EMBRACING NEW TECHNOLOGIES AND DELIVERY SYSTEMS INTO THE PHARMACIST CURRICULUM OF THE **SEMMELWEIS UNIVERSITY**

Zelkó Romána

Budapest

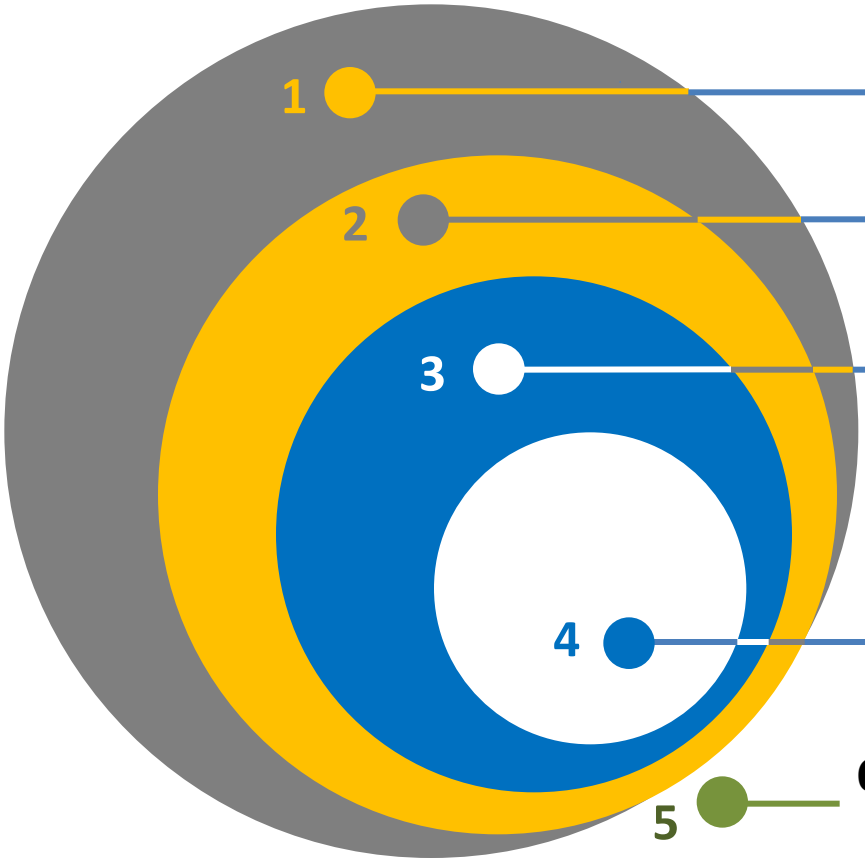
Hungary

History

Qeen Maria Theresia
(1717-1780)

1770 - Education of **pharmacy** within the scope of **University of Nagyszombat (1635)**

Education started first with five institutes:



1. **Physiology and Pharmaceutics (Prandt)**
2. **Anatomy (Trnka)**
3. **Surgery (Plenck)**
4. **Botany and Chemistry (Winterl)**
5. **General Pathology i.e. the real clinical science (Shoretich)**

Establishment

Faculty

Semmelweis Ignác

who discovered the cause of puerperal fever and was a professor in the Faculty of Medicine.

1818 - 1865

1955 - Present **Faculty of Pharmacy** was established as part of Budapest University

1969 - the name of the University honors **Ignác Semmelweis** who discovered the cause of puerperal fever and was a professor in the Faculty of Medicine.

Education

Pharmacy

- Natural science-based,
- Medical-sciences oriented,
- Professional specialities
- **inter- and multidisciplinary science and practice**
- Education in Hungary led to a master's degree (M.Sc.) and
- occupational doctorate (dr. pharm.)
- undivided, five-year, 300 credit points, full-time education,
- at four universities

Semmelweis Egyetem

160

SZTE (Szeged)

120

PTE (Pécs)

