ORGANIC CHEMISTRY IN THE FOUR YEAR COURSE AT THE UNIVERSITY OF LEIPZIG

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In the course of the reorganization of higher education taking place in the German Democratic Republic at present it has become necessary to shorten the chemistry courses at the universities and technical colleges from the hitherto five years to four years. The following conditions obtain:

First: A curriculum which provides for forty one weeks of study per year, thirty hours per week of lectures, consultations and laboratory work, and twenty five hours per week for individual study.

Second: The standard of the graduates should be at least equal to, and if possible higher, than that achieved in the five year course.

Third: The course should be productively academic or scientific, the students entering into research work as early as possible.

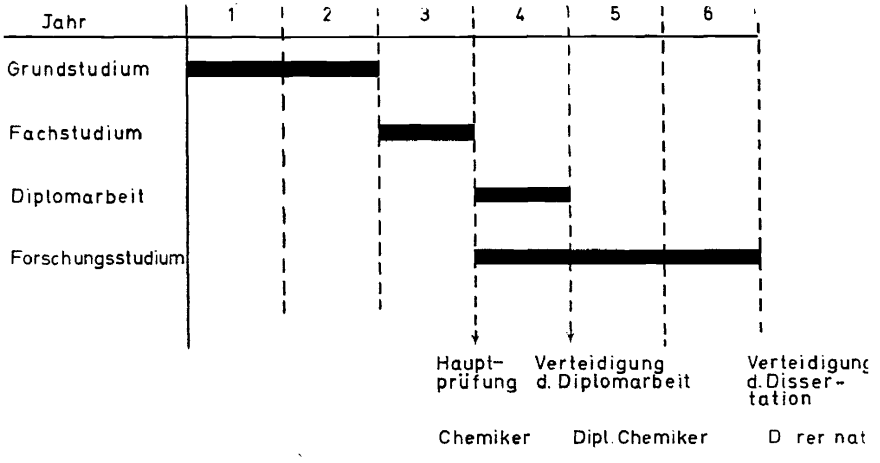

Figure 1

The following system is proposed for dealing with this problem (see *Figure 1*). The course is to be divided into three sections: basic course (two years), specialized course (one year) and research course (one year for chemists and three years for graduate chemists). Only the best students begin this course, about twenty per cent every year.

The curriculum for the basic course is the same at all universities and

technical colleges. Fundamental scientific knowledge of the chemist is taught as a basis for the subsequent specialized and research courses. Training in general chemistry, physical chemistry, inorganic chemistry, organic chemistry, analytical chemistry, physics, mathematics and philosophy is well balanced. The interlacing of these subjects or fields can be shown by a network diagram (see *Figure 2*). This is a very simplified diagram: for example, one line represents the quantum theory, and the traditional limits between these fields are beginning to disappear. We hope that we will be able to say in a few years: That's all general chemistry.

Figure 3 shows the tabulated hours to the network diagram and one can see that organic chemistry is taught in the last quarter of the basic course, twenty one weeks. Organic chemistry is taught in four parts. The first part is a condensed revision or repetition of the high school curriculum with programmed teaching aids. After this part the student knows all the classes of carbon compounds, their nomenclature and the three-dimensional structure of their molecules, he can determine the formula of a compound from experimental data and is capable of finding a compound in the literature. *Figure 4* shows an algorism for finding the constitution of a compound, *Figure 5* shows schematically the structure possibilities of a carbon skeleton.

Figure 6 shows the important functional groups resulting from combination of carbon with the other elements of the periodic system and their transformation by oxidation and reduction. In *Figure 7* each free valence of the groups signifies a hydrogen atom and for example toluene is 1 3, benzamidine is 3 10 16, and so on. The conversion of acetic acid into acetonitrile is 1 8 7 1 8 16 1 12.

Figure 8 shows the derivatives of the carbonyl compounds and *Figure 9* those of the carboxyl group. Each student is given these schemes and he must work with them and with the textbook at home; his individual study is controlled by seminars and examinations.

For the second part the student learns the fundamental types of reaction of organic chemistry, and the possibilities of producing the bonds that occur in the molecules of organic compounds (Weygand–Theilheimer system). He must work with the relevant handbooks, plan chemical syntheses for given compounds and be capable of finding a reaction in the literature. In these two parts an intensive training is given in the use of handbooks, chemical abstracts, chemical reviews etc.

