Department of Pharmacy

Curriculum

B. Pharm. (Hons.) Program

Session:

For Sessions 2025-26 (17th batch)
For Sessions 2026-27 (18th batch)

Jagannath University



April 2026

Syllabus Committee Meeting

Date : April 2026

Venue: Office of the Chairman, Department of Pharmacy, Jagannath University

Sl. No.	Name and Details	Role	Signature
01	Prof. Dr. Sukumar Bepary Chairman, Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Convener	
02	Prof. Dr. AZM Ruhul Momen Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
03	Prof. Dr. Mohammad Musarraf Hussain Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
04	Prof. Dr. Bishyajit Kumar Biswas Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
05	Prof. Dr. Mohammad Saydur Rahman Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
06	Dr. Monir Hossain Associate Professor, Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
07	Dr. Razia Sultana Associate Professor, Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
08	Anita Rani Chowdhury Associate Professor, Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
09	Sayeda Jahan Lecturer, Department of Pharmacy Jagannath University, Dhaka, Bangladesh	Member	
10	Prof. Dr. Mohammad Abdur Rashid Department of Pharmaceutical Chemistry University of Dhaka, Dhaka	External Member	
11	Prof. Dr. Jakir Ahmed Chowdhury Department of Pharmacy University of Dhaka	External Member	
12	Prof. Dr. Elias Al Mamun Department of Pharmaceutical Technology University of Dhaka, Dhaka	External Member	
13	Prof. Dr. Abul Kalam Md. Lutfor Rahman Department of Chemistry, Jagannath University, Dhaka.	External Member	

Organized by: Department of Pharmacy, Jagannath University

Rules and Regulations for Bachelor's Degree (revised)

Effective for the session 2025-26

With amendment done by the 72nd meeting of the Academic Council for 2024-25 session

1. PREAMBLE

This rule titled "Rules and Regulations for Bachelor Degree" includes the academic rules and regulations for four-year "Bachelor Degree Programme" divided into eight (8) Semesters in Jagannath University. The Bachelor Degree programme is under Semester system and would be guided and assessed by the credit point system. It is applicable for the Departments under different faculties as may be approved and/or opened by the University. Each academic Department of the University shall have autonomy to develop guidelines and conduct all types of academic activities within the Department either guided by or not in contradiction with this rule. Unless otherwise described, in this rule, a Semester means academic curriculum and activities conducted for a period of 6 (six) months named as 1st Semester and 2nd Semester in each academic year.

2. STUDENT ADMISSION AND RE-ADMISSION

Students shall be admitted into the 1st year 1st Semester of the Bachelor Programme as per University rules.

a) Eligibility: Students passed the Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) examinations or recognized equivalent examinations in Bangladesh or abroad may be admitted to the Bachelor degree programme in any subject in this University on such terms and conditions as may be determined by the University Admission Committee constituted by the Academic Council of Jagannath University.

b) Admission Cancellation:

(i) If a student remains totally absent without any permission from all classes for 15 (fifteen) consecutive working days after the start of 1st year 1st Semester classes, her/his admission would be cancelled on the recommendation of the Chairman of the concerned Department.

(ii) A student shall never take admission simultaneously in more than one subject of this University or any other university/institution with an exception of Certificate/Diploma course. If this provision is violated, studentship, examination, and examination results of the student shall immediately be cancelled.

c) Re-admission:

i. A student failing to appear in any Semester-final examination (not a single course), unless otherwise the clause 2.b (i) is applicable, may be allowed for re-admission with the same Semester of the next available batch. Readmitted students, however, shall always be assigned by the original student ID.

ii. If a student fails to appear at any Semester-final examination due to shortage of required percentage of attendance, or failure to pay the dues or expulsion from the University or any other reason, as the case may be, s/he shall have to get herself/himself re-admitted to the same Semester of the next available batch.

iii. If a student fails to earn the requisite CGPA for promotion (according to clause 14) from one Year to the next he/she may seek re-admission with the 1st Semester of the same year of the next available batch; however, if a student gets satisfied (as per the student) GPA in any odd Semester (First Year 1st Semester, 2nd Year 1st Semester, 3rd Year 1st Semester and 4th Year 1st Semester) but failed to get required CGPA in the even Semester (1st Year 2nd Semester, 2nd Year 2nd Semester, 3rd Year 2nd Semester and 4th Year 2nd Semester) he/she may seek re-admission with the 2nd Semester of the same year of the next available batch.

iv. If the final examination entry form fill-up of any odd semester (2nd Year 1st Semester, 3rd Year 1st Semester and 4th Year 1st Semester) completes before the publication of the result of immediate past even Semester (1st Year 2nd Semester, 2nd Year 2nd Semester and 3rd Year

2nd Semester) students may be allowed to sit in the odd Semester Final examination with a written pledge that if fails to get required CGPA in the immediate past even semester (when result published) he/she will have to get re-admission in odd/even semester (as applicable/appropriate) of the previous year with the immediate next batch. If the next batch already completed the odd/even semester the student shall get re-admission with the next available batch; in such cases his/her registration may be extended by one academic year (seven years to complete Bachelor programme).

v. Students studying in the 2nd Year 1st Semester or 3rd Year 1st Semester or 4th Year 1st Semester found obtain less than required CGPA for promotion (2.0 in the 1st Year 2nd Semester and 2.25 in the 2nd Year 2nd Semester 3rd Year 2nd Semester and 4th Year 2nd Semester) in the immediate past even Semester when result published shall have to get readmission with the next available batch either in 1st or 2nd Semester (whichever applicable/appropriate). Such students, if appeared in the improvement examinations of immediate past odd Semester and found secure required CGPA for promotion after adding the improvement result (when published), may be allowed get re-admission in the same odd Semester of the next available batch.

vi. On re-admission, grades earned earlier by a student in a Semester shall be cancelled and the student shall have to retake all the course-works (such as in-course/practical/quiz tests, internship programme, project, field work viva-voce and final examinations) of that Semester. If a student gets „F" grade in any practical course due to absence/participation and improves the „F" grade as per rule he/she can have the Continuous Assessment marks (if any) along with Semester Final marks.

vii. Percentage of class attendance of Re-admitted students shall be counted from the date of her/his re-admission. If the classes of the re-admission batch completed, the student shall receive either minimum attendance number (3) or previous year's attendance number, whichever higher. Mid-Semester examination, if completed before her/his re-admission, the Chairman of the Department shall arrange make-up Mid-Semester examination.

viii. A student has to complete the Bachelor programme within a maximum of six academic years of his/her admission session, therefore, shall not get chance for re-admission more than twice during the entire programme unless any other clause allowed for an extension of his/her registration.

ix. For re-admission, a student shall have to apply within 15 (fifteen) working days after announcement of the result of the concerned Semester.

3. REGISTRATION AND STUDENT ID

A student shall attain her/his studentship for the University to an academic programme as per the university rules. S/he shall be required to register with the University according to the University registration process and on payment of the required fees as determined by the University authority from time to time.

After completion of registration each student shall get a Student ID number to be carried as his/her identity throughout the programme. The ID number contains 10 Alphanumeric numbers indicating as follows:

Letter/Digit	Character	Description
1	Letter (B)	Bachelor Degree
2-3	Numeric	Year of admission session
4-5	Numeric	Faculty (For example, Social Science = 04)
6-7	Numeric	Department (For example, Social Work = 03)
8-10	Numeric	Student number in the Department (001, 002, …..999)

4. PROGRAMME AND DEGREE

a) All the Bachelor degree programmes are the composite programmes following a Semester system of learning, examination and evaluation.

b) All sorts of Bachelor degrees shall be treated as terminal degree.

c) The names of the degrees of different Faculties/Departments shall be as approved by the Academic Council of the University.

5. MEDIUM OF INSTRUCTION

The medium of instruction for the programme of different faculties shall be English and Bangla. The Academic Committee of the concerned Department, before each Semester, shall have the option to decide what shall be the medium of instruction for each course.

6. DURATION OF THE ACADEMIC PROGRAMME

The duration of the Bachelor degree programmes shall be of four (4) academic years and eight (8) Semesters unless otherwise approved by the Academic Council for any particular Department. Each academic year is divided into two Semesters to be called as 1st Semester (July-December) and 2nd Semester (January-June). Distribution of weeks in each Semester shall be as follows:

a) Class teaching (actual class)	= 14 weeks
b) Preparation time for Semester-final examination	= 2 weeks
c) Semester-final examination	= 4 weeks
Total	= 20 weeks

The remaining weeks in the Semester would be used for preparation of results.

7. SYALLABUS

There shall be a syllabus of the programme for every Department for each Academic Session prepared by the syllabus committee of the Department and approved by the competent authority as mentioned by the University Act. The syllabus should clearly indicate the courses, credit points by Semester and year. The syllabus shall be updated as and when required. Every Syllabus should include a summary at the beginning according to the format presented in appendix-II. The Registrar Office shall send the summary of every Syllabus to the Office of the Controller of Examinations after approval.

8. DEFINITION OF COURSES

Syllabus of the different Departments shall consist of several courses. Following structure shall be followed to articulate the courses:

a) Types of Courses: There shall be three types of courses as follows:

(i) Theoretical course: Includes class-teaching, open discussion, academic tasks, etc.

(ii) Practical course: Includes laboratory experiment/ internship/ monograph/ project /field work, etc.

(iii) Viva-voce: Includes class instruction; may be a part of practical/theoretical/field work course and shall have specific number of credit point.

Each course shall have specific course number and credit points. If a single course has Theoretical, Practical and Viva-voce, the course must be split into two/three courses and the Theory, Practical and Viva-voce courses should have separate course number and credit points.

b) Course Identification: Each course shall be designated by three to four letter words identifying the subject followed by a four-digit number as follows:

(i) The 1st digit indicates the "Year" in which the course is taken by the students;
(ii) The 2nd digit indicates the "Semester" in which the course is taken by the students;
(iii) The 3rd and 4th digits indicate a "Course" within a particular Department.

Example:

PHAT - 1 1 01 Inorganic Pharmacy

- Title of the course
- Identifying a course
- 1st Semester
- 1st year
- Subject identification (Department of Social Work)

9. DISTRIBUTION OF CREDIT POINTS (CP)

a) Course Title and Credit Points

(i) Every course shall have a short representative course title and a number including the total credit points as well as reference to prerequisite course, if any. Total credit points offered in the whole programme shall be at least 125.

(ii) There shall be at least 12 credit points in each Semester.

b) Contact Hours

(i) Theoretical Courses: There shall be at least one lecture-hour for each credit point in a week for each theoretical course; and there shall be one academic task-hours for each credit point (for open academic discussion) in the whole Semester. Therefore, in total, there shall be at least 15 (fifteen) contact hours for each theoretical credit point throughout the Semester.

