadility diexpe	to draw conclusions.  discussions.  how to process the acquired  to design an experimental  rimental plan the ability to
	ASS 8 (5)	cond	uct pra	ctical lab wor	k in an independe	nt way	
Activit	У	Credits (h) 1ECTS:		м	ethodology		Relationship with competences
Lectures		0,8	(20)		y teaching staff		, 2, 3, 4
			(10)	Presentation external/in profession			, 2, 3, 4
Seminars					315		
Case Study			(5)	Demonstra	ition	1	, 2
Case Study Laboratory cour	rse		(5) (40)	Practice co	ition ourse organized in obrane prepration	5	, 6, 9, 10, 11
Case Study Laboratory cou	rse	1,6		Practice copairs; men and charact Solving ex Solving qu the studen Offering su	ntion ourse organized in obrane prepration oterisation ercises, estions as raised t	5 by	, 6, 9, 10, 11
Case Study Laboratory cou		0,8	(40)	Practice co pairs; men and charac Solving ex Solving qu the studen Offering su orientation Individual study time	ution urse organized in nbrane prepration eterisation ercises, estions as raised t ts. upport and in assignments. preparations and reparation of	5 by 1	, 6, 9, 10, 11
Case Study Laboratory cour Tutorials Self-study, wor		0,8	(20)	Practice co pairs; men and charac Solving ex Solving qu the studen Offering su orientation Individual study time assignmen	ution urse organized in nbrane prepration eterisation ercises, estions as raised t ts. upport and in assignments. preparations and Preparation of ts. ntation and	5 by 1 1 1 1 1 1	, 6, 9, 10, 11 , 2, 3, 4 , 2, 3, 4, 5, 6, 7, 8, 9, 10
Case Study Laboratory count Tutorials Self-study, wor individually		0,8	(40) (20) (20) (10)	Practice co pairs; men and charac Solving ex Solving qu the studen Offering su orientation Individual study time assignmen Oral prese discussions	ution urse organized in nbrane prepration eterisation ercises, estions as raised t ts. upport and in assignments. preparations and Preparation of ts. ntation and	5 by 1 1 1 1 1 1	, 6, 9, 10, 11 , 2, 3, 4 , 2, 3, 4, 5, 6, 7, 8, 9, 10 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10

	ent						
ECTS Credits	5	Semeste	r	S3	Туре		Mandatory
					Some of the second		
Used source	es		sselingh,	Multi-compon	ent mass transp		
Short descri course cont		83. Appli 84. Reve 85. Ion e 86. Ultra 87. Mem 88. Mem	cation to rse Osmo exchange filtration brane co brane re	membrane se osis, Pervapora ntactors for he actors for adva	fan description of eparation proces ation eavy metal remo anced oxidation	ses	s transport
Competenci acquired by student		transp 140. The technology of	To undersort through the content of	stand main tra ugh liquid sepa general concept ed for water tr main application d new application terize and despranes. by to interpret to ences	eration membraing pts, state-of-the eatment. ons of membran ions of technology scribe mass transexperimental dar presentation and presentation and	nesart me es in se gical in sport p ta and	eparation terest. properties of to draw
		9. The a 10. Base expe	acquired ability to ed on a g erimenta ed on a g	information. perform team- eneral problem I plan eneral problem	-work. n description the	ability	rimental plan the
Acti	vity	9. The a 10. Base expe 11. Base abilit  Credits	acquired ability to ed on a g erimenta ed on a g ey to cond s ECTS	information. perform team- eneral problem I plan eneral problem duct practical I	-work. n description the	e ability d exper depend Rel	to design an
	vity	9. The a 10. Base expe 11. Base abilit  Credits (h 1ECTS	acquired ability to ad on a gerimenta ad on a gey to condess ECTS	information. perform team- eneral problem I plan eneral problem duct practical I	-work. In description the In description and In des	e ability d experi	to design an rimental plan the dent way.  ationship with ompetences
Lectures	vity	9. The a 10. Base expe 11. Base abilit  Credits	acquired ability to ad on a gerimenta ad on a gey to condition as ECTS  acceptable by the condition acceptable by	information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/ind professionals	-work. In description the lab work in an ir  odology  teaching staff is held by ustrial s	Rel  1, 2, 3	to design an rimental plan the dent way.  ationship with ompetences 3, 4
Lectures Seminars	vity	9. The a 10. Base expe 11. Base abilit  Credits (h 1ECTS	acquired ability to ad on a gerimenta ad on a gey to condition as ECTS  (20)  (10)	information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/ind professionals demonstratio	-work. In description the lab work in an in lab work i	Rel  1, 2, 3  1, 2	to design an rimental plan the dent way.  ationship with ompetences 3, 4
Lectures Seminars Case study		10. Base experiments of the second se	acquired ability to ed on a gerimenta ed on a gey to concess ECTS (20) (10)	Information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/ind professionals demonstratio	-work. In description the lab work in an in odology  teaching staff is held by ustrial son rse organized mbrane nd	Rel 1, 2, 1	ationship with competences 3, 4 3, 4
Lectures Seminars Case study Laboratory co		9. The a 10. Base expe 11. Base abilit  Credits (h 1ECTS 0,8 0,4	acquired ability to ad on a gerimenta ad on a gey to condition as ECTS  (20)  (10)	information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/ind professionals demonstratic Practice cour in pairs; mei prepration a characterisa Solving exer Solving ques the students Offering sup	-work. In description the lab work in an in lab work in an in lab work in lab work in an in lab work in lab	Rel (c) 1, 2, 3 1, 2 1, 2	ationship with ompetences 3, 4 3, 4
Lectures Seminars Case study Laboratory co	ourse	10. Base experiments of the second se	acquired ability to ed on a gerimenta ed on a gey to concess ECTS (20) (10)	Information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/indi professionals demonstratic Practice coul in pairs; mel prepration a characterisa. Solving exer Solving ques the students Offering sup orientation i Individual pr study time.	-work. In description the lab work in an in lab work in an in lab work in lab	Rel (c) 1, 2, 3 1, 2 1, 2	ationship with ompetences 3, 4 3, 4, 6, 7, 8, 9
Lectures Seminars  Case study Laboratory of Tutorials  Self-study, w	ourse	the a 9. The a 10. Base expe 11. Base abilit Credits (h 1ECTS 0,8 0,4 0,2 0,2 0,8	acquired ability to ed on a gerimenta ed on a gey to condition (20) (10) (5) (40)	information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/indiprofessionals demonstration Practice coul in pairs; mel prepration a characterisal Solving exer Solving ques the students Offering sup orientation i Individual pr	-work. In description the lab work in an in lab work in a staff is held by lab work in lab work	Rel (c) 1, 2, 1, 2, 1, 2, 10, 1	ationship with ompetences 3, 4 3, 4, 6, 7, 8, 9 1 3, 4, 5, 6, 7, 8, 9
Lectures Seminars  Case study Laboratory of Tutorials  Self-study, windividually	ourse	the a second sec	acquired ability to ad on a gerimenta ad on a gery to consist ECTS (20) (10) (5) (40) (20)	Information. perform team- eneral problem I plan eneral problem duct practical I  Metho  Lectures by Presentation external/indi professionals demonstratic Practice cour in pairs; mer prepration a characterisa' Solving exer Solving ques the students Offering sup orientation i Individual pr study time. assignments Oral present discussions.	-work. In description the lab work in an in lab work in a staff is held by lab work in lab work	Rel (c) 1, 2, 1, 2, 1, 2, 10, 11, 1, 2, 10, 11	ationship with ompetences 3, 4 3, 4, 6, 7, 8, 9 1 3, 4, 5, 6, 7, 8, 9