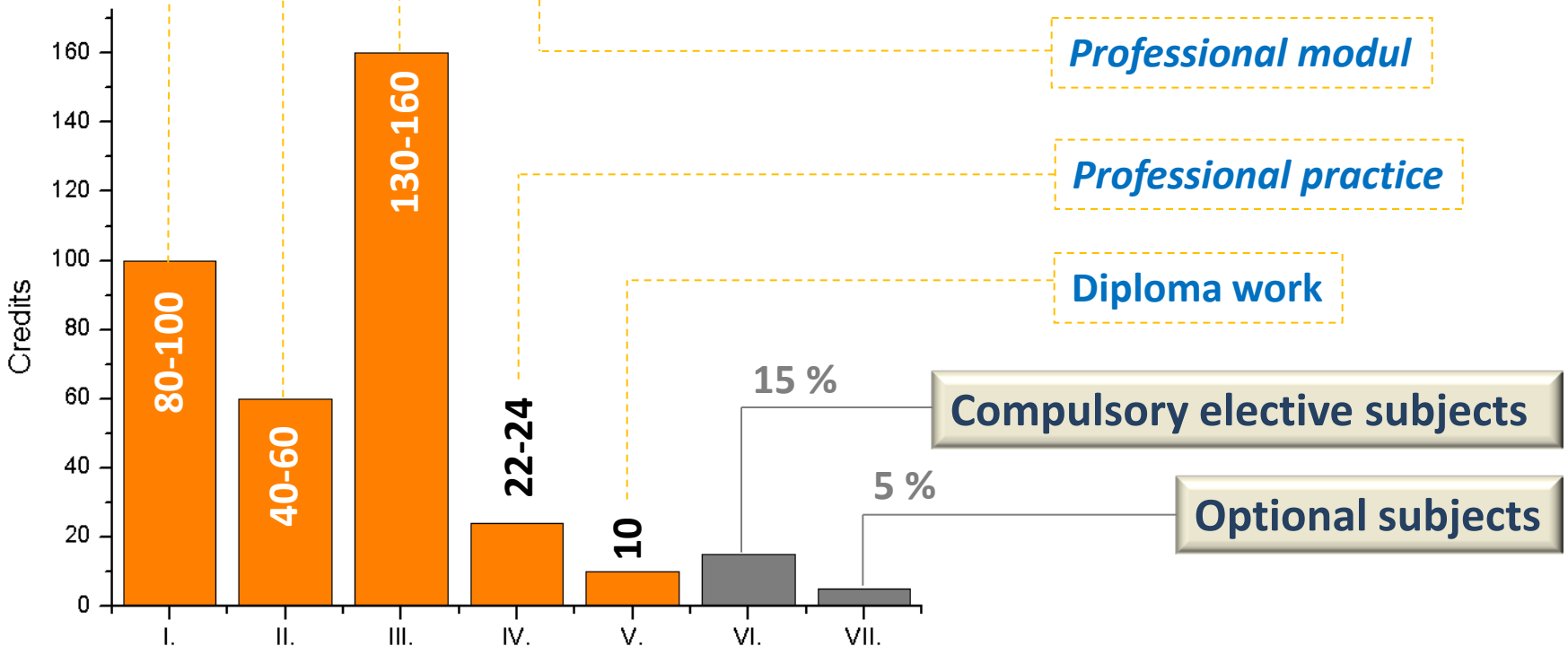
70

DE (Debrecen)

70

Distribution | Credits

Distribution of the 300 credits



Training

Programs

The Academic Program offered by the Faculty of Pharmacy leads to the degree of Master of Pharmacy.

Training is pursued in **Hungarian** and in **English** and **German** languages.

Current enrolment in the Faculty of Pharmacy is about **790 students** in the three training programs.

The Faculty of Pharmacy at Semmelweis University admits students after entrance examination in two general subjects (Biology, Physics or Chemistry) requiring some basic knowledge.

Education in Pharmacy has the characteristic feature that some subjects of basic sciences are given by ***Departments of Eötvös Loránd University*** and some medical subjects by ***Departments belonging to Faculty of Medicine***.

Departments

Pharmaceutical sciences

1. University Pharmacy Department of Pharmacy Administration
2. Department of Organic Chemistry
3. Department of Pharmacodynamics
4. Department of Pharmacognosy
5. Department of Pharmaceutics
6. Department of Pharmaceutical Chemistry

Curriculum

Parts of studies

The curriculum for pharmacy education includes **5 years of basic** and special studies.

The ***first two years*** are devoted to the basic sciences:
physics, mathematics, general chemistry, inorganic and organic chemistry, qualitative and quantitative chemical analysis, physical chemistry, colloid chemistry, biochemistry, pharmaceutical botany, biology.