(ii) Practical courses: In case of practical/lab course, there shall be at least two (02) contact hours for each credit point in a week. Therefore, there shall be at least 30 contact hours for each credit point practical/lab course throughout the Semester.

c) Viva-voce

Students shall appear in viva-voce examination (oral examination) having specified number of credit points at the end of 2nd Semester-final examination in each academic year (i.e. at the end of 2nd, 4th, 6th, and 8th Semester).

10. EXAMINATION ENTRY REQUIREMENTS

A student is required to fill in the examination entry form and pay the University fees within the time specified by the concerned authority for taking each Semester-final examination. The Chairman of the Department shall send these examination entry forms to the Controller of Examinations

11. EXAMINATION PROCEDURES

a) Examination schedule

At the end of each Semester, the Chairman of the Department shall prepare the Semester-final examination schedule and send to the Controller of Examinations for necessary arrangements.

b) Formation of the Examination Committee

The Academic Committee of the Department shall recommend an Examination Committee for each academic year consisting of two Semesters of the programme. The Examination Committee shall be composed of 4 (four) members (one chairman, two internal members and an external member appointed from any other reputed University not below the rank of Associate Professor). In case of absence or inability on the part of any one of the members of the examination committee, the examination work shall not be invalidated. If there is any vacancy in the examination committee, the position should be filled-in as soon as possible in accordance with the University rules. Chairman of the Department shall be the Chairman of the 4th year (7th and 8th Semester) examination committee. If available, Chairman of any examination committee shall not be below the rank of Assistant Professor.

c) Functions of the Examination Committee:

(i) The internal members of the relevant examination committee, through a meeting, shall recommend the names of the question setters and examiners to the Controller of Examinations for each theoretical and practical (if necessary) course who shall issue appointment letters subject to the approval of the Vice-Chancellor.

(ii) The examination committee shall arrange moderation and printing of question papers, conduct the examinations, and prepare the results.

d) Conduct of Examinations:

All Semester-final examinations shall be conducted by the Department with the assistance of the office of the Controller of Examinations. The examination committee shall be responsible for safe custody of manuscript, question papers and answer scripts. The Controller of Examinations shall supply the answer scripts along with the supporting papers of that examination to the Chairman of the Department at least three (3) days before the final examination of a particular Semester.

The Department, however, shall conduct Semester-final examinations complying the following principles:

(i) Chairman of the examination committee shall act as the Chief Invigilator (CI). In absence of him/her available senior member of the Examination Committee shall act as CI.

(ii) Excluding the CI, there shall be one invigilator for every 20 examinees in each course of Semester-final examination. However, excluding the CI, the minimum number of invigilator shall not be less than 2 (two). In case of valid ground, one extra invigilator may be appointed. All Invigilators shall be appointed by the Chairman of the Department.

e) Distribution of the Answer Scripts:

The 1st examiner shall receive the answer scripts with acknowledgement from the chairman of the examination committee along with necessary supporting documents (question, top sheet, instructions, blank mark sheets, envelops, etc.) on the date of examination. The 1st Examiner should evaluate and submit the answer scripts along with marks sheet to the chairman of the examination committee within two weeks from the date of examination of that particular course. On receipt of examined answer scripts from the 1st examiner, the Chairman of the examination committee shall send the answer scripts to the 2nd examiner along with supporting documents for evaluation. The 2nd examiner shall send the answer scripts along with marks to the chairman of the relevant examination committee.

f) Tabulation:

The concerned examination committee shall arrange tabulation works. The tabulation works shall not begin until marks of all courses are received.

g) Preservation of the Examination Documents:

The chairman of the examination committee, after finalizing the results, shall hand over the relevant answer scripts to the Controller of Examinations through the Chairman of the Department after the Final result of a Semester is published. All other documents related to the examination should be submitted to the Chairman of the Department. The Controller Office shall preserve the answer scripts until one year from the date of examination of the last course of the final examination of a programme (8th Semester of Bachelor and 2 Semester of Masters).

12. EVALUATION SYSTEM

a) Each theoretical/practical course offered should be composed of either 50 or 100 marks. The proportion of the total marks of a particular course shall be distributed for all departments as follows:

(i) Theoretical Course:

• Continuous Assessment		40%
Two Mid-Semester Exams	20%	
Class Attendance	10%	
Quiz/Case Study/Assignment/Class Performance	10%	
• Semester-final Examination		60%
Total =		**100%**

(ii) Practical Course:

• Continuous Assessment		40%
Labratory performance/Assigment/Oral or written test on Laboratory work/Field work/ Internship/Project /Research/Presentation/ Internship process record	20%	
Attendance (Labratory / Field work/Internship)	10%	
Labratory Note Book on experiment /Performance (Field work/ Internship)	10%	
• Semester end Practical Examination/Thesis/Project /Research report evaluation		60%
Total =		**100%**

- Continuous Assessment may or may not be a part of the Practical courses.
- If any report/answer script produced under practical course, the report / answer script shall be evaluated as per rules (clause 12/q(i & i))

b) Class Attendance:

The marks allocated for class attendance shall be given as following proportions:

Attendance	Marks	Example
95% and above	100%	10 out of 10
90% to 94%	90%	9 out of 10
85% to 89%	80%	8 out of 10
80% to 84%	70%	7 out of 10
75% to 79%	60%	6 out of 10
70% to 74%	50%	5 out of 10
65% to 69%	40%	4 out of 10
60% to 64%	30%	3 out of 10
Less than 60%	00%	0 out of 10

c) Continuous Assessment Report

(i) After completing 40% and 80% syllabus of a specific course, the respective course teacher shall take the 1st and the 2nd Mid-semester examination respectively.

(ii) The course teacher shall publish the marks of each Mid-semester examination through the notice board of the respective Department within seven (7) working days after the examination.

(iii) At the end of the course, the course teacher shall calculate total number of the continuous assessment (including class attendance) and prepare a marks sheet. S/he shall notify it to the students and submit the same to the Chairman of the respective examination committee as well as to the Controller of the Examinations before start of the Semester final examination.

(iv) The course teacher shall also submit the class attendance report with the register/documents to the Chairman of the Department for percentage calculation before sending the examination entry forms to the Controller of the Examinations.

d) Class Attendance Requirements to Appear at the Semester Final Examination:

A student shall be allowed to appear at the Semester final examination as a regular student if her/his class attendance is at least 70% on an average and a student shall not be allowed to appear at the examination if her/his class attendance is below 60% of the total classes held in a Semester. The Chairman of the Department may allow the students having attendance between 60% to less than 70%. However, in such as case, students shall have to pay fees as determined by the University authority.

e) 1st and 2nd Examiner:

There shall be two Question Setters and Examiners (1st and 2nd) for each theoretical course and practical course (if report/answer script produced) of the Semester final examination. The course teacher shall act as the 1st Question Setter & Examiner for a course. The examination committee shall select second examiner from the "Panel of Examiners" as approved by the Academic Council of the University. If more than one teacher conducts a course, the examination committee shall select any one of them as the 1st Question Setter & Examiner. In exceptional circumstances, the Examiner may be appointed/changed with the prior permission of the Vice-Chancellor on the basis of the recommendation of the respective examination committee. In any Semester Final examination, a teacher shall not act as Question Setter and Examiner (1st & 2nd) in more than one theoretical course.

f) Duration of the Final Examination:

There shall be 2-hour final examination for every one or two (2) credit point theoretical course, 3-hour for three (3) credit point courses, and 4-hour for four (4) credit point theoretical courses. Duration of the practical examination shall be of four to six hours for each credit point as per the decision of the respective academic committee.

g) Third Examination

(i) The average of the marks given by two examiners (1st and 2nd) shall be taken as final. If the marks given by the 1st and 2nd examiners differ by 20% or more, the examination committee shall recommend a "3rd examiner" to examine such script(s). In case of third examination, the average of the two nearest marks (in case of equal difference, highest two marks) shall be taken as final.

(ii) The 3rd examiner shall be recommended by the respective examination committee from the approved Panel of Examiners other than the members of the concerned examination committee, tabulators and examiners of that particular course and to be finally appointed by the Vice-chancellor. If 50% or more answer scripts of a particular course subject to be third examined, all the answer scripts of that particular course should be third examined.

(iii) The 3rd examiner shall be recommended by the respective examination committee from the approved Panel of Examiners other than the members of the concerned examination committee, tabulators and examiners of that particular course and to be finally appointed by the Vice-chancellor. If 50% or more answer scripts of a particular theoretical course subject to be third examined, all the answer scripts of that particular theoretical course should be third examined. This rule shall be effective from academic session 2024-25.

h) Submission of Marks Sheet:

All examiners including teachers involved in continuous assessment, viva-voce, etc., shall prepare three (3) copies of marks sheet and submit two (2) copies to the Chairman of the respective examination committee and one (1) copy to the Controller of Examinations.

i) Letter Grade and Grade Point:

Total marks obtained in each course shall be converted into LG (Letter Grade) and GP (Grade Point) as follows:

Numerical Grade	***Letter Grade***		***Grade Point***	**Interpretation**
80% and above	A+	(A plus)	4.00	Outstanding
75% to less than 80%	A	(A plain)	3.75	Excellent
70% to less than 75%	A–	(A minus)	3.50	Very Good
65% to less than 70%	B+	(B plus)	3.25	Good
60% to less than 65%	B	(B plain)	3.00	Satisfactory
55% to less than 60%	B–	(B minus)	2.75	Below Satisfactory
50% to less than 55%	C+	(C plus)	2.50	Average
45% to less than 50%	C	(C plain)	2.25	Below Average
40% to less than 45%	D	----	2.00	Pass
Less than 40%	F	----	0.00	Fail

j) Re-examination:

Re-examination of any script shall not be allowed.

k) Marks (internal evaluation/Class attendance/Assignment/Semester final, etc.) may remain as fraction. Only the total marks of each course shall be rounded up.

l) If a student remains absent in any course of a Semester Final Examination he/she will not be awarded any Grade Pont in that course.

13. RESULT PREPARATION AND PUBLICATION

a) Tabulator: Two among the three internal members of the Examination Committee, appointed by the academic council as per recommendation of the respective Examination Committee, shall act as Tabulators. If the members of an Examination Committee become unable to work as tabulator, the Academic Council may appoint Tabulator(s) other than the members of the Examination Committee upon recommendation of the respective Examination Committee.

b) The following information shall be shown in the tabulation sheets:

(i) The Semester-final result: Continuous assessment marks, Semester-final marks, total marks, LG and GP in each course (including Viva-voce/ asinternship/ practical/ project/ field work, etc.) and GPA/CGPA, points secured and earned credit points (ECP); and Comments.

