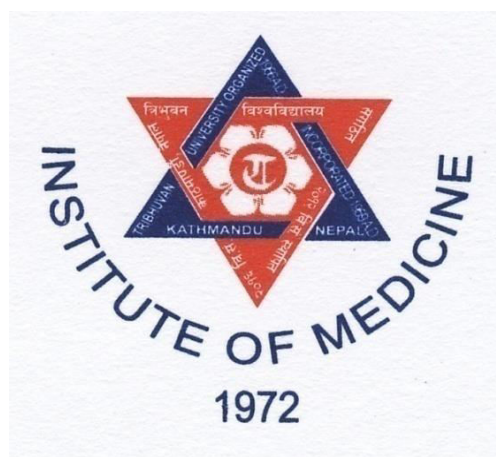


**Curriculum**  
**on**  
**Bachelor in Pharmacy**  
**(B. Pharm)**



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The first year consists of six-theory papers and three practical carrying a total load of 990 Teaching Hours (46) including both theory and practical. In the second year, there are six theory papers and six-practical carrying a total load of 1080 Teaching Hours (48). In the third year, there are seven theory papers and three practical carrying a total load of 900 Teaching Hours (48) and in the fourth year there will be four theory and one practical paper carrying a total load of 450 Teaching Hours (36). The course consists of total of 3420 Teaching Hours (178). Apart from these papers, a 3 months' period is allotted to Dissertation and a 2 months time is allotted to the in-plant training in the fourth year.

### 10. Curriculum structure of Bachelor of Pharmacy

Code No.	Name of the subject	Hrs/ wk	Hrs/ yr	Credit	Marks
<b>FIRST YEAR</b>					
BP 401 A	Anatomy, Physiology & Pathology-Theory	3	90	6	100
BP 402 A	Biochemistry- Theory	3	90	6	100
BP 402 B	Biochemistry-Practical	3	90	2	50
BP 403 A	Pharmaceutical Chemistry-Theory	3	90	6	100
BP 403 B	Pharmaceutical Chemistry-Practical	3	90	2	50
BP 404 A	Medicinal Chemistry I-Theory	3	90	6	100
BP 405 A	Pharmacology I-Theory	3	90	6	100
BP 406 A	Pharmaceutical Microbiology-Theory	3	90	6	100
BP 406 B	Pharmaceutical Microbiology-Practical	3	90	2	50
	<b>Total of First Year</b>	<b>33</b>	<b>990</b>	<b>46</b>	<b>750</b>
<b>SECOND YEAR</b>					
BP 501 A	Pharmaceutics I (Physical Pharmacy)-Theory	3	90	6	100
BP 501 B	Pharmaceutics I (Physical Pharmacy)- Practical	3	90	2	50
BP 502 A	Medicinal Chemistry II-Theory	3	90	6	100
BP 502 B	Medicinal Chemistry II-Practical	3	90	2	50
BP 503 A	Biopharmaceutics and Pharmacokinetics- Theory	3	90	6	100
BP 503 B	Biopharmaceutics and Pharmacokinetics- Practical	3	90	2	50
BP 504 A	Pharmacognosy -Theory	3	90	6	100
BP 504 B	Pharmacognosy –Practical	3	90	2	50
BP 505 A	Pharmacology II-Theory	3	90	6	100
BP 505 B	Pharmacology II-Practical	3	90	2	50