The ***second part of studies*** *(3rd, 4th and 5th years)* stresses special **pharmaceutical sciences and medicine:**
pharmaceutical chemistry and chemical analysis, pharmacology and toxicology, pharmaceutical technology, biopharmacy, pharmacy administration, clinical pharmacy, pharmacognosy, microbiology, physiology, pathophysiology, immunology, public health and epidemiology, ethics, pharmacy administration and management.

Professional practices

Periods

Summer

Period:

4 weeks, 35 hours/week

(after 4. and 6. semester)

4-4 credits

Before the final exam

Period:

8 + 16 weeks, 5 days-40 hours/week

Places

Summer practices

Optional

- Pharmaceutical industry
- Pharmacy
- Institutional/hospital pharmacy
- Research institute
- University department
- Health authority

Departments of Pharmaceutics

Past and Present

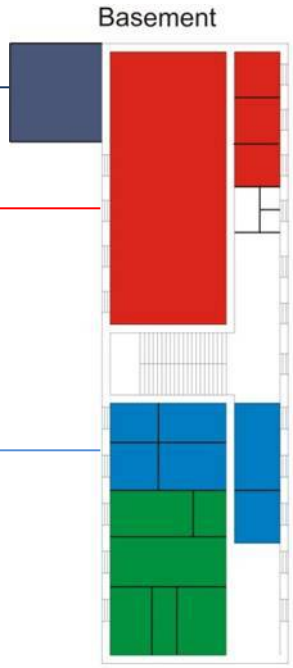
Reconstruction: 2003-2008 (≅ 1.200.000 EUR)

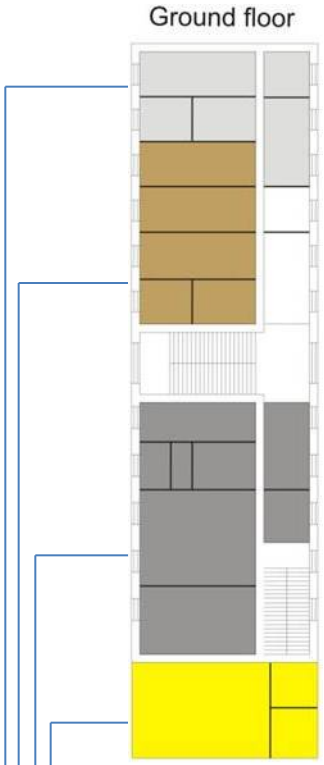
PAST

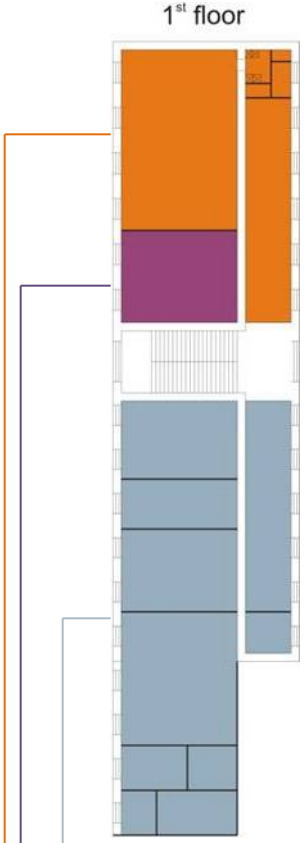
PRESENT

Departments

Laboratories







TOTAL AREA: 950 m²

- Biopharmaceutical Laboratory
- Physical Laboratory
- Sándor Mozsonyi Pharmacy
- Pilot Laboratory
- Compounding Research Laboratory
- Analytical Laboratory
- Officies and Secretariat
- Parenteral Laboratory
- Galenic Laboratory
- Library Laboratory
- Chemical Quality Control Laboratory

Departments

Gradual courses

OBLIGATORY COURSES	LECTURES	PRACTICES
Pharmaceutical technology		
3rd (compounding)	*60*	*120*
4th year (formulation+manufacture)	*90*	*270*
	150	***390***
Biopharmaceutics-pharmacokinetics (5th year)	*24*	*36*
ELECTIVE COURSES		
Industrial pharmacy (4th year)	*42*	
Innovation in pharmaceutics (5th year)	*36*	
Bioanalytics in pharmacokinetics (5th year)	*36*	
Veterinary preparations (5th year)	*36*	
Pharmaceutical compounding	*14*	
Cosmetics	*36*	
Pharmaceutical biotechnology	*36*	
Nano systems in pharmaceutical sciences	*24*	