(ii) The final result (after completion of the programme): Continuous assessment marks, Semester-final marks, total marks, LG and GP in each course, including Viva-voce/ internship/practical project/field work etc. marks with corresponding LG & GP, total points secured, CGPA, ECP, LG with interpretation and comments.

(iii) Manifestation in Semester-final result sheet: The Semester-final result sheets shall not show the numerical marks but shall show the GP (Grade Point) and LG (Letter Grade) in each course, GPA (Grade Point Average), CGPA (Cumulative Grade Point Average), ECP (Earned Credit Point) and "comment". Comment in the result sheet: In the Semester Final result sheet up to 4th year 1st Semester, the "comment" column should show the status of promotion (promoted or not promoted or withheld or anything else) of the student. If a student earns required CGPA but fails to earn the total number of credits up to that particular Semester ("F" in one or more courses), the "comment" column should show "Conditionally Promoted".

(vi) In case of Final Result (4th Year 2nd Semester or Supplementary) the "comment" should show the status of result as „Degree Earned" or „Degree Not Earned" or "Withheld".

(vii) In case of "withheld", specific reason(s) must be mentioned in the resolution of the Examination Committee. The marks of courses of withheld candidates should be tabulated but results (Result of this Semester and Cumulative Result up to this Semester) should not be calculated. The withheld result may be published as the reason(s) fulfilled/removed.

c) Preparation of Corrected Result:

Every examination committee shall be responsible for preparing and submitting corrected result(s) of the examinees of that particular examination as caused by improvement/re-take or any other examinations or any other reasons. The controller office should publish the corrected result(s) as per rule of the University. If corrected result consists change of number of course(s) valid documentary support shall have to be provided.

d) Submission of Result:

The tabulators must prepare two (2) sets of final results separately and the Chairman of the Examination Committee, after approved in the respective Examination Committee, shall send the result to the Controller of Examinations for publication duly signed by the Tabulators and the Chairman of the Examination Committee along with the following documents:

i. Two copies of Tabulation Sheets;
ii. Two copies of Result Sheets;
iii. The Recommendation of the Examination Committee for publication of the result;
iv. Top sheet of all courses; and v. A summary sheet about the result of the Examinees (no. promoted/degree awarded, not promoted, conditionally promoted, withheld, etc.)

e) Examination Statement:

An "Examination Statement" shall be sent by the chairman of the Examination Committee to the Controller of Examinations after publication of result. The statement shall include:

i. Number of courses with credit points;
ii. The name of the Mid-Semester examiners with number of examinees; iii.The name of the question setters of each course;
iv. The name of the 1st, 2nd & 3rd (if any) examiners/evaluators in each course with the number of scripts, monograph/fieldwork report/project report/ internship report etc.
v. The name of the question moderators and number of questions (course) moderated;
vi. The name of the participating members in the viva voce examinations and number of examinees; and
vii. The name of the tabulators with the number of examinees

f) Result Publication:

The Controller of Examinations shall publish the results of each Semester-final and the whole programme, subject to the approval of the Academic Council and Syndicate of the University and thereafter shall send a copy of the result and tabulation sheets, duly signed by him with date, to the Chairman of the concerned Department. The Controller of Examinations shall also provide the transcript/grade sheet showing course-wise LG and the corresponding GP (the numerical marks shall not be shown), the CGPA, LG and the interpretation of the CGPA of the candidates for the Bachelor degree. Final Grade must be spelled out clearly in the certificate/transcript.

[Example: C+ = 'C+' (C plus); A- = 'A-' (A minus); B = 'B' (B regular)].

g) Result Preparation Time:

The result of the Semester-final examinations (except 4th Year 2nd Semester) shall be published within 08 (eight) weeks from the date of last examination. The final Semester (4th year 2nd Semester) result of the programme shall be published within 12 weeks from the date of last examination including internship/practical/monograph/ fieldwork/project/Viva-voce, etc.

h) Results of each examination as submitted by the Examination Committee shall be verified by the Office of Controller of Examinations as per the documents submitted to the Office of the Controller of Examinations. If mistake(s) found in the submitted result, the respective Examination Committee shall have to make the arrangement for correction.

14. PROMOTION

a) All promotions shall be yearly based.

b) For promotion from 1st Year to 2nd Year, a student shall require to earn a minimum CGPA of 2.00 (Letter Grade: D).

c) For promotion from 2nd year to 3rd Year and 3rd Year to 4th Year, a student shall require to earn minimum CGPA of 2.25 (Letter Grade: C).

d) A student will not be promoted if s/he fails to appear in at least one course of any Semester final examination even if s/he has requisite CGPA (2.00/2.25) for promotion.

15. DEGREE REQUIREMENTS

For the Bachelor degree, each student requires to:

a) Earn required number of total credit points successfully. In case of re-admission, the number of total credit points for the respective student shall be counted according to the syllabus of the re-admitted batch(es). In such cases, the total earned credit points throughout the programme may be different from the students of his/her original batch or the batch(es) re-admitted. However, if the number of credit points earned throughout the programme is less than the minimum required number of credit point for the degree (125), the respective student shall have to complete (including Continuous Assessment) one or more courses as „Complementary Course" with the existing Semester(s) to be decided by the Academic Committee of the department according to the number of credit points short. Such course(s) should be those that the particular student has not studied during his/her entire bachelor programme. The results of the courses of such students shall be published by the Examination Committee(s) of the respective Semester(s) and finally compiled and published by the respective 4th Year / Supplementary Examination Committee as Complementary Examination. The transcript/marks sheet/grade sheet of such students shall include a separate part as „Complementary Examination".

b) Earn a minimum CGPA of 2.25; and

c) Complete the programme within six academic years of her/his 1st admission year into the programme.

16. IMPROVEMENT OF GRADES

a) 'F' Grade

i) A student earning "F" grade in any written course of any Semester up to 4th year 1st (7th) semester shall be required to improve the "F" grade(s) with the next two available batches.

ii) After the Honours final result of 4th year 2nd Semester, if a student has „F“ grade in any course of any Semester he/she will have to improve the „F“ grade through the Supplementary Examination or with the next available batch if such students haven“t passed six academic years since admission.

iii) In case of practical course(s) with „F“ Grade in any Semester a student may improve the grade with next available two batches or Supplementary Examination, whichever applicable. Continuous Assessment marks for practical courses (if any) shall be given by the respective course teacher of the current session and considered for result preparation.

(iv) In case of „F“ grade in viva voce, a student may get the chance to improve grade through appearing at the viva voce of the next available batch or Supplementary Examination, whichever applicable.

(v) Re-take: If a student fails to clear „F“ grade due to poor marks in „Continuous Assessment“ he/she may re-take the course(s) with the Semester where the course(s) being taught within the allowed sessions, i.e., within six sessions since admission. In such cases, the student shall have to apply to the Department for registration of such course(s) before the start of the class of the course(s) and the Academic Committee of the Department will consider for registration for the particular course(s) of the particular Semester(s). The Department shall send the prescribed form filled-in by such students to the Registrar Office. Such students shall have to pay Tk.1000/- (one) thousand per course and regular examination fees. If the course code changed due to change of syllabus the tabulators shall post the marks against the original course code of the student.

Answer scripts of the Re-take examinees should be sent to the examiners in a separate envelope along with separate marks sheet within the same packet and the Examiners, after evaluation, should submit the answer scripts and marks sheet separately as per rules. Upon receipt of the marks, the examination committee shall send the marks sheets to the chairman of the respective (original Semester of the course) examination committee(s). The chairman of the respective examination committee will take necessary measure to prepare the result of the Re-take examinee(s) through appointing Tabulators and submit to the office of the controller of examinations for publication. If the Committee becomes non-existent in the meantime, the marks shall be sent to the Chairman of the Department who will arrange preparation and submit the result through appointing Tabulators. The Tabulation and Result Sheets should mention "re-take examination“ clearly. The Tabulators of re-take examination shall be eligible for honorarium as per University Rules.

Students fail to improve the "F“ grade(s) thereafter shall be considered as failed to earn the degree.

b) Improvement of Grades / Grade Point

Students earned Grade Point less than 3.00 (letter grade less than 'B') in any theoretical course up to 4th year 2nd (8th) Semester may choose to improve the grade by appearing at the Semester-final examination with the next available batch except 4th year 2nd (8th) Semester. Improvement Examination of 4th year 2nd (8th) semester courses shall be held with the Supplementary Examination of the respective batch. In such case result of the Supplementary Examination and Improvement Examination has to be prepared seperately. If there is no student to appear in Supplementary Examination but improvement candidate(s) are there Supplementary Examination shall be arranged for the improvement candidate(s) only. Students who are intersted to apear in Suplementary Examnation shall not be allowed to apply for Certificate and Transcript before publish the result of Supplementary Examination. This rule shall be effective from the 99th syndicate meetting dated 02/01/2025.

ii) There shall be no such opportunity of improvement examination for the courses of 4th Year 2nd (8th) Semester.

iii) A student shall have the improvement opportunity once for each course.

(iv) No improvement shall be allowed in „practical“ and „viva voce“ courses (except F grade as stated in 16 a).

(v) No improvement shall be allowed in continuous assessment and except „F“ grade in practical courses. In such cases, earlier marks shall stand.

(vi) The regular Examination Committee shall make arrangement for improvement examination of the regular courses of a particular Semester with the students of that Semester. In case of students registered for improvement of courses not taught in that particular Semester due to syllabus change, the Examination Committee shall arrange setting questions as per university rules according to the syllabus applicable for the students registered for improvement. Examination of such courses should be held simultaneously with the regular students.

(vii) For improving the grade and appearing at the examination, a student shall have to pay fees two (2) times of the normal examination fee for each course.