BP 506 A	Pharmaceutical analysis and quality assurance I-Theory	3	90	6	100
BP 506 B	Pharmaceutical analysis and quality assurance I- Practical	3	90	2	50
	<b>Total of Second Year</b>	<b>36</b>	<b>1080</b>	<b>48</b>	<b>900</b>
<b>THIRD YEAR</b>					
BP 601 A	Pharmaceutical Engineering-Theory	3	90	6	100
BP 602 A	Pharmaceutics II (Dosage Forms and Formulation) -Theory	3	90	6	100
BP 602 B	Pharmaceutics II (Dosage Forms and Formulation)–Practical	3	90	2	50
BP 603 A	Pharmaceutical analysis and quality assurance II- Theory	3	90	6	100
BP 603 B	Pharmaceutical analysis and quality assurance II- Practical	3	90	2	50
BP 604 A	Ayurvedic and Herbal Technology-Theory	3	90	6	100
BP 604 B	Ayurvedic and Herbal Technology-Practical	3	90	2	50
BP 605 A	Biostatistics & Research Methodology-Theory	3	90	6	100
BP 606 A	Pharmaceutical Jurisprudence-Theory	3	90	6	100
BP 607 A	Community Pharmacy and First Aid-Theory	3	90	6	100
	<b>Total of Third Year</b>	<b>30</b>	<b>900</b>	<b>48</b>	<b>850</b>
<b>FOURTH YEAR</b>					
BP 701 A	Clinical and Hospital Pharmacy-Theory	3	90	6	100
BP 701 B	Clinical and Hospital Pharmacy-Practical	3	90	2	50
BP 702 A	Pharmaceutical Management-Theory	3	90	6	100
BP 703 A	Pharmaceutics III (Industrial Pharmacy) – Theory	3	90	6	100
BP 704 A	Pharmacotherapeutics-Theory	3	90	6	100
BP 705 DT	Dissertation			6	100
BP 706 IP	In-plant Training in Hospital +Industry (4 weeks each)			4	100
	<b>Total of Fourth Year</b>	<b>15</b>	<b>450</b>	<b>36</b>	<b>650</b>
	<b>Grand Total</b>	<b>114</b>	<b>3420</b>	<b>178</b>	<b>3150</b>

For the dissertation work, each student should develop a thesis topic, which will be carried out under the guidance of teachers. The students should submit a thesis and defend it.

Recognizing the need to develop the ability to translate theory into practice, students are placed for in-plant training in pharmaceutical manufacturing units, hospitals, drug stores as a part of curriculum at the beginning of 4<sup>th</sup> year.

## MEDICINAL CHEMISTRY – I

Subject: Theory	Year: First	Code: BP 404 A
Full Marks: 100	Total Teaching hours: 90	Credit hour: 6

**Course description:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

**General objectives:** At the end of the course, the student will be able to:

- a. Interpret the chemistry of drugs with respect to their pharmacological activity
- b. Explain the adverse effect and therapeutic value of drugs
- c. Describe the Structural Activity Relationship (SAR) of different class of drugs
- f. Describe the importance of Structure Activity Relationships (SAR) of drugs.
- d. Discuss the chemical synthesis of mention drugs.
- e. Introduce the structure and property of new drugs use in therapy

**Specific objectives:**

### Unit 1: Introduction to Medicinal Chemistry [5 Hrs]

After the completion of the course, students will be able to

1.1. Mention the history and development of medicinal chemistry

1.2. Discuss the physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

1.3. Describe about the drug metabolism

- a. Differentiate and understand the Phase I and II metabolism.
- b. Describe the Factors affecting drug metabolism including stereo chemical aspects.
- c. Classify Drug Receptors
- d. Draw the chemical reaction of drug receptors interactions

### Unit 2: Local anesthetics [3 Hrs]

After the completion of the course, students will be able to

- a. Classify local Anaesthetics
- b. List out the ester and amide derivatives
- c. Enumerate the synthetic scheme of Lidocaine from 2,6 Xylidine.
- d. Explain the SAR and properties of local Anaesthetics
- e. Mention the Mechanism of action (MOA) properties of Lignocaine HCl, Tetracaine,

### **Unit 3: Drugs acting on Autonomic Nervous System**

#### **3.1. Adrenergic Neurotransmitters: [9 Hrs]**

After the completion of the course, students will be able to

- a. Draw a biosynthetic scheme and catabolism of catecholamine.
- b. Mention the Adrenergic receptors (Alpha & Beta) and their distribution.
- c. Classify Sympathomimetic agents
- d. Describe the SAR of Sympathomimetic agents
- e. Discuss about the structure, MOA and properties of directly acting Sympathomimetic agents: Nor-adrenaline, adrenaline, Phenylephrine, Methyldopa, Clonidine, Dopamine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol, Naphazoline, Oxymetazoline and Xylometazoline.
- f. Enumerate the synthetic scheme of Adrenaline and Ephedrine.
- g. Discuss about the structure, MOA and properties of indirect acting agents: Hydroxyamphetamine, Pseudoephedrine.
- h. Discuss about the structure and properties agents with mixed mechanism: Ephedrine, Metaraminol.