Education

Industrial cooperation

Gradual courses
Diploma works

Postgradual courses

RESIDENT SYSTEM

Ph.D. COURSES

IN-HOUSE TRAINING AT COMPANIES

(e.g. Pharm. tech. course, 40 hours)

WORKSHOP TRAINING

Lectures

Curriculum of pharm technology

4th year

Lectures

Scope of industrial pharmaceutical technology. History and development.
Aspects of the pharmaceutical development. Preformulation studies.
Applying principles of chemical engineering for the manufacturing of pharmaceutical preparations.
Critical manufacturing parameters and principles of scaling up.
Requirements and conditions for manufacturing (Good Manufacturing Practice)
Quality assurance and manufacturing. Safety regulations.
Validation. Concepts of the statistical process control.

Unit operations: comminution, powdering, sieving.
Unit operations: separation, filtering, settling, extraction.
Unit operations: homogenization, dispersing, distillation, evaporation.
Unit operations: fluidization.
Unit operations: drying.
Unit operations: freeze-drying.
Unit operations: crystallization.

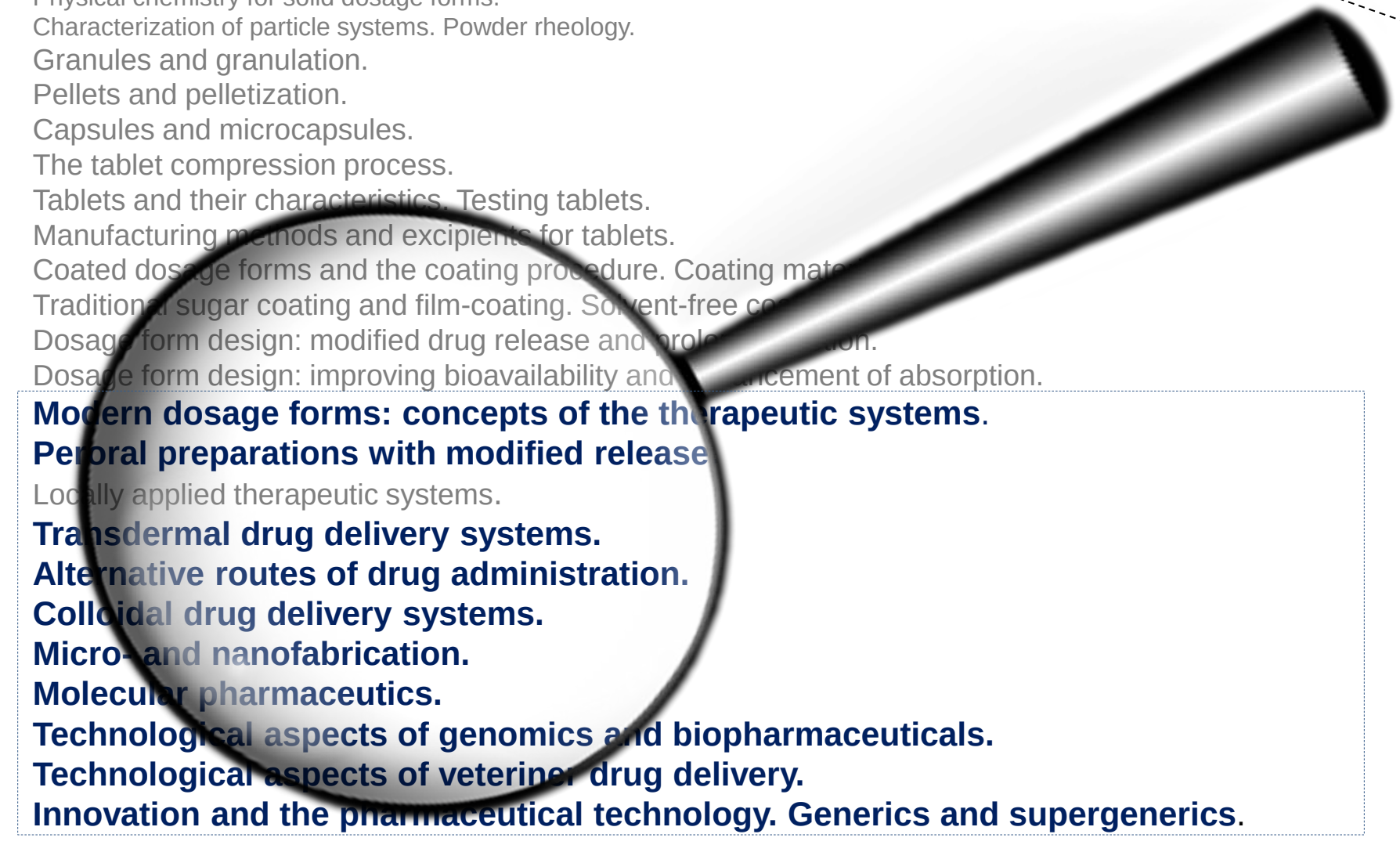
Sterilization.
Formulation of parenteral preparations.
Manufacturing of large and small volume parenterals.
Pirogenicity. Endotoxins.
Stability of pharmaceutical preparations. Stability tests. Stabilization methods.
Preparations for inhalation. Aerosols.

