

B. PHARM SEMESTER - IV

**SEMESTER-IV
SCHEME OF TEACHING**

SUB CODE	NAME OF SUBJECT	CONTACT HOURS PER WEEK		CREDITS	
		T	P	T	P
B401T	Pharmaceutical Microbiology-II Theory	4	--	3	--
B401P	Pharmaceutical Microbiology-II Practical	--	3	--	3
B402T	Pharmaceutical Unit Operations Theory	4	--	3	--
B402P	Pharmaceutical Unit Operations Practical	--	3	--	3
B403T	Pharmacology-II Theory	4	--	3	--
B403P	Pharmacology-II Practical	--	3	--	3
B404T	Pharmacognosy-II Theory	4	--	3	--
B404P	Pharmacognosy-II Practical	--	3	--	3
B405T	Organic Chemistry-II Theory	4	--	3	--
B405P	Organic Chemistry-II Practical	--	3	--	3
	Tutorial	1	--	--	--
Total		36		30	

SCHEME OF EXAMINATION

SUB CODE	NAME OF SUBJECT	DURATION OF EXAM (HRS)		MARKS			
				THEORY		PRACTICAL	
		T	P	University level evaluation	Institute level evaluation	University level evaluation	Institute level evaluation
B401T	Pharmaceutical Microbiology-II Theory	3	--	80	20	--	--
B401P	Pharmaceutical Microbiology-II Practical	--	3	--	--	80	20
B402T	Pharmaceutical Unit Operations Theory	3	--	80	20	--	--
B402P	Pharmaceutical Unit Operations Practical	--	3	--	--	80	20
B403T	Pharmacology-II Theory	3	--	80	20	--	--
B403P	Pharmacology-II Practical	--	3	--	--	80	20
B404T	Pharmacognosy-II Theory	3	--	80	20	--	--
B404P	Pharmacognosy-II Practical	--	3	--	--	80	20
B405T	Organic Chemistry-II Theory	3	--	80	20	--	--
B405P	Organic Chemistry-II Practical	--	3	--	--	80	20
TOTAL		30		400	100	400	100

SUBJECT : Pharmaceutical Microbiology-II

SUBJECT CODE : B401T & B401P

RATIONALE :

Microbiology is an exciting discipline with far-reaching impacts in human health and disease. This course will focus on the study of bacteria, viruses, and fungi and their interrelationship with human disease development. There will be emphasis on microbial structure, growth, metabolism, genetics and microbial diversity. Laboratory focuses on microbial identification, handling, staining and growth. During the first half of the course we will cover the basic principles of microbiology including microbial growth and metabolism, reproduction, and microbial diversity. In the second half of the course we will draw on the basic principles learned in the first half of the semester to understand microbiology as it relates to human health, and human disease

COURSE OBJECTIVES:

This course will cover topics in the history of microbial morphology and physiology, bacterial metabolism, genetics, and the classification of microorganisms.

- This course will increase your awareness and appreciation for microscopic organisms in environment and their relationships to humans in health and disease
- This course will also provide with tools for a better understanding of microbial Pathogenesis, means of control and treatment
- This course will give information about the most important microbial diseases caused By bacteria, fungi, protozoans and worms
- Additionally, this course will also cover special topics: emerging infectious diseases and Global public health, nosocomial infections and antibiotic resistance the practical laboratory portion of the course will provide a review of procedures used to isolate and identify microorganisms, as well as understanding in bacterial transmission and how to avoid it, antimicrobial agents, antibiotics and correct handling of laboratory samples.

LEARNING OUTCOMES:

- Understand how microorganisms survive where they do, how they are related, and how they interact with us.
- Have a solid grasp of the scope of the microbial world and its role in human disease
- How to control bacterial growth- use of chemical and physical agents to control microbe propagation How to provide a microbe-free environment for the health professional
- Understand the rationale behind the use of chemicals to control bacterial propagation (anti-microbial agents)
- How microorganisms relates with us causing disease
- Summarize mechanisms of animal defenses to infection, including primary defenses, innate immunity, and acquired immunity.
- How microbes harm us by causing Pathogenesis
- Learn the most important disease-causing organisms: Bacteria, viruses, protozoans and worms. Classification and characteristics
- The laboratory work will help acquire basic bacteriological skills so as to successfully use them.