After the third part the student knows the static electronic effects in the molecules of organic compounds, he is acquainted with the fundamentals of the theory of mesomerism and the MO theory, can determine the three-dimensional structure of molecules from the degree of hybridization of the atoms, can calculate simple conjugated systems according to the LCAO–MO-method and interpret molecule diagrams.

After the fourth part the student knows the most important reaction mechanisms and the methods of their recognition, he knows the relationships between structure and reactivity of carbon compounds, including steric effects, he can judge the reactivity of a compound from its structure, he is able to assess the influence of the reaction conditions on the course of the reaction, and is in a position to give thought to the optimization of the reaction conditions with a view to the desired product.

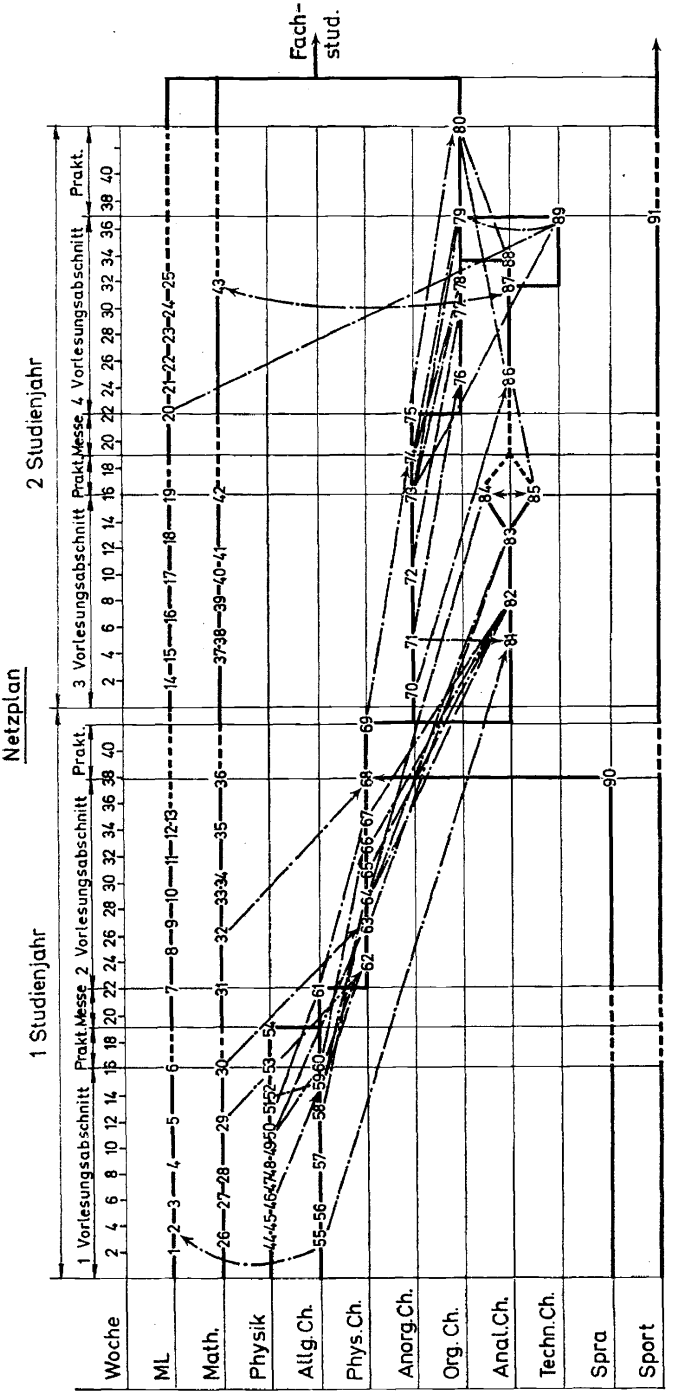
Netzplan
1 Studienjahr
2 Studienjahr
Fach-
stud.
Woche
ML
Math.
Physik
Allg.Ch.
Phys.Ch.
Anorg.Ch.
Org.Ch.
Anal.Ch.
Techn.Ch.
Spra
Sport
1 Vorlesungsabschnitt
Prakt.
Messe
2 Vorlesungsabschnitt
Prakt.
3 Vorlesungsabschnitt
Prakt.
Messe
4 Vorlesungsabschnitt
Prakt.