Lectures

Curriculum of pharm technology

4th year

Physical chemistry for solid dosage forms.
Characterization of particle systems. Powder rheology.
Granules and granulation.
Pellets and pelletization.
Capsules and microcapsules.
The tablet compression process.
Tablets and their characteristics. Testing tablets.
Manufacturing methods and excipients for tablets.
Coated dosage forms and the coating procedure. Coating mate
Traditional sugar coating and film-coating. Solvent-free co
Dosage form design: modified drug release and prole ion.
Dosage form design: improving bioavailability and ancement of absorption.



Modern dosage forms: concepts of the therapeutic systems.
Peroral preparations with modified release
Locally applied therapeutic systems.
Transdermal drug delivery systems.
Alternative routes of drug administration.
Colloidal drug delivery systems.
Micro- and nanofabrication.
Molecular pharmaceutics.
Technological aspects of genomics and biopharmaceuticals.
Technological aspects of veteriner drug delivery.
Innovation and the pharmaceutical technology. Generics and supergenerics.

Practices

Curriculum of pharm technology

4th year

9 hours/week in

- *Pilot plant laboratory*
- *Parenteral laboratory*
- *Chemical laboratory*
- *Physical laboratory*

Practices

Curriculum of pharm technology

4th year

Pilot plant laboratory

Controlling the drying process.

Study of the filtration process.

Mixing of solids.

In-process control of the homogenization process.

Study on parameters of fluidization.

Investigations of factors affecting the size red[illegible]-mill.

Control of raw materials.

Preparation and stability test of em[illegible]ns.

In-process control of manufacturing solid dosage forms.

Manufacturing suppositories. Determination of the replacing factor.

Preformulation studies and product development.

Ointment preparation.

Preparation of liquid dosage forms (solutions, elixirs, syrups, mixtures).

In-process control tests for solutions.

Tablet compression and in-process control of tablet manufacturing.

Pellet preparation in a high-shear mixer

Preparation of coating dispersions.

Coating of pellets in fluid bed.

Coating of tablets.

Practices

Curriculum of pharm technology

4th year

„BATCH REPORT”

PILOT PLANT LABORATORY
DEPARTMENT OF PHARMACEUTICS

„BATCH REPORT" 2007/2008

Suppositorium antipyreticum pro parvulo (FoNo VII.)	*Batch number:*	*Batch size:*

Produced by	Date	Start of production
Controlled by	Date	End of production
Approved by	Date	Expiry date
Checked by	Date	

Identification of substances

Identification of substances is made according to the label.

Name of substance	Identification No	Checked by	Date
Aminophenazonum			
Adeps solidus 50			
Butyrum cacao			
Checked by:		Date:	

Weighing-in (100 pcs):

Name of substance	Prescribed weight (g)	Tare (g)	Weight (g)	Gross(g)	Balance No:	Weight by:	Controlled by	Name of substance
Aminophenazonum	15,0							
Adeps solidus 50	70,0	-						
Butyrum cacao	120,0	-						
Screened by:				Date (yr.month.day, hour, min):				

Preparation of suppositories:
Suspend the medical compound in the melted, filtered and cooled base material (~40 °C). Fill the suspended mass into semi-automatic Erweka equipment suppository mold and continuously fill up the suppository chill-mould previously lubricated with liquid paraffin.