#### **3.2. Adrenergic Antagonists: [8 Hrs]**

After the completion of the course, students will be able to

- a. Classify Alpha-adrenergic blockers
- b. Discuss about the structure, MOA and properties of Phentolamine, Phenoxybenzamine, Prazosin, Ergometrine and methylergometrine.
- c. Classify Beta-adrenergic blockers
- d. Describe the SAR of beta-blockers
- e. Discuss about the structure, MOA and properties of Propranolol, Atenolol, Timolol, Metoprolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.
- f. Enumerate the synthetic scheme of Propranolol.

#### **3.3. Cholinergic neurotransmitters: [3 Hrs]**

After the completion of the course, students will be able to

- a. Draw a biosynthetic scheme and catabolism of acetylcholine.
- b. Mention the cholinergic receptors (Muscarinic & Nicotinic) and their distribution.
- c. Classify Parasympathomimetic agents: SAR of Parasympathomimetic agents [6 Hrs]
- d. Discuss about the structure, MOA and properties MOA of direct acting agents like Acetylcholine, Carbachol, Bethanechol, Methacholine, Pilocarpine.
- e. Enumerate the synthetic scheme of Carbachol and Neostigmine.
- f. Discuss about the structure, MOA and properties of indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Pyridostigmine, Edrophonium chloride, Isoflurophate, Echothiophate iodide, Parathione, Malathion.
- g. Discuss about the structure, MOA and properties cholinesterase reactivator- Pralidoxime chloride and its mechanism of reactivation with reaction scheme.

### **3.4. Cholinergic Blocking agents: SAR of cholinolytic agents [6 Hrs]**

After the completion of the course, students will be able to

- a. Classify Solanaceous alkaloids and analogues
- b. Discuss about the structure, MOA and properties of Atropine sulphate, Hysocine butylbromide, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide.
- c. Enumerate the synthetic scheme of Atropine sulphate and Dicyclomine
- d. Discuss about the structure, structure, MOA and properties and properties of synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Glycopyrrolate, Propantheline bromide, Benztropine mesylate, Biperidine hydrochloride, Ipratropium bromide, Procyclidine hydrochloride, Tridihexethyl chloride, Oxybutinin, Favoxate and Pirenzepine.

## **Unit 4: Drugs acting on Central Nervous System**

### **4.1. Sedatives and Hypnotics: [7 Hrs]**

After the completion of the course, students will be able to

- a. **Benzodiazepines:** Classify Benzodiazepines
- b. Describe the SAR of Benzodiazepines
- c. Discuss about the structure, MOA and properties of Chlordiazepoxide, Diazepam, Oxazepam, Chlorazepate, Lorazepam, Alprazolam,
- d. Discuss about the structure, MOA and properties of Zolpidem, Zaleplon, Zopiclone.
- e. Classify Barbiturates
- f. Describe the SAR of barbiturates
- g. Discuss about the structure, MOA and properties of Phenobarbitone, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital,
- h. Enumerate the synthetic scheme of Phenobarbitone

### **4.2. Antipsychotics [7 Hrs]**

After the completion of the course, students will be able to

- a. Classify Phenothiazines
- b. Describe the SAR of Phenothiazines
- c. Discuss about the structure, MOA and properties of Promazine hydrochloride, Chlorpromazine hydrochloride, Triflupromazine, Prochlorperazine maleate, Trifluoperazine hydrochloride. Chlorprothixene (Loxapine succinate, Clozapine). Fluro buterophenones (Haloperidol, Droperidol, Risperidone). Beta amino ketones (Molindone hydrochloride) and Benzamides (Levosulpride).

### **4.3. Anticonvulsants [6 Hrs]**

After the completion of the course, students will be able to

- a. Classify anticonvulsants
- b. Describe the SAR of Hydantoins, ,
- c. Mention anticonvulsant effect of barbiturates
- d. Enumerate the synthetic scheme of Phenytoin and Carbamazepine.

- e. Discuss about the structure, MOA and properties of Fosphenytoin, Ethotoin Oxazolidine diones (Trimethadione), Succinimides (Ethosuximide), Urea and monoacylureas (Carbamazepine) and Benzodiazepines (Clonazepam), Miscellaneous: Primidone, Valproic acid, Gabapentin, Pregabalin).