(viii) Students willing to improve grade should apply within 10 (ten) working days after the announcement of the results of the Semester.

c) If the grade point obtained in improvement examination is lower than the earlier, the earlier one shall stand.

d) In the improvement/ supplementary /re-take/such examination, a student shall be eligible to get highest' A- grade corresponding to GP 3.50 in a course even if he/she gets more than that. This rule shall be effective from 2nd Semester Examinations2023

17. SUPPLEMENTARY EXAMINATION

a) After the 4th Year 2nd Semester (8th Semester) result, if a student fails to earn required total Credit Points due to "F" grade in one or more courses throughout the programme (1st to 8th Semester), Supplementary Examination(s) shall be arranged and completed within two months of the publication of 4th Year 2nd Semester result for such students. Only the students appeared but failed to improve "F" grade(s) through Supplementary Examination may be allowed to improve only "F" grade(s) with the Supplementary Examination of the next available batch but must be within the allowed academic sessions since admission. The degree completion year of such students shall be the year of the present batch (Year of Examination).

b) To take part in the Supplementary Examination, a student is required to pay examination fees four (4) times of the regular fees for each course and send an application to the Controller of Examinations through the Chairman of the Department within 20 working days from the date of publication of his/her 4th year 2nd Semester result.

c) Students taking Supplementary Examination may be allowed to take part in Masters Classes. Such students, if fails to earn Bachelor degree through Supplementary Examination, shall not be allowed to continue Masters programme.

d) The respective 4th year 2nd Semester Examination Committee shall work as „Supplementary Examination Committee“ separately to conduct the examination and publish the result as per University rules. The committee shall start and conclude the examination within the shortest possible time. That is, examination of all courses with different students (whatever the numbers are) should be taken on the same day.

e) Results of the students taking courses to fulfill the gap of required minimum total credit earned for the degree and total earned credit up to 4th year 2nd (8th) Semester shall also be compiled and published by the „Supplementary Examination Committee“. The courses studied by such students should be considered as complementary and denoted with „Com“ along with the regular course code of the particular batch(es). Such as a course with a course code „BSW 3204“ should be written as „BSW 3204Com“ in the tabulation and result sheet. The name of examination for such student(s) shall be „Complementary Examination“. Such students must register (no fee) for the course(s) through the department and duly fill up the examination entry forms paying regular fees.

f) This rule shall be effective from the academic session 2011-12.

18. DROP OUT

a) If a twice re-admitted student in any Semester failed to earn minimum required CGPA for promotion shall be dropped out from the programme.

b) If it seems that it is not possible for a student to complete the programme within 6 academic years (12 Semesters), s/he shall be dropped out from the programme.

c) In the Supplementary Examination, if a student even after appearing the examination, fails to earn all necessary total Credit Points and if „F" grade remains in any course (between 1st to 8th Semester), s/he will be dropped-out from the programme and will no more be allowed to continue her/his studentship with other students.

d) If a student fails to earn required total credit points within six academic years since admission s/he will be dropped-out from the programme and will no more be allowed to continue her/his studentship with other students unless any other clause allows for an extension of his/her registration.

19. CREDIT TRANSFER

No credit transfer from any other programs/ Universities/Institutions to the Jagannath University is allowed for the programme.

20. ACADEMIC ADMINISTRATION

a) Academic Calendar: The Academic Calendar showing dates of beginning and closing classes, commencement of examinations and probable dates for publication of the results shall be published by the respective Departmental academic committee before commencement of each Semester. The copy shall be sent to the Dean of the faculty, Controller of Examinations and the respective University authority.

b) Course Advisor: After admission, every student shall be assigned to a „Course Advisor" from the teachers of her/his discipline to guide him/her throughout the Semesters. The academic committee of each Department shall nominate a teacher as course advisor for each batch. S/he shall meet the students on a regular basis and advise them on all academic matters.

c) Academic and co-academic activities: Within the framework of these rules & regulations and the rules of the University, the Departmental academic committee may adopt policies for strengthening the academic and co-academic activities of the Department.

21. ADDITION, ALTERATION, CHANGE OR MODIFICATION IN THE RULES AND REGULATIONS

In order to make any addition, alteration, change or modification in the rules and regulations (if required), it must be placed to the „Departmental Academic Committee", "Executive Committee" of the concerned Faculty and the „Academic Council" for approval.

List of Courses with Credit points

First year

Code	*Title*	*Credit*	*Marks*
PHAT-1101	Inorganic Pharmacy-I	3	100
PHAT-1102	Organic Pharmacy-I	3	100
PHAT-1103	Pharmacognosy-I	3	100
PHAR-1107	Functional English	2	50
PHAR-1108	Mathematics	3	100
PHAR-1110	Fundamental Computer Science	3	100
PHAL-1104	Inorganic Pharmacy Lab-I	1	30
PHAL-1105	Organic Pharmacy Lab-I	1	30
PHAL-1106	Pharmacognosy Lab-I	1	30
	Total (First year First Semester)	**20**	**640**

Code	*Title*	*Credit*	*Marks*
PHAT-1201	Inorganic Pharmacy-II	3	100
PHAT-1202	Organic Pharmacy-II	3	100
PHAT-1203	Physical Pharmacy-I	3	100
PHAT-1204	Pharmacognosy-II	3	100
PHAR-1211	Basic Anatomy	3	100
PHAL-1206	Inorganic Pharmacy Lab-II	1	30
PHAL-1207	Organic Pharmacy Lab-II	1	30
PHAL-1208	Physical Pharmacy Lab-I	1	30
PHAL-1209	Pharmacognosy Lab-II	1	30
PHAV-1210	Viva Voce-I	1	30
	Total (First year Second Semester)	**20**	**650**

Second year

Code	*Title*	*Credit*	*Marks*
PHAT-2101	Physical Pharmacy-II	3	100
PHAT-2103	Pharmaceutical Microbiology-I	2	50
PHAT-2104	Physiology-I	3	100
PHAR-2109	Biostatistics	3	100
PHAR-2111	History of Emergence of Independent Bangladesh	2	50
PHAT-2112	Biochemistry and Molecular Biology	3	100
PHAL-2105	Physical Pharmacy Lab-II	1	30
PHAL-2106	Pharmaceutical Microbiology Lab-I	1	30
PHAL-2107	Physiology Lab-I	1	30
	Total (Second year First Semester)	**19**	**590**

Code	*Title*	*Credit*	*Marks*
PHAT-2201	Physiology-II	3	100
PHAT-2202	Pharmaceutical Microbiology-II	2	50
PHAT-2203	Pharmaceutical Technology-I	3	100
PHAT-2204	Pharmacology-I	3	100
PHAT-2205	Clinical Pathology	3	100
PHAT-2211	Pharmaceutical Analysis-I	3	100
PHAL-2206	Physiology Lab-II	1	30
PHAL-2207	Pharmaceutical Technology Lab-I	1	30
PHAL-2208	Pharmacology Lab-I	1	30
PHAL-2212	Pharmaceutical Analysis Lab-I	1	30
PHAV-2210	Viva Voce-II	1	30
	Total (Second year Second Semester)	**22**	**700**

Third year

Code	*Title*	*Credit*	*Marks*
PHAT-3102	Pharmacology-II	3	100
PHAT-3103	Pharmaceutical Technology-II	3	100
PHAT-3104	Biopharmaceutics and Pharmacokinetics-I	3	100
PHAT-3105	Medicinal Chemistry-I	3	100
PHAT-3111	Pharmaceutical Analysis-II	3	100
PHAL-3107	Pharmacology Lab-II	1	30
PHAL-3108	Pharmaceutical Technology Lab-II	1	30
PHAL-3109	Biopharmaceutics and Pharmacokinetics Lab-I	1	30
PHAL-3110	Medicinal Chemistry Lab-I	1	30
PHAL-3112	Pharmaceutical Analysis Lab-II	1	30
	Total (Third year First Semester)	**20**	**650**

Code	*Title*	*Credit*	*Marks*
PHAT-3202	Medicinal Chemistry-II	3	100
PHAT-3203	Pharmaceutical Engineering-I	2	50
PHAT-3204	Cosmetology	3	100
PHAT-3205	Pharmaceutical Biotechnology-I	3	100
PHAT-3211	Pharmacology-III	3	100
PHAT-3212	Pharmaceutical Marketing	3	100
PHAL-3207	Medicinal Chemistry Lab-II	1	30
PHAL-3208	Cosmetology Lab	1	30
PHAV-3209	Viva Voce-III	1	30
	Total (Third year Second Semester)	**20**	**640**

Fourth year

Code	*Title*	*Credit*	*Marks*
PHAT-4101	Pharmaceutical Technology-III	3	100
PHAT-4102	Pharmaceutical Engineering-II	2	50
PHAT-4103	Pharmaceutical Biotechnology-II	2	50
PHAT-4104	Biopharmaceutics and Pharmacokinetics-II	3	100
PHAT-4106	Toxicology	2	50
PHAT-4111	Pharmacology-IV	3	100
PHAL-4108	Pharmaceutical Engineering Lab	1	30
PHAL-4109	Pharmaceutical Technology Lab-III	1	30
PHAL-4110	Biopharmaceutics and Pharmacokinetics Lab-II	1	30
PHAL-4113	Pharmacology Lab-III	1	30
	Total (Fourth year First Semester)	**19**	**570**

Code	*Title*	*Credit*	*Marks*
PHAT-4204	Hospital and Community Pharmacy	3	100
PHAT-4205	Regulatory Affairs	2	100
PHAT-4212	Pharmaceutical Analysis-III	3	100
PHAT-4213	Quality Control and Quality Assurance	3	100
PHAT-4214	Clinical Pharmacy	3	100
PHAT-4215	Pharmaceutical Management	2	50
PHAL-4216	Quality Control and Quality Assurance Lab	1	30
PHAP-4209	Research Project	3	100
PHAV-4210	Viva Voce-IV	1	30
PHAI-4217	Internship	1	30
	Total (Fourth year Second Semester)	**22**	**740**

Curriculum, Syllabus and Course Outline for B. Pharm. (Hons.)

---------- B. PHARM. (HONS.) FIRST YEAR FIRST SEMESTER ----------

Course Title	Inorganic Pharmacy-I			
Course Code	PHAT-1101		**Year**	First Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60 Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building knowledge of inorganic chemistry, chemistry of elements in periodic table, basic knowledges on medicinal application of inorganic compounds, etc.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	have basic knowledge on chemistry of inorganic compounds.
CLO2	gain an idea of the elements in the periodic table.
CLO3	understand ionic and covalent bonds.
CLO4	perceive the medicinal and pharmaceutical application of inorganic compounds.
CLO5	realize the properties of inert gases.
CLO6	Understand the basic concept of chemical impurities

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				1					
CLO2		3									
CLO3		3									
CLO4		2				3					
CLO5		2				1					
CLO6		3									

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Chemical Bonds:** Different types and formation of chemical bonds, e.g., ionic, covalent, co-ordinate covalent, metallic, Vander Waal's force, hydrogen bond, etc., bond length, bond angle and bond energy, hybridization and shapes of molecules.	6	CLO1, CLO3
2.	**Classification of Elements:** Modern periodic table and periodic law, variation of periodic properties within periods and groups, usefulness and limitation of periodic table.	3	CLO1, CLO2
3.	**Chemistry of Alkali and Alkaline earth metals:** Alkali and alkaline earth metals, chemistry of group IA and II elements and compounds, pharmaceutical applications of alkali and alkaline earth metals.	4	CLO1, CLO2, CLO4
4.	**Mid-term-I**	1	
5.	**Chemistry of Co-ordination Compounds:** Ligands, coordination number, stability of metal complexes, isomerism of coordination compounds, Werner's theory, Sidgwick's electronic concept of coordinate bonds, valence bond theory, pharmaceutical importance of chelation.	3	CLO1, CLO2, CLO3, CLO4
6.	**Mid-term-II**	1	