Course name								
Membrane proces	s plan	t design						
ECTS Credits	5	Semester S3 Type Mandatory						
Used sources		62. Lecture notes, slides 63. W.D. Seider, J.D. Seader, D.R. Lewin; Product and Process Design Principles: synthesis, analysis and evaluation. 64. R.W. Baker; Membrane Technology and Applications						
Short description of course contents		89. Introduction to systematic process design 90. Introduction to process simulation (flowsheeting: Unisim or) 91. Introduction to cost estimation						
Competencies acquired by the student		(catalytic) interest.  145. Clea 146. gene membran operation.  147. Simu 148. To u membran 149. The area, opti 150. tech Generic Con 8. Commun 9. The abilit the obta	now main ap membrane rly define so erate process e module(s) al process. National ulate (membrand mes. ability to demal module nical en econ petences ication skills y to conduct ined information	reactors, and new ope and design bas alternatives in sy with additional ur dake balanced chorane) processes whain transport mechanism a (membrane configuration etc. nomical evaluation); Oral presentation a systematic bibliation.	v applications is a systematic point operation in the comment of t	mercial flowsheeter.  In different types of calculate membrane		
Activity		Credits EC (h) 1ECTS=25		Methodology	F	Relationship with competences		
Lectures + tutoria	als	1,0 (25		res by teaching sta	aff 1, 2,	3, 4, 5, 6, 7		
Seminars		0,2 (5)	Prese	esentations held by cternal/industrial ofessionals				
Assignment		3,5 (88	) Desig	Design of a membrane process in a systematic		3, 4, 5, 6, 7, 8, 9, 10		
Evaluation		0,3 (8)	Repor	Report and Oral presentation and discussions.		3, 4, 5, 6, 7, 8, 9, 10		
System for assessment and evaluation		101. 102.	Assignmer Report, or		nd participa	ation in discussions		

Course nam	ie							
Individual project								
ECTS Credits	6	Semester	S1-S3	Туре	Mandatory			
Used sources		65. Data bases ( like SciFinder Scholar – CAS), University library 66. Documents (papers, theses, books, patents) 67. Laboratory						
Short description of course contents		In the individual project, the student conducts a bibliographic and/or experimental study. The project is formulated and carried out in consultation with a supervisor. A report is presented at the end of the project and the project presented orally and discussed publicly. External experts may be invited for monitoring the progress and/or attendance of oral presentations.  1. Bibliographic study 2. Experimental study 3. Preparation of a written report 4. Oral presentation and defense						
Competencies acquired by the student		Specific Competencies  151. The ability to deal with and address specific problems, and to integrate previous knowledge acquired.  Generic Competences  2. The ability to manage and/or conduct an individual project (bibliographic search and/or experimental study), and to process acquired information.  3. Communication skills; Oral presentation and group discussions.						
Acti	vity	Credits ECTS (h) 1ECTS=25h	Method	dology	Relationship with competences			
Self-study, windividually	vorking	5(125)	Preparation of Personal study		1			
Evaluation		1(25)	report Oral presental	2, 3				
System for assessment evaluation	t and	103. Written report 104. Oral Presentation and defense						