PREREQUISITES: Basic principles of Biology and Chemistry

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	TEACHING SCHEME			CREDITS		EVALUATION SCHEME				TOTAL MARKS
		T	P	TOTAL HRS	T	P	INTERNAL		EXTERNAL		
							T	P	T	P	
B401T & B401P	Pharmaceutical Microbiology-II	4	3	7	3	3	20	20	80	80	200

CONTENTS:

1	Methods of isolation of microorganisms-Qualitative and Quantitative. Total count, Viable count, pour plate method, Dilution calculations. Handling and storage of microorganisms—Inoculation of agar surface by streaking, Inoculation of slopes, and of liquid medium. Cultivation of anaerobes., Isolation of pure bacterial culture	20
2	Aseptic techniques-methods and applications. Concept of aseptic area design.	15
3	Control of microorganisms in pharmaceuticals: <ul style="list-style-type: none"> • Chemical method: Disinfection and preservation Methods of disinfection, Different disinfectants. Concept of Bacteriostatic and bactericidal actions through preservatives. • Physical method: Sterilization-Introduction, Methods, advantages, disadvantages, industrial applications of each method. • Validation of sterilization process. 	30
4	Test for sterility: Standard methods for all types of products.	15
5	Application of microbial testing: Pharmacopoeia methods of Antibiotic assay, MIC, Preservative efficacy test, Microbial limit test, Pyrogen testing by rabbit method and LAL method.	20

B401P Pharmaceutical Microbiology-II Practicals

1	Isolation of pure bacterial culture.
2	Isolation of microorganisms by different methods.
3	Test for sterility of various products.
4	Study of disinfectant action.
5	To perform antibiotic assay, Microbial limit test for given samples.

BOOKS RECOMMENDED:

1.Principles Of Microbiology By Ronald M. Atlas, W.C. Brown Publishers
2.Pharmaceutical Microbiology By W.B. Hugo And A. D. Rusell, Blackwell Science
4.“Introduction To Medical Microbiology”, Ananthanarayan R., Orient Longman Publication
5.“Introduction To Microbiology”, Rao A.S., Prentice-Hall Of India
3.“Fundamentals Of Microbiology”, Frobisher, W B Saunders Publication
6.“General Microbiology”, Stanier, Macmillan Publication
7.“Mechanisma Of Microbial Disease”, Schaechter Moselio, Williams And Wilkins Publication
8.“Medical Microbiology : A Guide To Microbial Infection - Pathogenesis Immunity Laboratory Diagnosis And Control”, Greenwood David Ed., Churchill Livingstone Publication
9.“Medical Microbiology”, Baron Ellen Jo (Et Al...), Willey - Liss Publication
10.“Microbiology”, Pelczar Michael J., Tata McGraw-Hill Publication
11.“Microbiology An Introduction”, Tortora Gerard, Benjamin Cumming Publication
12.Bergey’s Manual Of Systematic Bacteriology By Williams & Wilkins- A Waverly Co.

B. PHARM SEMESTER - IV

SUBJECT : **Pharmaceutical Unit Operations**
SUBJECT CODE : **B402T & B402P**
RATIONALE : Some basic operations such as filtration, mixing, drying etc., become day to day work in a pharmaceutical industry. The course enables the student to learn all these basic processes in depth.

COURSE OBJECTIVES:

1. Learn the various unit operations
2. Understand the principles of the equipments and machineries used for these processes.
3. Learn how efficiently these processes can be carried out in an industry.
4. Learn what problems can arise if these processes are not carried out properly.

LEARNING OUTCOMES: The student should be able to:

1. Explain the fundamental principles lying behind these processes.
2. Explain the construction, principles, applications, merits and demerits of all equipments used in industry to carry out these processes.
3. Troubleshoot the problems underlying these processes.