7.	**Inert or Noble Gases:** Electronic configuration, inertness, isolation of inert gases from dry air and liquid air, properties and uses of noble gases, conditions and types of compounds formed by inert gases.	3	CLO1, CLO5
8.	**Chemical Impurities:** The sources of impurities in medicinal chemicals, qualitative and quantitative analysis for purity.	3	CLO1, CLO6
9.	**Medicinal Gases:** Official medicinal gases and their properties, uses, container and fittings, handling and storages.	3	CLO1, CLO4
10.	**Assignment/Presentation**	3	
11.	**Contact hour**	12	
12.	**Final exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Satya Prakash, Tuli, Basu & Madan: Advanced Inorganic Chemistry

1. R.D. Madan: Modern Inorganic Chemistry

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Course Title	Organic Pharmacy-I			
Course Code	PHAT-1102		**Year**	First Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60 Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building knowledge of organic chemistry, structure, bonding, reactivity of various functional groups, basics on arrow-pushing theories, organic compounds, stereochemistry, overview of organic reactions, chemistry of benzene, alcohol, phenol, aldehyde, ketone, carboxylic acid, amine, etc.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on Organic Chemistry.
CLO2	understand the structure and bonding of organic molecules and their properties.
CLO3	draw structures of the different organic molecules and their reactivity.
CLO4	comprehend a good idea about reaction mechanism, IUPAC nomenclature of organic compounds and their applications.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				1					
CLO2		3				1					
CLO3		3				1					
CLO4		3				1					

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Introduction to organic Chemistry:** Concept of arrow pushing, atomic structure and bonding, hybridization, arrow pushing theory, Molecular formula and molecular structures.	6	CLO1, CLO2, CLO3

2.	**Classes of Organic Compounds:** Acids and bases, functional groups, classification of organic compounds, systematic naming of alkanes, alkenes, alkynes and their preparations and properties	3	CLO1, CLO2, CLO3
3.	**Cycloalkanes and stereochemistry**: Cis-Trans isomerism, stability of cycloalkanes, axial and equatorial bonds in cyclohexane and stereochemistry at tetrahedral centers, enantiomers, sequence rules for specifying configurations, diastereomers, meso compounds, racemic mixtures, chirality and prochirality	5	CLO1, CLO2, CLO3
4.	**Midterm-I Exam**	1	
5.	**Types of organic reactions**: kinds of organic reactions, mechanisms, radical reactions, polar reactions, nucleophilic substitution reactions, SN2 reaction, SN1 reaction; Elimination reactions, E1, E2, E1cB	3	CLO1, CLO3, CLO4
6.	**Organohalides**: naming and properties of alkyl halides, preparations and pharmaceutical preparations.	3	CLO1, CLO4
7.	**Chemistry of aromatic compounds**: aromaticity, electrophilic aromatic substitution reaction, substituents effects in substituted aromatic rings	3	CLO2, CLO4
8.	**Midterm-II Exam**	1	
9.	**Alcohols, Phenol and ethers**: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.	6	CLO1, CLO3
10.	**Aliphatic and Aromatic Aldehydes and ketones**: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.	3	CLO1, CLO3, CLO4
11.	**Aliphatic and Aromatic Carboxylic acids**: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.	5	CLO3, CLO4
12.	**Aliphatic and Aromatic Amines**: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.	3	CLO1, CLO4
13.	**Final Exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Organic Chemistry: John McMurry, 2. Organic Chemistry: Morrison and Boyd, 3. Textbook of Organic Chemistry- Bahl and Bahl

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Course Title	Pharmacognosy-I			
Course Code	PHAT-1103		**Year**	First Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building fundamental knowledge in pharmacognosy, specifically with regards to crude drugs (classification, sources, identification, separation, extraction, evaluation, processing etc.), official references, complementary and alternative medical systems, introduction to phytochemistry and pharmaceutical applications.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	comprehend and acquire fundamental knowledge of pharmacognosy
CLO2	learn about the morphological structure and microscopic evaluation of plant cell
CLO3	obtain detailed knowledge about the crude drugs and plant analysis (sources, their collection, evaluation, classification, processing and evaluation)
CLO4	comprehend the main concepts of phytochemistry (applications, benefits and risks in human health improvement and treatment)
CLO5	gain knowledge about traditional medicines and their pharmaceutical uses.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				2		1			
CLO2		3				2					
CLO3		3				2		3			
CLO4		3				2					
CLO5		3				2		1			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl	Contents of Course	Credit Hours	CLOs met
1.	**Definition and scope of Pharmacognosy:** Historical development, contribution to modern medicines, Pharmacopoeias, National formularies, Monograph, etc.; official, non-official & un-official drugs.	3	CLO1
2.	**Structure of plant cell:** Its function and form, introduction to general structure of the morphological parts of plants, microscopic examinations.	3	CLO2
3.	**Midterm-1 examination**	1	
4.	**Crude drugs and Plant analysis:** Origin, distribution, cultivation, collection, drying, storage, commerce and quality control.; classification of drugs; preparation of drugs for commercial market; evaluation of crude drugs; drug adulteration. Extraction, separation, chromatography; types of plant constituents, comparative phyto-toxicity and chemo-toxicity.	9	CLO1, CLO4
5.	**Midterm-2 examination**	1	
6.	**Phytochemistry and pharmaceutical uses** of plant constituents: • Lipids: Castor oil, linseed oil, olive oil, peanut oil, coconut oil, beeswax. • Carbohydrate and related compounds: Sugars and sugar containing drugs-sucrose, dextrose, glucose, fructose, etc. • Polysaccharide containing drugs-starches, dextrin, etc. • Gums, mucilage: Tragacanth, acacia, sodium alginate, agar, cellulose.	9	CLO4
7.	**Plants in complementary and traditional systems of medicine:** Alternative treatment systems (Ayurvedic, Unani, Homeopathic medicine), role of traditional drugs to modern medicines. Common indigenous traditional drugs; Punarnava, Vashaka, Anantamul, Arjuna, Chirata, Picrorhiga, Kalomegh, Amla, Asoka, Bahera, Haritaki, Tulshi, Neem, Karela, Shajna, Bael, Garlic, Jam.	3	CLO1, CLO5
8.	**Assignment**	2	
9.	**Counselling**	11	
10.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. E. P. Claus and V.E. Tyler : Pharmacognosy, 2. W.C. Evans : Trease and Evan's Pharmacognosy, 3. Pharmacognosy and Pharmacobiotechnology by Kar Ashutosh

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Course Title	Functional English			
Course Code	PHAR-1107		**Year**	First Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description: This course aims to make students capable in verbal and written communication in English in different practical situations.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Communicate in English in different situations
CLO2	Read and summarize English texts in scientific articles and magazines
CLO3	Write English with correct spelling and grammar in professional situations
CLO4	Become familiarized with Internationally recognized English language Tests

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1									3		
CLO2								2	2		
CLO3								2	3		
CLO4								2	2		

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Communication**: Fluent speaking, language of presenting information, conversation in a meeting and giving a speech, making a PowerPoint presentation, facing a viva-board	7	CLO1, CLO4
2.	**Reading and Writing**: Spelling (Bengali and English), Reading science news, brochures, Writing e-mail, formal Letter, Explaining plots and graphs.	6	CLO1, CLO2,
3.	**Mid-term I**	1	
4.	**English for Pharmacy Practice**: How to Make a Curriculum Vitae and Resume, understanding pharmaceutical vocabulary, prescription parts, pharmaceutical idioms, body parts vocabulary	6	CLO3, CLO4
5.	**Mid-term II**	1	
6.	**English for Higher Study:** Basic on GRE, TOFEL and IELTS examinations.	3	CLO4
7.	Course review and contact hour	4	
8.	**Final Examination**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: Michaela Buchler, *et al.*: English for the Pharmaceutical Industry, Sidney Greenbaum: The Oxford English Grammar, Vanessa Jakeman: New insight into IELTS, ETS: The official guide to revised GRE test.

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Course Code	Mathematics			
Course Title	PHAR-1108		**Year**	First Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will cover the theoretical concepts, tools, and methods related to mathematical calculations in pharmacy, including density, dilution, buffer preparation, milliequivalents, and osmolarity. Topics in calculus will be explored, such as rules of differentiation, successive and partial differentiation, differentiation of a function of a function, the relationship between derivatives of inverse functions, and integration techniques, including integration as a summation, area under a curve, integration by partial fractions, and graphical integration. Applications of these mathematical principles in the field of pharmacy will be emphasized.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	know the calculations such as density, specific gravity, specific volume, dilution, active ingredient and excipients calculation
CLO2	learn about introductory calculations in pharmacy
CLO3	Evaluate the relationship between two or more variables and predict based on this relationship
CLO4	learn about the rules of differentiation, successive and partial differentiation, and rules of integration- integration as a summation, area under a curve

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		1					3	2			
CLO2			2				3	2			
CLO3		1					3	2			
CLO4							3	2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Mathematical Concepts**: Ratios, percentages, mixture problems; sets, numbers, intervals, relations, functions, density, specific gravity, specific volume.	4	CLO1, CLO2
2.	**Concentration and dilution:** PPB, PPM, converting expressions of concentration from one form to another, Calculating ingredient required to prepare, a ratio strength solution, simple and serial dilution, multiple dilution, mixing concentration, Calculation necessary for organic reactions.	6	CLO1, CLO2,
3.	**Determinants and Matrixes:** Definition, Types of matrixes, Matrixes algebra, Simultaneous linear equations.	6	CLO1, CLO3
4.	**Midterm-I Exam**	1	
5.	**Co-ordinate Geometry:** Ordinate systems, Transformation of co-ordinates, Translation & rotation of axes, application of Co-ordinate Geometry, Rectangular co-ordinates, determination of slope, intercept and points of intersection, equation of first degree in both x and y (circle), ellipse, rectangular hyperbola, etc. Exponential and logarithmic curves, graphical solution equation, graphical solution of simultaneous equation.	6	CLO1, CLO2, CLO3
6.	**Functions and its application in life sciences:** Domain, range, graph, even/odd functions. Compositions, one-to-one functions, inverse functions. Arithmetical and geometrical growth, power functions, exponential and logarithmic functions, trigonometric functions.	5	CLO1, CLO3
7.	**Midterm-II Exam**	1	

8.	**Differential calculus:** Intuitive concept of limits; Continuity Instantaneous growth rate. Definition of derivative, general and geometrical meaning, equation of the tangent line. Second derivative, acceleration, and concavity. Differentiation rules. Relation between the growth and concavity and the derivatives, graphical and numerical study. Find maxima, minima and the maximal growth rate. Investigation processes in Pharmacy.	7	CLO1, CLO2, CLO4
9.	**Integral calculus:** Solving different forms of Indefinite and definite integral, geometric meaning (area under, between curves), Simple numerical methods of integration. Area function, Newton-Leibniz formula.	6	CLO4
10.	**Final Exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Howard C. Ansel: Pharmaceutical Calculations, 2. Differential and Integral Calculus by GEORGE A. OSBORNE, S.B