#### **4.4. General anesthetics: [7 Hrs]**

After the completion of the course, students will be able to

- a. Classify Inhalation anesthetics:
- b. Discuss about the structure, MOA and properties of Halothane, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.
- c. Enumerate the synthetic scheme of Halothane, Thiopental sodium and Ketamine hydrochloride.
- d. Discuss about the structure, MOA and properties of ultra-short acting barbiturates: Thiopental sodium, Methohexital sodium, Thiamylal sodium, Dissociative anesthetics: Ketamine hydrochloride.

#### **4.5. Narcotic and non-narcotic analgesics [7 Hrs]**

After the completion of the course, students will be able to

- a. Classify narcotic analgesics.
- b. Describe the SAR of Morphine analogues
- c. Discuss about the structure, MOA and properties of Morphine sulphate, Codeine, Meperidine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate, Brupenorphone. Methadone hydrochloride, Pentazocine, Levorphanol tartarate. Narcotic antagonists: Nalorphine hydrochloride, Naltrixone, Naloxone hydrochloride.
- d. Classify non-narcotic analgesics (NSAIDs)
- e. Discuss about the structure, MOA and properties of Aspirin, Diclofenac, Nimesulide, Naproxen, Ibuprofen, Ketorolac, Mefenamic acid, Piroxicam, Paracetamol
- f. Enumerate the synthetic scheme of Ibuprofen, Mefenamic acid and Paracetamol.

#### **Unit 5: Prostaglandin and other eicosanoids [2 Hrs]**

After the completion of the course, students will be to

- a. Discuss the physiological role and therapeutic uses of PGE<sub>1</sub>, PGE<sub>2</sub>, Misoprostol inhibitor
- b. Discuss about the structure, MOA and properties of Oxytocin

#### **Unit 6: Cardiovascular agents [9 Hrs]**

After the completion of the course, students will be able to

- a Describe about the antianginal agents and vasodilators: Amyl nitrite, Nitroglycerine, Isosorbide.
- b Describe about the Calcium antagonists: Verapamil, Nifedipine,
- c Describe about the Antiarrhythmic drugs: Procainamide, Amiodarone, Diltiazem with Verapamil.

- d** Describe about other antihypertensive drugs: Reserpine, Prazocin, Methyldopa, Clonidine, Hydralazine, Sodium nitroprusside, Minoxidil, Captopril, Enalapril, Losartan, Telmisartan.
- e** Classify Antihyperlipidemic agents
- f** Discuss about the structure, MOA and properties of Clofibrate, Atorvastatin, Rosuvastatin Cholestyramine.
- g** Classify Coagulants and Anticoagulants
- h** Discuss about the structure, MOA and properties of Ethmysylate, Protamine sulphate, Dicumorol, Warfarin, Phenindione, Dipyridamole.

#### **Unit 7: Drugs acting on endocrine system [5 Hrs]**

After the completion of the course, students will be able to

- a.** Discuss the Stereochemistry and metabolism of steroids
- b.** Discuss about the structure, MOA and properties of Sex hormones (testosterone, progesterone, estrogen). Oral contraceptives (mifepristone, levonorgesterol, norethindrone)
- c.** Discuss about the structure, MOA and properties of drugs for erectile dysfunction – sildenafil citrate
- d.** Discuss about the structure, MOA and properties of Corticosteroids (hydrocortisone, prednisolone, betamethasone, dexamethasone)
- e.** Discuss about the structure, MOA and properties of Thyroid and anti-thyroid drugs.

#### **Recommended Books (Latest Editions)**

##### **Text Books:**

1. Kadam S. S, Mahadik H. R, Bothara K. G. Principles of Medicinal Chemistry, Vol I and Vol II.
2. Hoover J. E. Remington's Pharmaceutical Sciences. Mack Publishing Company.

##### **Reference Books**

1. Abraham D. J. Burger's Medicinal Chemistry. Vol I to VI. Wiley-Interscience, Hoboken, NJ.
2. Block J, Beale J. M. Wilson and Gisvold's Organic Medicinal and Pharmaceutical Chemistry.
3. Lemke T, Foye W. Foye's Principles of Medicinal Chemistry. Lippincott Williams & Wilkins
4. Lednicer. The Organic Chemistry of Drug Synthesis. Vol. 1-5.
5. Kar A. Textbook of Medicinal Chemistry. New Age International Publishers.
6. Alagarsamy V. Textbook of Medicinal Chemistry. Elsevier.
7. Finar I. L. Organic Chemistry. Vol. I & II, ELBS/ Longman, London.