Figure 2

Stundenplan

	1. Studienjahr												
	Woche: 1–16				17–19		20–22	23–38				39–41	
	V	S	P	Se	P	Se	Se	V	S	P	Se	P	Se
ML	2	1	—	3	—	—	18	2	1	—	6	—	—
									13 Wochen				
	32	16	—	48	—	—	55	26	13	—	78	—	—
Spra.	—	2	—	2	—	—	—	—	2	—	3	—	—
											+3·9		
	—	32	—	32	—	—	—	—	32	—	75	—	—
Sport	—	—	2	—	—	—	—	—	—	2	—	—	—
	—	—	32	—	—	—	—	—	—	32	—	—	—
Math.	4	4	—	7	—	—	18	3	2	—	8	—	—
	64	64	—	102	—	—	55	48	32	—	128		—
Phys.	4	3	—	5	30	25	—	—	—	—	—	—	—
	64	48	—	80	90	75	—	—	—	—	—	—	—
Allg. Ch.	3	4	2	7	—	—	18	—	—	—	—	—	—
	48	64	32	102	—	—	55	—	—	—	—	—	—
Phys. Ch.	—	—	—	—	—	—	—	3	4	4	15	30	25
	—	—	—	—	—	—	—	48	64	64	240	90	75
Anorg. Ch.	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—
Org. Ch.	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—
Anal. Ch.	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—
Techn. Ch.	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—
V	13				—		—	8				—	
S	14				—		—	9				—	
P	4				30		—	6				30	
Se	24				25		55	32				25	

Figure 3a

Stundenplan

2. Studienjahr

1–16				17–19		20–22	23–37				38–40		Ges. Std.
V	S	P	Se	P	Se	Se	V	S	P	Se	P	Se	
2	1	—	4	—	—	37	2	1	—	4	—	—	V 110
								10	Wochen				S 55 } 610
													P —
32	16	—	64	—	—	110	20	10	—	40	—	—	Se 445
—	—	—	—	—	—	—	—	—	—	—	—	—	V —
													S 64 } 171
													P —
—	—	—	—	—	—	—	—	—	—	—	—	—	Se 107
—	—	2	—	—	—	—	—	—	2	—	—	—	V —
													S —
													P 126 } 126
—	—	32	—	—	—	—	—	—	30	—	—	—	Se —
2	1	—	6	—	—	—	3	—	—	4	—	—	V 174
								10	Wochen				S 112 } 707
													P —
32	16	—	96	—	—	—	30	—	—	40	—	—	Se 421
—	—	—	—	—	—	—	—	—	—	—	—	—	V 64
													S 48 } 357
													P 90
—	—	—	—	—	—	—	—	—	—	—	—	—	Se 155
—	—	—	—	—	—	—	—	—	—	—	—	—	V 48
													S 64 } 301
													P 32
—	—	—	—	—	—	—	—	—	—	—	—	—	Se 157
—	—	—	—	—	—	—	—	—	—	—	—	—	V 48
													S 64 } 581
													P 154
—	—	—	—	—	—	—	—	—	—	—	—	—	Se 315
3	2	4	10	30	25	18	—	—	—	—	—	—	V 48
													S 32 } 524
													P 154
48	32	64	160	90	75	55	—	—	—	—	—	—	Se 290
—	—	—	—	—	—	—	3	3	11	13	30	25	V 45
													S 45 } 615
													P 255
—	—	—	—	—	—	—	45	45	165	195	90	75	Se 270
2	1	10	5	—	—	—	2	—	3	4	—	—	V 62
													S 16 } 423
													P 205
32	16	160	80	—	—	—	30	—	45	60	—	—	Se 140
—	—	—	—	—	—	—	4	2	—	8	—	—	V 20
								5	Wochen				S 10 } 70
													P —
—	—	—	—	—	—	—	20	10	—	40	—	—	Se 40
	9			—	—		10				—		V 619=14%
	5			—	—		4				—		S 510=11%
	16			30	—		16				30		P 1016=23%
	25			25	55		25				25		Se 2340=52%