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Course title	Fundamental Computer Science			
Course code	PHAR-1110		**Year**	First Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will introduce the history of computer, types of computer, its evolution, computer generation, basic computer organization, basic components of computer, hardware and software, types of storage, central processing unit, number systems, computer codes, computer arithmetic, Boolean algebra, Logic gates, processor and memory, ROM, RAM, operating systems, DOS, Windows, application of computer in pharmacy, application of word processing program (MS word), spreadsheet program (MS Excel), multimedia, programming languages, computer networks etc.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	learn the history of computer, its evolution and generations, basic organization of computer, types of storages, central processing unit, hardware, software, data processing.
CLO2	Know number systems, computer codes, computer arithmetic, Boolean algebra, Logic gates.
CLO3	understand processor and memory, operating systems, DOS, Windows, application of word processing program (MS word), spreadsheet program (MS Excel).
CLO4	learn programming language, multimedia, computer networking communications.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1										3	
CLO2								2		3	
CLO3								2		3	
CLO4							1	2		3	

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction to computers**: History of computers, characteristic features of computers, computers' evolution to their present form, Computer generations, Data processing, basic operations performed by all types of computer systems, basic organization of a computer system, input unit and its functions, output unit and its functions, storage unit and its functions, types of storage used in a computer system	6	CLO1
2.	**Number systems**: Non-positional number system, positional number system, decimal number system, Binary number system, octal number system, hexadecimal number system, Computer data, computer codes: representation of data in binary, most commonly used computer codes, collating sequence, computer arithmetic, binary arithmetic,	6	CLO2
3.	**Boolean algebra:** Fundamental concepts and basic laws of Boolean algebra, Boolean function and minimization, Logic gates, Logic circuits and Boolean expressions, Combinational circuits and design.	6	CLO3
4.	**Midterm-I and II Exam**	2	
5.	**Processor and Memory**: Internal structure of processor, Memory structure, determining the speed of a processor, Different types of processors available, Determining the capacity of a memory, Different types of memory available, RAM, ROM, types of ROM several other terms related to the processor and main memory of a computer system, secondary storage devices, magnetic disks, optical disks, memory storage devices.	6	CLO3
6.	**Operation Systems:** Meaning of operating systems, Review of different operating systems, understanding and using DOS and windows.	6	CLO3
7.	**MS Word and MS Excel**: Word processing program (MS word), spreadsheet program (MS Excel) and their applications.	3	CLO4
8.	**Computer languages**: Computer languages, classification, architecture, characteristics of various types of computer languages like C^{++}, Visual Basic, Fortran, Java, Javascript, PASCAL, .NET and their applications	6	
9.	**Multimedia:** Introduction, characteristics, types, features, multimedia at present, advantages and disadvantages, uses; **Computer networking systems**: Introduction: Network, Uses of Networks, Types of Networks, Reference Models: TCP/IP Model, The OSI Model, Comparison of the OSI and TCP/IP reference model, architecture of Internet, protocol, server model, HTTP, E-mail, WWW, TELNET, DNS; RSA algorithm		3
11.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Computer Fundamentals- Pradeep K. Sinha & Priti Sinha, 2. Computer Networks - Andrew S Tanenbaum, Pearson Education.

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Course Title	Inorganic Pharmacy Lab-I			
Course Code	PHAL-1104		**Year**	First Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/ Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in Chemical laboratory, including handling of chemicals, reagents and solvents. This course will also give experiences in running chemical reactions in laboratories, synthesis and analysis of inorganic compounds.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop basic idea about inorganic compounds.
CLO2	calculate potency of antacid preparation.
CLO3	synthesize table salt.
CLO4	determine the amount of zinc in commercial product.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3							
CLO2		3		3			2				
CLO3		3		3							
CLO4		3		3			3				

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs
1.	Introduction to common laboratory glassware and equipments	3	CLO1,
2.	Identification of various inorganic ions and radicals	7	CLO2
3.	Determination of the amount of zinc present in a commercial product.	4	CLO4
4.	Formulation of oral saline in the laboratory.	4	CLO3
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1. Introduction to Modern Inorganic Chemistry: S.Z. Haider, 2. Vogel: A Text Book of Inorganic Qualitative Analysis, 3. Rogers Inorganic Pharmaceutical Chemistry.

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Course Title	Organic Pharmacy Lab-I			
Course Code	PHAL-1105		**Year**	First Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:
This course focuses on hands-on experiences in Chemical laboratory, including handling of chemicals, reagents and solvents. This will provide exposure to chemical reactions in laboratory followed by reaction monitoring, crude product separation and purification and characterization of the synthesized compounds.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on Organic Chemistry.
CLO2	understand the structure of molecules and their properties.
CLO3	analyze and draw structures of the different organic molecules.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		1				2			
CLO2		3		2				2			
CLO3		3		3				2			
CLO4		3		3				2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of melting points of organic compounds.	3	CLO1
2.	Detection of functional groups like Ar-COOH, Ar-COOR, RCOR, ROH, etc.	5	CLO1,
3.	Purification of organic liquid by distillation.	4	CLO1
4.	Synthesis of compounds, like methyl benzoate, ethyl benzoate.	5	CLO1
5.	Application of KingDraw and ChemSketch in chemistry	4	CLO3
6.	Midterm Examinations	3	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Organic Chemistry- Morrison and Boyd. Organic Chemistry - Finar
Supplementary readings Textbook of Organic Chemistry- Bahl and Bahl

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Course Title	Pharmacognosy Lab-I			
Course Code	PHAL-1106		**Year**	First Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:
This course will focus hands-on experiences in pharmacognosy, including identification (morphological and anatomical) and analysis method of several phytoconstituents and crude medicinal products, different extraction methods, preparation of different test reagents, and their application in laboratory

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on pharmacognosy.
CLO2	learn identification and analysis of phytoconstituents and crude medicinal products
CLO3	Understand the morphological and anatomical descriptions of the crude medicinal plants for proper identification
CLO4	comprehend good knowledge about different extraction methods, preparation of test reagents, and their application

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3				3			
CLO2		3		3				3			
CLO3								3			
CLO4		1		3				3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Study of morphological characteristics e.g. flowers, fruits, leaves, petals, stamens, etc. of some Bangladeshi medicinal plants	4	CLO1, CLO3
2.	Tests for carbohydrates: glucose, fructose, lactose, sucrose, maltose	5	CLO4
3.	Drying and extraction techniques of plant samples.	4	CLO4
4.	Extraction of starch and related products.	4	CLO4
5.	Examinations of gums and mucilage's: Acacia, tragacanth, sterculia, agar, alginates.	4	CLO1, CLO2,
6.	Midterm Examinations	3	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References:

1. E. P. Claus and V.E. Tyler : Pharmacognosy
2. W.C. Evans : Trease and Evan's Pharmacognosy

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---------- B.PHARM. (HONS.) FIRST YEAR SECOND SEMESTER ----------

Course Title	Inorganic Pharmacy-II			
Course Code	PHAT-1201		**Year**	First Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building knowledge of inorganic chemistry, knowledges on medicinal application of inorganic compounds, etc.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	have basic knowledge on inorganic Chemistry.
CLO2	gain an idea of the trace elements.
CLO3	perceive knowledge of electrolytes.
CLO4	understand the medicinal and pharmaceutical application of inorganic compounds.
CLO5	grasp an idea about radiopharmaceuticals.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				3					
CLO2		3				3					
CLO3		3				3					
CLO4		3				3					

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Inorganic Medicinal Agents:** 1. **Gastrointestinal agents:** Classification, inorganic gastrointestinal agents, systematic and non-systematic antacids, preparation and application of antacids, adsorbents, saline cathartics or laxatives. 2. **Agent for bone and bone growth:** Calcium preparations. 3. **Hematinic agent:** Iron and iron preparations. 4. **Dental preparations:** Dental plaque antiplaque agents, dental caries, fluorides, other anticaries agents (preparation, applications), dentifrices. 5. **Inorganic Topical agents:** Introduction & application of topical agents.	12	CLO1 CLO4
2.	**Midterm-1**	1	
3.	**Major Intra and Extra-cellular Electrolytes:** Major physiological ions, electrolytes for replacement therapy and acid-base therapy, electrolyte in combination therapy etc.	6	CLO1 CLO3 CLO4
4.	**Essential Trace Elements:** Essential trace elements and their preparations (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), Essential trace elements in pharmaceutical sciences.	3	CLO1 CLO2 CLO4
5.	**Midterm-2**	1	
6.	**Radio Activity and Radiopharmaceuticals:** Introduction, types of radiation, radioactive decay, half-life, average life, modes of radioactive decay, interaction of radiation with matter, measurement of radioactivity, radiation hazard and radiological safety, biological effects of radiation, control of radiation exposure, storage of radioactive materials, medical application of radionuclide, official radioactive compounds and their importance, toxicity of radioactive isotopes.	4	CLO1 CLO4 CLO5

7.	**Presentation/ Assignment**	3	
8.	Counseling	12	
9.	**Final exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Textbook of inorganic chemistry- Hemraj Sharma, 2. L. M. Atherden: Bentley and Driver's Textbook of Pharmaceutical Chemistry, 3. J.H. Block, E.B. Roche: Inorganic Medicinal & Pharmaceutical Chemistry

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Course Title	Organic Pharmacy-II			
Course Code	PHAT-1202		**Year**	First Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building knowledge of organic chemistry, strategic applications of named reactions in organic synthesis, basic chemistry, synthesis pathways, properties and applications of some common drugs, biomolecules and heterocyclic compounds.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	learn the mechanisms of various named reactions and their applications.
CLO2	know basic synthetic pathways and properties of some common drugs.
CLO3	understand the chemistry and application of biomolecules like, carbohydrates, lipids, amino acids and proteins.
CLO4	learn the chemistry, synthesis and properties of heterocyclic compounds.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				3		2			
CLO2		3		2		3		2			
CLO3	3	3		2		3		2			
CLO4		3		2		3		2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Named reactions:** Aldol reaction**,** Aza-Wittig reaction, Baeyer-Villiger oxidation, Birch reduction, Clemmensen reduction, Diels Alder, Friedel-Crafts, Gabriel synthesis, Sandmeyer, Grignard, Hofman, Mannich reaction, Michael addition, Eschweiler-Clarke Methylation, Dess-Martin oxidation, Staudinger reaction, Swern oxidation, Reimer-Tiemann reaction, Vilsmeier-Haack, Wolf-Kishner reduction, Suzuki Cross-Coupling.	9	CLO1, CLO4
2.	**Introduction to common drugs:** Preparation and uses of salicylic acid, aspirin, paracetamol, benzoic acid, benzyl benzoate, sulfa-drugs, PASA, PABA, isoniazid, etc.	6	CLO2, CLO4