PREREQUISITES: Basics of Physics, Chemistry and fundamentals of pharmaceutics learnt in past semesters.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	TEACHING SCHEME			CREDITS		EVALUATION SCHEME				TOTAL MARKS
		T	P	TOTAL HRS	T	P	INTERNAL		EXTERNAL		
		T	P	TOTAL HRS	T	P	T	P	T	P	
B402T & B402P	Pharmaceutical Unit Operations	4	3	7	3	3	20	20	80	80	200

CONTENTS:

1	Size reduction and size separation: <ul style="list-style-type: none">• Definition and Objectives• Mechanisms of size reduction.• Pretreatment of materials before size reduction.• Factors affecting choice of equipment.• Construction, Function, advantages, disadvantages, uses and variants/modifications of mills: Ball mill, Hammer mill and Fluid energy mill.• Differentiation: Dry milling and Wet milling Objectives of wet milling, techniques, equipments (Colloid mill, Silversion homogenizer, triple roller mill) and applications. <ul style="list-style-type: none">• Size reduction of API, Excipients and crude drugs-characteristic features.• Auxiliary processes. Various methods of size separation and their importance: <ul style="list-style-type: none">• Sieving- Standard sieves, Pharmacopoeial requirements, sieve shaker.• Cyclone separator.	25
2	Mixing	25

	<ul style="list-style-type: none"> • Objectives –Importance of mixing as unit operation • Theory of mixing • Classification –Solid-Solid mixing, liquid mixing, semisolid mixing. • Solid -solid mixing: Mechanisms of mixing • Construction, function, advantages and disadvantages, uses and modifications of mixers: Ribbon mixer, Sigma blade mixer, RMG, Fluid bed mixer, D-Nauta mixer, Tumbler mixer. • Factors affecting choice of mixer. • Liquid mixing: Mechanism of mixing. • Construction, function, advantages and disadvantages, uses and modifications of mixers: Impeller mixers. • Factors affecting choice of mixers • Importance of plug flow, Vortex, Baffles, De-mixing, De-aeration • Semisolid mixing: Construction, function, advantages and disadvantages, uses and modifications of mixers—Planetary mixer. <p>Note: Use visual images of actual industrial equipments.</p>	
3	<p>Drying:</p> <ul style="list-style-type: none"> • Objectives – Importance as unit operation • Types of moisture-Bound and unbound and its importance • Drying behavior of different types of substances.-Crystalline and granular • Mechanism of drying process. • Factors affecting rate of drying • EMC curve and its application • Numerical based on drying rate calculation • Construction, function, advantages and disadvantages, uses and modifications of industrial driers---Tray drier, Fluid bed drier Rotary drier. • Special drying process –Spray drying, Freeze drying. 	20
4	<p>Crystallization:</p> <ul style="list-style-type: none"> • Characteristics of crystals: Purity, size, shape, habit, forms. • Concept of crystal growth and Ostwald’s ripening, Nucleation theory. • Caking of crystals and its preventions. • Application of crystallization in pharmaceuticals. 	15
5	<p>Filtration in pharmacy:</p> <ul style="list-style-type: none"> • Objectives of filtration in Pharma industry. Factors affecting rate of filtration • Filter aids • Brief description of industrial filters—Plate and frame filter press, Vacuum filters and Rotary filters. 	15

B402P Pharmaceutical Unit Operations Practicals

1	Size reduction using ball mill.
2	To determine mixing efficiency of given system.
3	To find out optimum time and speed of mixing.
4	To determine rate of drying for given sample.
5	To study the factors affecting rate of drying for given sample.-Surface area, Solid content.
6	To find out % LOD for given samples.
7	To study drying behavior of different solids.
8	To construct super solubility curve for given substances.
9	To study factors affecting rate of filtration

BOOKS RECOMMENDED:

1	“Pharmaceutical Engineering”, Sambhamurthy K.
2	“Pharmaceutical Engineering”, by CVS Subramanian, Vallabh Prakashan
3	“Elementary Chemical Engineering”, Peters Max
4	“Perry’s Chemical Engineers Handbook”, Perry Robert H
5	“Pharmaceutics: The Science Of Dosage Form Design”, Aulton Michael E, Churchill Livingstone Publication.
6	“The theory And Practice Of Industrial Pharmacy”, Lachman Leon, Varghese Publication
7	“Pharmaceutical Process Engineering Vol. 112”, Hickey Anthony J., Marcel Dekker Publication