Figure 3b

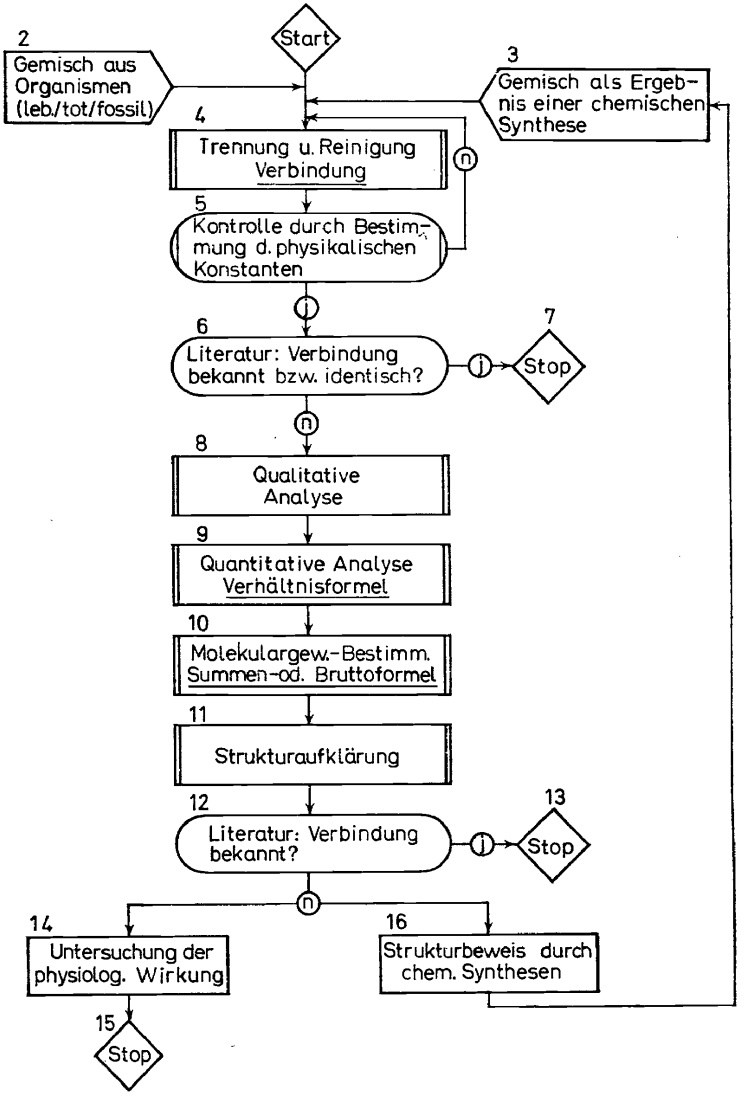
Start
2
Gemisch aus Organismen (leb./tot/fossil)
3
Gemisch als Ergebnis einer chemischen Synthese
4
Trennung u. Reinigung Verbindung
n
5
Kontrolle durch Bestimmung d. physikalischen Konstanten
j
6
Literatur: Verbindung bekannt bzw. identisch?
j
7
Stop
n
8
Qualitative Analyse
9
Quantitative Analyse Verhältnisformel
10
Molekulargew.-Bestimm. Summen-od. Bruttoformel
11
Strukturaufklärung
12
Literatur: Verbindung bekannt?
j
13
Stop
n
14
Untersuchung der physiolog. Wirkung
15
Stop
16
Strukturbeweis durch chem. Synthesen

Figure 4

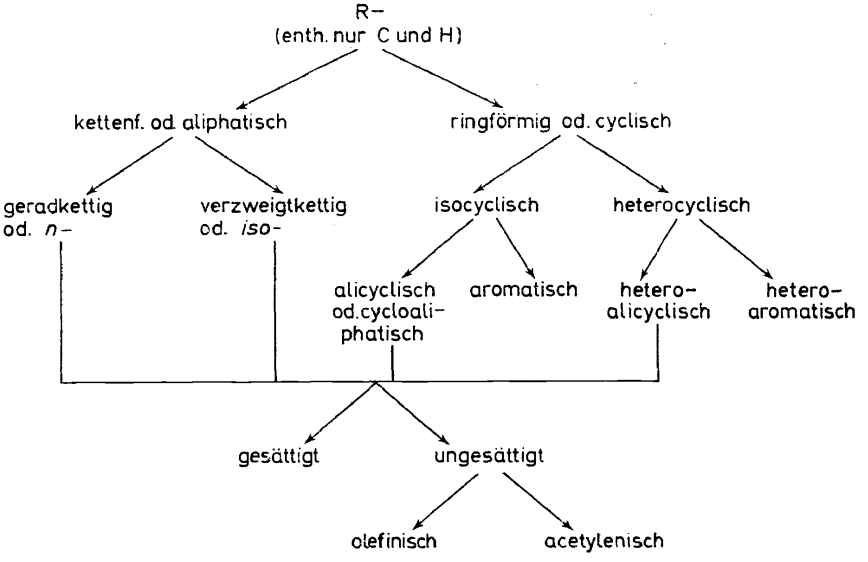
R–
(enth. nur C und H)
kettenf. od. aliphatisch
ringförmig od. cyclisch
geradkettig
od. n–
verzweigtkettig
od. iso-
isocyclisch
heterocyclisch
alicyclisch
od. cycloali-
phatisch
aromatisch
hetero-
alicyclisch
hetero-
aromatisch
gesättigt
ungesättigt
olefinisch
acetylenisch