3.	**Carbohydrates:** Chemistry, stereochemistry, classification, aldoses, ketones, oxidation, effect of alkali, Kiliani- Fisher synthesis of aldoses, Ruff degradation, optical family, D-L. R-S cyclic structure of D(+)glucose, mutarotation, hemiacetal, acetal form of glucose, ring size determination, disaccharide, structure determination of polysaccharides, starch, cellulose, glycogen, chemical and pharmaceutical importance of carbohydrate, etc.	8	CLO3, CLO4
4.	**Midterm-I Exam**	1	
5.	**Lipids:** Chemistry of fat, triglyceride, Fatty acid, soap, micelle, saturated and unsaturated fatty acids and phosphoglyceride.	6	CLO3, CLO4
6.	**Amino acids and proteins:** Structure of amino acids, acidity and basicity of amino acids, isoelectric point, preparations and reactions of amino acids, essential amino acids.	8	CLO3, CLO4
7.	**Midterm-II Exam**	1	
8.	**Basic heterocyclic chemistry:** Introduction of heterocyclic compounds, heterocyclic carbocyclic compounds. Their importance.	3	CLO4
9.	**Final Exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Organic Chemistry: Morrison and Boyd, 2. Organic Chemistry: John McMurry, 3. Strategic Applications of Named Reactions in Organic Synthesis -László Kürti & Barbara Czakó. 4. Textbook of Organic Chemistry- Bahl and Bahl

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Course Title	Physical Pharmacy-I			
Course Code	PHAT-1203		**Year**	First Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This will focus on knowledge of Physical Chemistry, chemical equilibrium, thermodynamics, thermo-chemistry, phase equilibrium, ionic equilibria, solutions, buffer, isotonic solutions.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	gain basic knowledge on Physical Chemistry.
CLO2	perceive thermodynamics and thermochemistry
CLO3	understand the chemical, ionic and phase equilibrium
CLO4	Know types and properties of solutions
CLO5	perform pharmaceutical calculations

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3						2			
CLO2		3					3	2			
CLO3		3					3	2			
CLO4		3					3	3			
CLO5		2					3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Chemical Equilibrium:** Law of mass action, determination of equilibrium constant, homogenous and heterogeneous equilibrium, Le-Chatelier principle, Van't Hoff equation.	3	CLO1, CLO3
2.	**Chemical Thermodynamics:** First law of thermodynamics, work energy and heat, work of expansion, internal energy, heat change at constant volume and pressure, thermodynamic reversibility, work of isothermal reversible expansion of gases, the maximum work under the isothermal expansion of gas, heat capacities, difference between molar heats, adiabatic processes, Joule-Thomson experiment.	6	CLO1, CLO2
3.	**Midterm-exam I**	1	
4.	**Thermochemistry and Thermochemical law:** Second law of thermodynamics, Carnot's cycle and efficiency of perfect engine, entropy, entropy changes for ideal gas expansion, entropy changes under various conditions, free energy, Gibbs-Helmholtz equation, free energy changes under equilibrium, Clausius-Claperon equation.	6	CLO1, CLO2
5.	**Phase Equilibrium:** Phase, component and degree of freedom, the phase rules and its thermodynamic deviation, the phase diagrams of water and sulphur systems, partially miscible liquid pairs: the phenol and water, nicotine water system, completely miscible liquid pairs and their separation by fractional distillation, freeze drying (lyophilization).	6	CLO1, CLO2,
6.	**Mid-term Exam II**	1	
5.	**Solution:** Types and properties of solution, units of concentration, ideal and real solution, Henry's law, distribution of solids between immiscible liquids, distribution law, partition coefficient, solvent extraction.	6	CLO1, CLO4, CLO5
6.	**Solution of Electrolytes:** Concentration expressions, equivalent weights, colligative properties of dilute solution, osmotic pressure, measurement of osmotic pressure, Vant Hoff and Mores equations for osmotic pressure, coefficient for expressing colligative properties.	6	CLO1, CLO4, CLO5
7.	**Ionic Equilibria:** Modern theories of acids, bases and salts, acid-base equilibria, Sorensen's pH scale, species concentration as a function of pH, calculation of pH, acidity constants.	3	CLO1, CLO3,
8.	**Buffer and Isotonic Solutions:** Buffer equations, buffer capacity, buffer in pharmaceutic and biologic systems, buffered isotonic solutions, methods of adjusting toxicity and pH.	4	CLO2, CLO3, CLO4
9.	Semester Final Exam	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: A. Martin & J. Swarbrick: Physical Pharmacy, Atkins: Physical Chemistry

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Course Title	Pharmacognosy-II			
Course Code	PHAT-1204		**Year**	First Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will emphasize developing basic understanding of pharmacognosy regarding various macromolecules (their biological sources, chemistry, classification, pharmacological uses, and side effects etc.), as well as the separation, characterization, quality control, and pharmaceutical applications of several phytochemicals and herbal drugs.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on pharmacognosy
CLO2	obtain comprehensive knowledge on various macromolecules along with their biological source, chemistry, classification, pharmacological uses and side effects.
CLO3	learn about different techniques to separate and characterize different medicinal components from natural resource, their quality control and pharmacological uses.
CLO4	Gather knowledge on the applications, benefits and risks of different phytoconstituents and herbs in human health improvement and treatment.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	1	3				3					
CLO2		3				3					
CLO3		3		2		3		2			
CLO4	1	1				3					

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Glycosides and glycoside-containing drugs:** Classification, source and use of different type's glycosides, including – Isothiocyanate (Mustard), Cyanogenetic (Wild cherry), Anthraquinone glycoside (Cascara sagrada, aloe, senna, rhubarb), Saponins (glycyrrhiza), Cardiac (Digitalis, strophanthus, squill).	3	CLO1
2.	**Midterm-1 examination**	1	
3.	**Alkaloids:** Distribution, properties, tests, extraction, structure and classification. Details of Pyridine-piperidine (Areca), Tropane (Belladonna, stramonium, cocoa, hyoscyamus, Quinoline (Cinchona), Isoquinoline (Ipecac, opium), Indole (Rauwolfia, nux-vomica, ergot), Purine bases (Coffee, tea), Imidazole (Policarpus), Steroidal (Veretrumviride), Alkaloidal amine (Colchicine, Ephedrine).	3	CLO1, CLO2
4.	**Midterm-2 examination**	1	
5.	**Volatile oils and related terpenoids:** Methods of obtaining volatile oils, chemistry of volatile oils and their medicinal & commercial uses.	7	CLO2, CLO4
6.	**Midterm-2 examination**	1	
7.	**Phenolic compounds and tannins:** Chemical nature and test for tannins, some tannin containing drugs such as Nutgall.	7	CLO1, CLO3
8.	**Resin and resin combinations (resin, oleoresin, oleo gum resin, balsam):** Jalap, Cannabis, Capsicum, Ginger, Myrrh, Tolu Balsam, Benzoin.	3	CLO1, CLO2,
9.	**Herbs as health foods:** Alfa alfa, Apricot pits, Arnica, Garlic, Onion, Ginseng, Spirulina, Fenugreek, Honey and Glycyrrhiza.	3	CLO1, CLO4
10.	**Assignment/Presentation**	2	
11.	Counselling	11	
12.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. E. P. Claus and V.E. Tyler : Pharmacognosy2. W.C. Evans : Trease and Evan's Pharmacognosy, 3. Kar Ashutosh: Pharmacognosy and Pharmacobiotechnology

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Course Title	Basic Anatomy			
Course Code	PHAR-1211		**Year**	First Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will focus on building knowledge on general structure and related function of human body.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	learn the fundamental aspects of anatomy
CLO2	understand the basic composition and functions of cells and tissues
CLO3	Get details of digestive, cardiovascular, nervous, respiratory, urinary, reproductive system.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3		1								
CLO2	3		1								
CLO3	3		1								

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Cell and Tissue**: General structure and function of cell, cellular organelles, and knowledge of cell division. Definition, classification, characteristics, distribution, and functions of different tissues.	4	CLO1, CLO2
2.	**Alimentary System:** Oral cavity, pharynx, esophagus, stomach, small intestine, caecum, appendix, colon, sigmoid, rectum, and canal.	4	CLO1, CLO3
3.	**Cardiovascular System:** Heart, various aorta, composition and functions of blood, plasma and components, plasma proteins. Blood forming cells-characteristics, functions, their formation and destruction.	4	CLO1, CLO3
4.	**Nervous System:** General structure, classification, function of nervous system. Neuron, classification functions of Neuroglial cells, properties of nerve fibers. Introduction to synapse and neurotransmitters.	4	CLO1, CLO3
5.	**Respiratory System:** Organs of respiratory system, nose, pharynx, larynx, trachea, bronchus, lung; Mechanism of respiration, pulmonary ventilation, ventilation volumes, gaseous exchange, carriage of O2 and CO2	4	CLO1, CLO3
6.	**Urinary System:** Kidney, ureter, urinary bladder, urethra and nephron.	4	CLO3
7.	**Reproductive System:** Name, structure and function of male and female reproductive organs.	4	CLO1, CLO3
8.	**Mid Term Exam-I and II**	2	
9.	Contact Hour	12	
10.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Reference: 1. Guyton: A Textbook of Medical Physiology, 2. W. F. Ganong: Review of Medical Physiology

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Course Title	Inorganic Pharmacy Lab-II			
Course Code	PHAL-1206		**Year**	First Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in Chemical laboratory, including handling of chemicals, reagents and solvents. This course will also give experiences in running chemical reactions in laboratory followed by formulation, analysis and determination of components.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Analyze and determine the presence of calcium carbonate.
CLO2	formulate gels as pharmaceuticals.
CLO3	prepare inorganic drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3			3	3			
CLO2		3		3			3	3			
CLO3		3		3			3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of calcium carbonate present in the eggshell.	6	CLO1
2.	Analysis of commercial $CaCO_3$ tablets.	6	CLO1
3.	a. Preparation of aluminum hydroxide and magnesium hydroxide gel. b. Preparation of hematinic: ferrous chloride and ferrous fumarate. c. Preparation of tooth paste and tooth powder. d. Formulation and preparation of talcum powder.	6	CLO3
4.	Midterm Examinations	6	
5.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1. Introduction to Modern Inorganic Chemistry: S.Z. Haider, 2. Vogel: A Text Book of Inorganic Qualitative Analysis, 3. Rogers Inorganic Pharmaceutical Chemistry