B. PHARM SEMESTER - IV

SUBJECT : Pharmacology-II
SUBJECT CODE : B403T & B403P
RATIONALE : This is one of the core subjects of Pharmacy field where student learns the biological effects of drugs. The subject has direct application to the profession as it teaches the student about how the drug produce effect, what effects are produced, what side effects are produced, where and when it should be used etc. The subject is an extension of Pharmacology-I learnt in Semester-III

COURSE OBJECTIVES :
To learn the mechanism of action, pharmacological effects, pharmacokinetics, adverse effects, therapeutic application of various classes of drugs with special attention to drugs acting on central nervous system and certain inflammatory disorders

LEARNING OUTCOMES: The student should be able to:

1. Narrate the principles involved in measurement of drug effects
2. Classify the drugs according to pharmacological classes
3. Explain the mechanism of action, pharmacodynamic and pharmacokinetic effects of drugs, adverse effects, contraindications and therapeutic application of various classes of drugs.
4. Conduct some simple *in vivo* experiments to demonstrate the pharmacological actions of the drugs.

PREREQUISITES:

Knowledge of Human Anatomy Physiology, Health Education, Biochemistry and basic physics and chemistry.

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	TEACHING SCHEME			CREDITS		EVALUATION SCHEME				TOTAL MARKS
		T	P	TOTAL HRS	T	P	INTERNAL		EXTERNAL		
							T	P	T	P	
B403T & B403P	Pharmacology-II	4	3	7	3	3	20	20	80	80	200

CONTENTS:

1. Central Nervous System (CNS):	45
Neurohumoral transmission in the CNS, General and local Anesthetics, Drug Addiction and Drug Abuse, Alcohol, hallucinogens, centrally acting muscle relaxants, CNS Stimulants.	
2. Pathophysiology and Drugs used in treatment of :	45
Insomnia, Anxiety, Psychosis, Depression, Epilepsy, Parkinson's Disease, Alzheimer's Disease, Pain pathway & Opioids	
3. Pharmacology of inflammatory modulators and pathophysiology of Joint and Connective Tissue Disorders & their treatment	10
Rheumatoid Arthritis, Gout and Hyperuricemia	

B403P Pharmacology-II Practical

1. To study the sedative –hypnotic effect of diazepam & phenobarbitone sodium in mice.
2. To study the effect of diazepam on motor co-ordination by rotarod test in mice.
3. To study the effect of drugs on spontaneous motor activity & evaluate their nature as CNS stimulant or depressant using photoactometer.
4. To study the analgesic effect of aspirin by acetic acid induced writhing method.
5. To study the analgesic effect of given drug by thermal method.
6. To study the cataleptic activity of haloperidol in rats.
7. To study the anti-parkinsonian activity of levodopa by phenothiazine induced catatonia.
8. To evaluate the anti-epileptic effect of phenytoin using maximum electroconvulsive shock (MES) induced seizures in rats.
9. To study the effect of mydriatics and miotics on rabbit eye using simulation software.
10. To evaluate the local anesthetic effect of xylocaine using rabbit eye (Infiltration anaesthesia).
11. To evaluate the local anesthetic effect of xylocain using G.pig (intradermal method).
12. To determine analgesic activity and pain threshold of aspirin for healthy human volunteers.
13. To determine CNS stimulation activity of caffeine on healthy human volunteers.
14. To study the effect of CNS stimulant or anxiolytics using different mazes.

BOOKS RECOMMENDED:

1. Pharmacological Basis Of Therapeutics By Goodman & Gillman
2. Pharmacology And Pharmacotherapeutics By Satoskar & Bhandarkar
3. Essentials Of Pharmacotherapeutics By F.S.K. Barar
4. Essentials Of Medical Pharmacology By K.D. Tripathi
5. Pharmacology By Rang & Dale
6. Fundamentals Of Experimental Pharmacology By M.N. Ghosh
7. Handbook Of Experimental Pharmacology By S.K. Kulkarni
8. Experimental P'cology by R.K.Goyal
9. Lewis Pharmacology By Crossland
10. Textbook Of Pharmacology By Bowman & Rand
11. Toxicology: The Basic Science Of Poisons By Casorett & Doull
12. Clinical Pharmacology By Lawrence
13. Principles Of Drug Action By Goldstein Aronow & Kalaman
14. Pharmacological Experiments On Isolated Preparations By Perry
15. Robin's basic pathology by Ninay Kumar
16. Pathology by Harshmohan
17. Drug Treatment By Avereby
18. Medical Pharmacology By Goth
19. Pharmacology By Gaddum
20. Elements Of Pharmacology By Dr. Derasari & Dr. Gandhi
21. Drug Interactions By Hansten
22. Introduction To General Toxicology By Aries Simonsis & Offermeier