Figure 5

		—H							
	—CH_2—H	CH—H	—C—H						
—X	—CH_2—OH	CH—OH	—C—OH		—O—OH	—NH_2	—NH—NH_2	—N_3	—Me
							$\overset{\oplus}{\text{—N}}\text{=N}$		
						—NHOH			
	—C(=O)—H	C=O				—NO			
	—C(=O)—OH					—NO_2			
				—O—	—O—O—		—NH—NH—		
							—N=N—		
							—N=NO—		
	—SH					—PH_2			
	—SO_2H					—PO_2H			
	—SO_3H					—PO_3H			
				—S—	—S—S—				
				—SO—					
				—SO_2—					
HX	H_2O	H_2O	H_2O	H_2O	H_2O_2	H_3N	H_2N—NH_2	HN_3	HMe

Figure 6

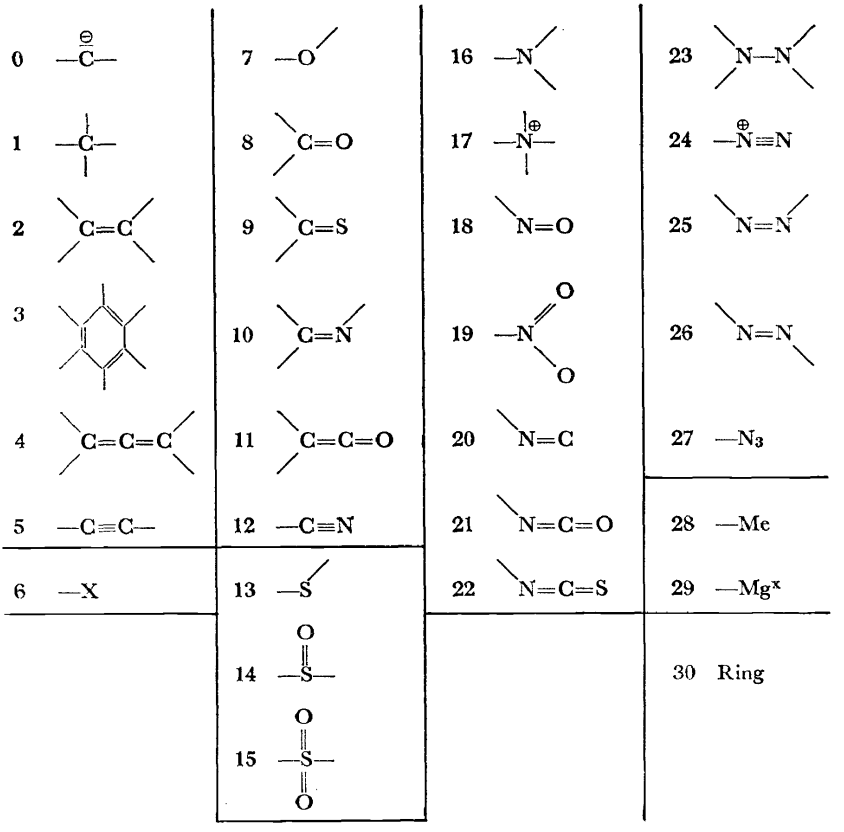
0 —C⊖—
1 —C—
2 C=C
3
4 C=C=C
5 —C≡C—
6 —X
7 —O
8 C=O
9 C=S
10 C=N
11 C=C=O
12 —C≡N
13 —S
14 —S(=O)—
15 —S(=O)(=O)—
16 —N
17 —N⊕—
18 N=O
19 —N(=O)=O
20 N=C
21 N=C=O
22 N=C=S
23 N—N
24 —N⊕≡N
25 N=N
26 N=N
27 —N3
28 —Me
29 —Mgx
30 Ring