Melted:	Checked, date:
Melt is ready for filtering:	*Signature: .....date:.....*
Filtered:	Checked, date:
Suspended:	Checked, date

Equipment:

Cleaned:	Checked:	Date:
Suppository mold set by:	Checked:	Date:
Filling of suppositories prepared:	Checked:	Date:
Preparation of the forms:	Checked:	Date:
Label:	Checked:	Date:

The suppository prepared according to the prescription and checked by the analitics is ready to be packed.

	Sign	Date
Procedure controlled by, batch report of bulk product checked by		

Therapeutic use of any samples or preparation made during practice is PROHIBITED!

Within the time of lesson after having finished the practice a student can leave the laboratory only at own risk!

	Date	time	Sign
Practice work is completed	.....year.....month.....day	....	

Practices

Curriculum of pharm technology

4th year

Laboratory for parenteral preparations

Aseptic processing.

Autoclaving.

Determination of inside pressure of bottles at different filling volumes.

Preparation of dextrose infusion.

Preparation of mannitol infusion.

Filtration by frame filter.

Control of infusions and injections containing dextrose (pH, refractive index, degradation product).

Preparation and control of infusions containing electrolytes and sugars.

Preparation of infusions used in acidosis.

Determination of endotoxin concentration in parenteral solutions by the quantitative LAL test.

Adjustment of isotonicity.

Preparation of injections liable to hydrolysis.

Determination of the chloride ion concentration by ion selective electrode.

Filling and closing of ampoules.

Preparation and control of aerosols.

Preparation of heat sensitive injections.

Sterilization by membrane filtration. Integrity testing of membranes.

Nonaqueous injections.

Freeze-drying.

Preparation of injections liable to oxidation

Control of drug content of ascorbic acid injection

Preparation of suspension injections

Color determination of ascorbic acid injections

Isotonicity setting based on freezing point depression

Isotonicity setting based on sodium chloride equivalents

Chemical laboratory

Control of the formation of calcium acetilsalicylate with oscillometry.

Acid neutralizing tests of antacids (USP tests and "pH-stat" method).

Determination of the lipase activity.

Investigation on the catalytic oxydation of ascorbic acid.

Stability test of hydrocortisone-hemisuccinate solutions.

Stability test on the decrease of acetic acid content of Spiritus antirheumaticus.

Stability test of solutions containing penicillin.

Real-time stability test of tablets containing aspirin.

Accelerated stability test of solutions containing phenobarbital sodium.

Computer Aided Practice (accelerated stability testing).

Testing of containers (hydrolytic resistance; physical resistance; blister closing testing; light transmission test, adsorption test)

Investigation of the interaction between acetylsalicylic acid and caffeine.

Investigation of the interaction between papaverine hydrochloride and phenobarbital sodium with potenciometric method.

Investigation of the interaction between methyl-p-oxy-benzoate and macromolecules by dynamic dialysis.

Formulation of KCl prolonged release capsules and their dissolution test.

Dissolution test of aspirin containing tablets with rotating basket method.

Study on impurities

Preparation of oxytetracyline containing microcapsules.

Testing dissolution profile of coated pellets.

Practices

Curriculum of pharm technology

4th year

Physical laboratory

Test of ion-exchange resins.

Determination of the dissociation constant of drugs.

Increasing of solubility of salycilic acid by changing permittivity.

Concentration determination of sugar syrups by viscometry.

Viscometric evaluation of macromolecular colloids used as stabilizers

Investigation of phase-inversion of emulsions by viscometry.

Determination of the average molecular mass of polyethylene glycols by viscometry.

Determination of the critical micelle concentration by stalagmometry.

Investigation of surfactants using the Donnan's pipette.

Investigation of solubilization of volatile oils by aqueous titration method.

Particle size analysis of suspensions by the Andreasen's cylinder.

Particle size analysis of suspensions by the the Wiegner's tube.

Slipping-and drop point determination of ointment and suppository bases.

Study on drug release of suppositories.

Investigation of compression strength of suppositories.

Study of disintegration of suppositories.