B. PHARM SEMESTER - IV

SUBJECT : Pharmacognosy-II
SUBJECT CODE : B404T & B404P
RATIONALE : It provides knowledge of drugs of natural origin. Since ages humans have been using drugs from natural origin. Many of the allopathic drugs also have herbal origin. Learning these drugs is of great value for pharmacy professionals as these drugs have important place in treatment of diseases.

COURSE OBJECTIVES :

1. To learn general morphological and microscopical characters of crude drugs
2. To understand general methods of checking purity of herbal drugs.

LEARNING OUTCOMES: The student should be able to:

1. Identify the crude drugs belonging to different classes based on morphological, microscopical and chemical properties.
2. Narrate the therapeutic and pharmaceutical uses of these drugs

PREREQUISITES: Biology and Pharmacognosy-I of semester-III

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	TEACHING SCHEME			CREDITS		EVALUATION SCHEME				TOTAL MARKS
		T	P	TOTAL HRS	T	P	INTERNAL		EXTERNAL		
							T	P	T	P	
B404T & B404P	Pharmacognosy-II	4	3	7	3	3	20	20	80	80	200

CONTENTS:

1	Lipids: Definition, classification & chemical tests of lipids; Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Hydnocarpus Oil, Linseed oil, Shark liver oil and Wool fat.	20
2	Resins: Definition, classification & chemical tests of resins; Study of Drugs containing Resins and Resin combinations like podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, benzoin, turmeric, ginger, garlic, Guggal.	30
3	Volatile oils: Definition, classification & chemical tests of volatile oils; General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, cinnamon, lemon peel, orange peel, lemon grass, caraway, dill, clove, fennel, nutmeg, eucalyptus, cardamom, valerian, gaultheria.	40
4	Study of pharmaceutical aids and Natural Colors.	10

B404P Pharmacognosy-II Practical

	Morphological, Microscopic and chemical tests of
1	Cinnamom bark
2	Eucalyptus leaf
3	Coriander fruit
4	Fennel fruit
5	Mentha leaf
6	Clove flower bud
7	Cardamom seed
8	Ginger rhizome
9	Capsicum fruit
10	Dill fruit
11	Linseed.
12	To study morpholgy and chemical tests of lipid containing drug.
13	To study morpholgy and chemical tests of resin containing drug.
14	TLC study of volatile oil containing drugs.
15	Demonstration of clevenger's apparatus
16	Powder mixture 1
17	Powder mixture 2
18	Powder mixture 3

BOOKS RECOMMENDED:

1. Atal C.K. And Kapur B.M., Cultivation and Utilization Of Medicinal Plants, Rrl Jammu.
2. Rangari & Rangari, Text Book Of Pharmacognosy
3. Quadry J S, Shah And Qadry Pharmacognosy, B. S. Shah Publication
4. Wallis T.E., Text Book Of Pharmacognosy, 5th Edition, CBS Publishers And Distributors
5. Kokate C.K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
6. Kokate C.K, Purohit A.P. And Gokhale S.B. Pharmacognosy (Degree) Nirali Prakashan, Pune.
7. Khandelwal K R, Practical Pharmacognosy, Nirali Prakashan
8. Trease E and Evans W.C., Pharmacognosy, Balliere Tindall. Eastbourne, U.K.
9. Tyler V.C., Brady L.R. And Robers W.E. , Pharmacognosy, Lea And Febiger, Ph
10. Iyengar, Text Book of Pharmacognosy, Manipal Power Press.
11. MG Chauhan, Microscopy Of Leaf Drug, Jamnagar Ayurved University
12. MG Chauhan, Microscopy Of Bark Drug, Jamnagar Ayurved University
13. Jackson Betty P., Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, CBS Publication.
14. Anasari, Pharmacognosy Textbook of Natural Products, Latest Edition.
15. Ashutosh Kar, Pharmacognosy And Pharmacobiotechnology, New Age International