Figure 7

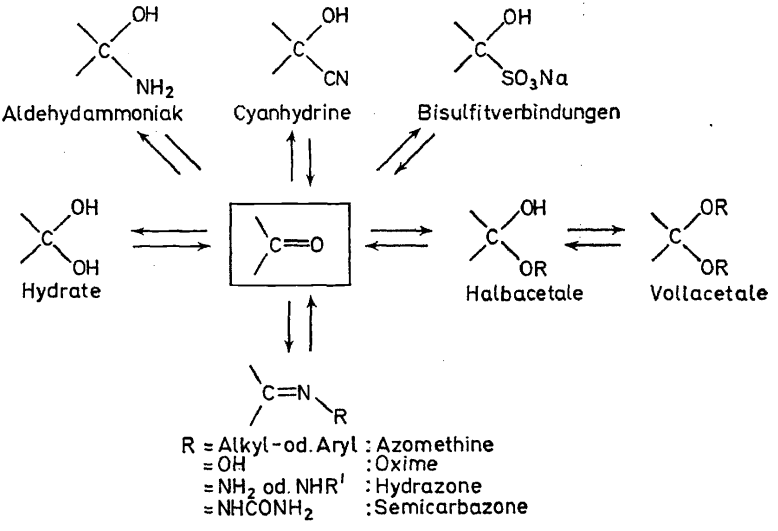
OH
NH2
Aldehydammoniak
OH
CN
Cyanhydrine
OH
SO3Na
Bisulfitverbindungen
OH
OH
Hydrate
C=O
OH
OR
Halbacetale
OR
OR
Vollacetale
C=N
R
R = Alkyl-od. Aryl : Azomethine
= OH : Oxime
= NH2 od. NHR' : Hydrazone
= NHCONH2 : Semicarbazone

Figure 8

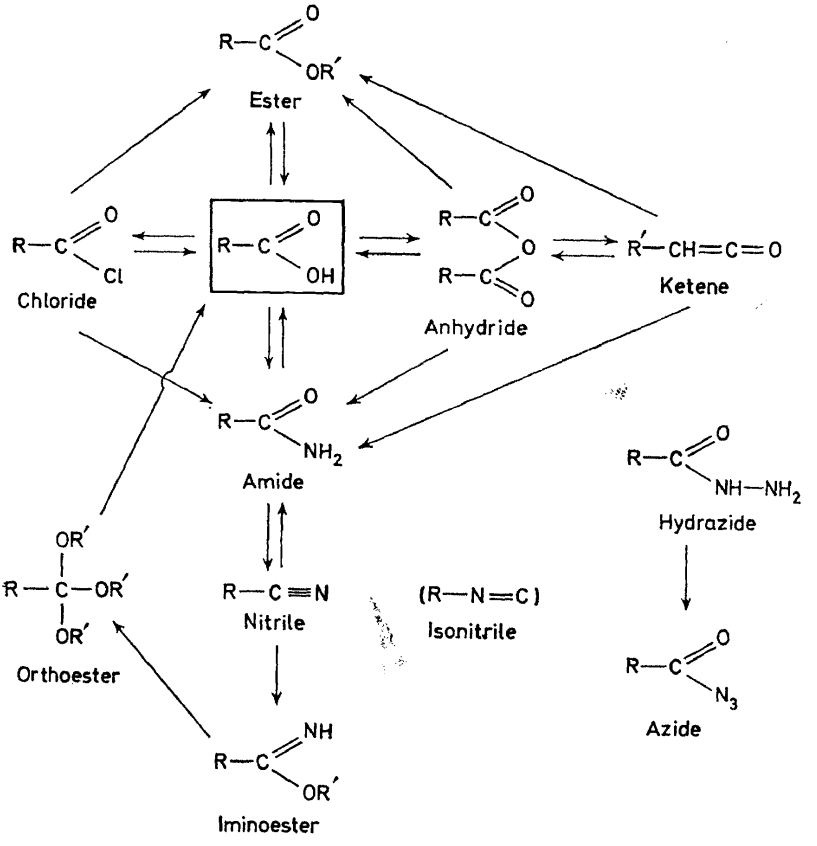
Ester
Chloride
Anhydride
Ketene
Amide
Hydrazide
Orthoester
Nitrile
Isonitrile
Azide
Iminoester

Figure 9