Congealing-and softening point determination of ointment and suppository bases

Penetrometric test of ointments.

Study on the rheological behaviour of ointments with rotational viscometer.

Examination of drug distribution in suspension type suppositories.

Determination of the adsorptive surface of medicinal charcoal.

Determination of particle size and particle size distribution by sieve analysis.

Investigation of flow properties and real density of granules.

Investigation of disintegration of tablets and capsules.

Curriculum

Biopharmacy-pharmacokinetics

5th year

Lectures

Introduction into biopharmacy and pharmacokinetics. Terms and definitions.

Modeling the fate of drugs in the body (LADME, LADMER and other models).

Transport processes and absorption mechanisms. Factors influencing the absorption.

Basic concepts and importance of the Biopharmaceutical Classification System.

Biopharmaceutical considerations of drug distribution and metabolism.

Excretion and clearance of drug. The biological half-life.
Bioavailability and bioequivalence.
Compartmental and non-compartmental modeling.
Pharmacokinetics of single dosing.
Pharmacokinetics of multiple dosing.
Individualization and optimization of the dosage regimens.
In vitro – in vivo correlation and relationship.

Practice

Study on the distribution of salicylic acid in a three-phase system.
In vitro test for drug penetration from a gel system.
In vitro drug release from oinments with local effect.
In vitro dissolution profile of conventional and modified release nitrofurantoin containing preparations.
Determination of diclofenac sodium in synovial fluid samples.
Urinary excretion kinetics of aspirin.
Determination of theophylline plasma levels in beagle dogs after iv. administration.
Determination of theophylline plasma levels in beagle dogs after po. administration.
Calculation of bioavailability.
Computer modeling in pharmacokinetics (***with KINETICA software***)
Analyzing data to establish in vitro-in vivo correlation.

Curriculum

Industrial pharmacy course

Objective

The subject is recommended for the students interested in several fields of industrial pharmaceutical technology such as research and development of new formulations, manufacturing and production, quality assurance and control.

Topics

History of pharmaceutical industry
Profiles of the pharmaceutical industry
Career for pharmacists.
R&D strategies
Pharmaceutical technological aspects of product registration
Manufacturing in connection with quality assurance and quality control.
Validation of the manufacturing method.
In-process control methods of the manufacturing. PAT.
Critical parameters in the production.
Methods for statistical process control.
Current Good Manufacturing Practice.
Preformulation and formulation studies.
Optimization of dosage form composition.
Optimization of manufacturing methods.
Comparison of scaling-up methods.

Research | ... and development

Research activity

The most important research fields involve **technological and biopharmaceutical aspects** of

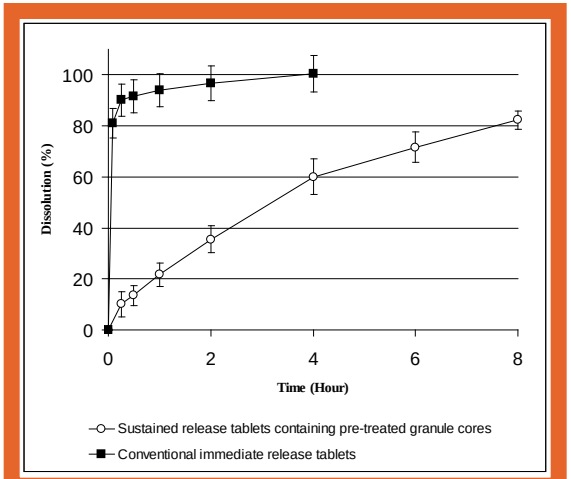
- **FORMULATION of dosage forms**
  - controlled/modified release
  - solubility improvement
- **STUDY on drug release considering in vitro – in vivo relationships through bioanalytical methods,**
- **DEVELOPMENT of bioanalytical methods**
- **OPTIMISATION manufacturing process parameters,**
- **APPLICATION and characterisation of new excipients.**

Research

... and development

GEDEON RICHTER *Plc.*

Semmelweis Innovations *Ltd.*



- **Controlled** release pharmaceutical composition of tolperison hydrochloride,

  PCT/HU2008/000086

- **Aqueous solvent system** for solubilization of azole compounds.

  USA application 61/ 041930
  104115 US Specification

Discussion

Questions ?

THANK YOU FOR YOUR ATTENTION

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