SUBJECT : Organic Chemistry-II

SUBJECT CODE : B405T & B405P

RATIONALE : Majority of the drugs used are organic in nature and therefore understanding the basics of organic chemistry, naming these complex chemical structures, understanding the chemical and physical properties of the common groups of compounds and also doing synthesis of these compounds becomes very important in understanding drug properties

COURSE OBJECTIVES:

1. To learn fundamentals of heterocyclic chemistry
2. To learn application of reagents in chemistry.
3. To learn the novel organic chemical reactions and its application.
4. To identify organic compounds by testing their physical and chemical properties.

LEARNING OUTCOMES: The student should be able to:

1. Application of Heterocyclic chemistry in drug discovery.
2. Write chemical reactions depicting synthesis and chemical properties of these organic compounds.
3. Synthesis of heterocyclic compounds.
4. Identify unknown organic compounds by conducting different physical and chemical tests and its derivatization.

PREREQUISITES: Basic organic chemistry learnt at HSc level and organic chemistry learnt in previous semester

TEACHING AND EVALUATION SCHEME:

SUB CODE	TITLE OF SUBJECT	TEACHING SCHEME			CREDITS		EVALUATION SCHEME				TOTAL MARKS
		T	P	TOTAL HRS	T	P	INTERNAL		EXTERNAL		
							T	P	T	P	
B405T & B405P	Organic Chemistry-II	4	3	7	3	3	20	20	80	80	200

CONTENTS:

1	The subject of organic chemistry will be treated in its modern perspective keeping for the sake of convenience, the usual classification of organic compounds. Nucleophilic aromatic substitutions Nucleophilic aromatic substitutions; α,β -unsaturated carbonyl compounds	20
2	Conservation of orbital symmetry and rules Conservation of orbital symmetry and rules, Electrocyclic, Cycloaddition and sigma tropic reactions; Neighboring group effects, Catalysis by transition metal complexes.	20
3	Reagents in drug synthesis New organic reagents used in drug synthesis.	10
4	Heterocyclic Compounds Heterocyclic Compounds: Chemistry, preparations and properties of some important heterocyclics containing 3,4,5,6 and 7 atoms with one or two heteroatoms like O, N, S.	50

B405P Organic Chemistry-II Practical

1-10	Qualitative analysis of given unknown compounds and synthesizes its derivatives
11	Synthesis of N-acetyl-glycine from glycine.
12	Synthesis of 4-Benzylidene-2-methyloxazol-5-one from N-acetyl-glycine.
13	Synthesis of 2-methylbenzimidazole from o-phenylenediamine and acetic acid
14	Synthesis of 5, 5-diphenylhydantoin from benzyl and urea.
15	Synthesis of 3-methyl-1-phenylpyrazol-5-one from ethyl acetoacetate and phenylhydrazine.
16	To perform purity study of synthesized compound (Anyone)

BOOKS RECOMMENDED:

1. Morrison & Boyd, Organic Chemistry, Prentice-Hall, 6th, 2001.
2. Solomon & Fryhle, Organic Chemistry, Wiley, 8th, 2004.
3. Furniss. Vogel's Textbook of Practical Organic Chemistry, Pearson education, 5th, 2004.
4. Miller J. Aromatic Nucleophilic Substitution, Elsevier, 7th, 1968.
5. Gould E. Mechanism & Structure in Organic Chemistry, Wiley, 3rd, 1959.
6. Norman R. Principles of Organic Synthesis, Wiley, 4th, 1981.
7. Orchin M. The Importance of Antibonding Orbitals, Houghton-Mifflin, 3rd, 1967.
8. Sykes P. A Guide to Mechanism in Organic Chemistry, Longman, 3rd, 1981.
9. Hammett H. Physical Organic Chemistry, McGraw-Hill, 2nd, 1970.
10. Barton D. Compressive Organic Chemistry, Pergamon, Vol.6, 1979.
11. Greene T. Protective Groups in Organic Chemistry Synthesis, Wiley, 3rd, 1975.