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Course Title	Organic Pharmacy Lab-II			
Course Code	PHAL-1207		**Year**	First Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will deal with organic synthesis of simple compounds and their identification, extraction of acidic, basic or neutral compounds, soap preparation from oil, purification of impure compounds.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	learn about basic organic synthesis and the detection procedures of compounds.
CLO2	learn about the extraction and separation of an acidic, a basic and a neutral substance.
CLO3	learn about the synthesis of soap from oil.
CLO4	know the techniques to purify the impure compounds.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3			2	3			
CLO2		2		2				3			
CLO3		3					2	3			
CLO4		3		2				3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Synthesis and identification of simple organic compounds - methyl benzoate, ethyl benzoate, aniline, benzoic acid, diazonium salt, anisole, phenol, etc.	6	CLO1, CLO2,
2.	Extraction: Separation of Acidic, Basic, Neutral Substance	3	CLO1, CLO3,
3.	**Midterm-I Exam**	3	
4.	Synthesis of soap from oil.	3	CLO1, CLO3,
5.	**Midterm-II Exam**	3	
6.	Purification of impure organic compound by crystallization.	6	CLO2, CLO4,
7.	**Final Exam**	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References:

1. A.I. Vogel: Elementary Practical Organic Chemistry, Part-I, II & III
2. Shriner, Fusion and Curtin: The Systematic Identification of Organic Compounds

Supplementary readings H.T. Clarke & B. Haynes: A Hand Book of Organic Analysis

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Course Title	Physical Pharmacy Lab-I			
Course Code	PHAL-1208		**Year**	First Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in Chemical laboratory, including handling of chemicals, reagents and solvents. This course will also give experiences in preparation of solutions of different pH, buffers, standardization of acid and bases etc.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	prepare buffers, solutions of different pH
CLO2	standardize acid and bases
CLO3	determine distribution coefficient

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		2		3	1		3	3			
CLO2		2		3	1		3	3			
CLO3		1		3	1		3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Preparation of solutions of different pH, buffers	6	CLO1
2.	Standardization of acid, base; determination of pKa & pKb.	6	CLO2
3.	Determination of distribution coefficient	6	CLO3
4.	Midterm Examinations	6	
5.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: A. Martin and J. Swarbrick: Physical Pharmacy

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Course Title	Pharmacognosy Lab-II			
Course Code	PHAL-1209		**Year**	First Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will focus hands-on experiences in pharmacognosy, including identification (morphological and anatomical) and analysis method of several phytoconstituents and crude medicinal products, different extraction methods, preparation of different test reagents, and their application in laboratory

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop fundamental knowledge on pharmacognosy.
CLO2	Learn about the identification and confirmatory tests of different phytochemicals
CLO3	Understand different extraction and isolation techniques for phytoconstituents and crude drugs

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3				3			
CLO2		3		3				3			
CLO3		3		3			1	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Extraction and identification of caffeine from tea and coffee.	5	CLO1, CLO2
2.	Isolation of volatile oils from oil-containing drugs.	5	CLO1, CLO2
3.	Preparation of TLC plate, activation, sampling and screening of different plant extracts by TLC	5	CLO1, CLO2
4.	General tests for phenols, glycosides, alkaloids, flavonoids, etc.	4	CLO3
6.	Midterm Examinations	6	
7.	Final examination	5	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: E. P. Claus and V.E. Tyler : Pharmacognosy

1. W.C. Evans : Trease and Evan's Pharmacognosy

Supplementary readings Pharmacognosy and Pharmacobiotechnology by Kar Ashutosh

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Course Title	Viva Voce-I			
Course Code	PHAV-1210		**Year**	First Year
Credit	1		**Semester**	Second Semester
Credit Hours	15		**Final Examination**	-----
Evaluations (30 marks)	Final Examination: 30			

Course Description:

The students will sit for the oral assessment based on the total contents taught in first year.

---------- B.PHARM. (HONS.) 2nd YEAR 1st SEMESTER ----------

Course Title	Physical Pharmacy-II			
Course Code	PHAT-2101		**Year**	Second Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will focus on building knowledge of Physical chemistry, chemical kinetics, interfacial phenomena, rheology, colloids, electrochemistry, micrometrics etc.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	gain basic knowledge on Physical Chemistry.
CLO2	understand the basis of chemical kinetics
CLO3	Know about the physical and chemical degradation of pharmaceutical products
CLO4	comprehend electrochemistry
CLO5	Perceive the importance and methods of particle size determination

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		2				1			
CLO2		3		2			2	1			
CLO3		3		2			2	1			
CLO4		3		2			2	1			
CLO5		3		2			2	1			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Kinetics:** a. Physical degradation of pharmaceutical products: loss of water, absorption of water, loss of volatile constituents, polymorphism, color change. b. Chemical degradation: hydrolysis, oxidation, Decarboxylation, isomerization, polymerization, factors affection chemical degradation c. Chemical kinetics: Definitions, rates and orders of reactions, methods for determination of orders of reactions, influence of temperature on rate of reactions, theories of reaction rates, decomposition of pharmaceuticals, accelerated test for physical, stability aspects, shelf life determination.	9	CLO1, CLO2, CLO3
2.	**Interfacial phenomena:** Adsorption and Interface, Freundlich and Langmuir isotherm, BET equation, electrical properties of interfaces, electrical double layer, Nernst and zeta potential, Gibbs equation, spreading surface active agents, Emulsifiers, detergents and antifoaming agents, surfactants and drug activity, surfactants and pharmaceuticals.	6	CLO1
3.	**Mid-term exam I**	1	
4.	**Rheology and rheology of dispersed system:** Newtonian liquids, Non-Newtonian materials, yield value, plastic & pseudo plastic flow, dilatants and thixotropic flow, viscosity of suspending agents.	3	CLO1
5.	**Colloids**: Classification, Preparation, properties, sedimentation, Stoke's law, stability of colloidal dispersion, protective colloid, sensitization, dialysis, Donnan membrane equilibrium, application and uses in pharmacy.	6	CLO1
6.	**Mid-Term exam II**	1	
5.	**Electrochemistry**: Electrical units and interrelation, Faradays laws of electrolysis and electrochemical equivalents, electrolytic conduction, equivalent	6	CLO1, CLO4

	conductance and the related facts, conductometric titrations, transference numbers and their determination.		
6.	**Electrochemical cell:** Electrode and cell potentials energies involved in electrode process, reference electrode, buffer solution, measurement of PH; Potentiometric titrations, oxidation-reduction systems, concentration cells.	6	CLO1, CLO4
7.	**Micromeritics:** Importance of particle size determination, Different means of expressing particle size, Methods of particle size determination, optical and electron microscope studies, coulter counter methods, Laser beam technique, Sieve analysis, sedimentation methods, particle shape and surface area, Measurement of particle surface area.	4	CLO2, CLO3, CLO4
8.	**Semester Final exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1.M. M. Haque and M. A. Nawab: Principles of Physical Chemistry. 2. A. Martin and J. Swarbrick: Physical Pharmacy, 3. Gordon M. Barrow: Physical Chemistry, 4. N. Kundu and S.K. Jain: Physical Chemistry

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Course Title	Pharmaceutical Microbiology-I			
Course Code	PHAT-2103		**Year**	Second Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description:

This course will focus on building an in-depth knowledge of microbiology and enable students to interpret and integrate applications of pharmaceutical microbiology.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on microbiology.
CLO2	demonstrate a broad range of knowledge on microorganisms.
CLO3	comprehend idea microscopic observations of microorganisms.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3			2				2			
CLO2	3			2				2			
CLO3	3			2				2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**History and evolution of microbiology:** Introduction to microbiology, Microbiology as a field of biology, place of microbiology in the living field, prokaryotic and eukaryotic protests, groups of microorganisms, areas of microbiology, application of microbiology, germs theory of diseases; pure culture concept: immunization; widening horizons.	2	CLO1
2.	**Microscopic observations of microorganisms:** Bright field, dark field, fluorescence and phase contrast microscopy, electronic microscopy, preparations of microscopic examinations, wet mount and hanging drop	6	CLO1, CLO2,

	techniques, fixed and stained smears, microbiological stains: simple and differential staining methods.		CLO3,
3.	**Midterm-1**	1	
4.	**Bacteria:** Nomenclature, morphology, fine structures, nutritional requirements, bacteriological media, growth, reproduction, quantitative measurements of bacterial growth, nutritional requirements, culture media, maintenance and preservation of pure culture of bacteria.	6	CLO1, CLO2, CLO3
5.	**Midterm-2**	1	
6.	**Microorganisms other than bacteria (brief study):** • **Yeasts-** Types, morphology, reproduction, physiology, pathogenicity.. • **Rickettsiae –** Introduction, characteristics of rickettsiae, pathogenic rickettsiea, laboratory diagnosis of rickettsial diseases. • **Viruses –** History, classification, characteristics of viruses; reproduction and cultivation of viruses, virus inhibition, control of virus infection, bacteriophages, morphology and composition, cultivation and reproduction of bacterial viruses.	5	CLO1, CLO2
7.	**Presentation/ Assignment**	3	
8.	**Counseling**	4	
9.	**Final exam**	2	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. M.J. Pelczar, E.C.G. Chan and N.R. Kreig: Microbiology, 2. Stainer: General Microbiology, 3. Tortora, Berdell R. Funkee, Prentice-Hall.: Microbiology: An Introduction

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Course Title	Physiology-I			
Course Code	PHAT-2104		**Year**	Second Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course describes the functions of organs and systems within the body, including cardiovascular system, digestive system and endocrine system.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	understand the general terminologies and scopes of physiology
CLO2	know the composition and function of blood and to describe of blood cells.
CLO3	get idea about function of cardiovascular, digestive, endocrine, exocrine system.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3					1					
CLO2	3					1					
CLO3	3					1					

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	General physiology: Physiology and its scope in pharmacy, knowledge of systems biology, body fluid compartments and its composition, homeostasis, and transport across cell membrane.	5	CLO1
2.	Blood: Composition blood, knowledge of different blood cells, blood groups, blood transfusion, hemolysis, ESR, and blood coagulation. Hemoglobin- its structure, properties, function and hemoglobin derivatives.	7	CLO1, CLO2
3.	Cardiovascular system: Origin of heart beat and action potential, cardiac cycle, heart sounds, cardiac output, ECG, regulation of cardiac function, blood pressure- types, significance, measurement and regulation.	6	CLO1, CLO3
4.	Digestive system and metabolism: Secretion of digestive juices of saliva, gastric, pancreatic, intestinal glands and bile, Functions of digestive juices and their mechanism and regulation of secretion, digestion and absorption of various foodstuffs. Liver-its function, formation of bile and its circulation.	6	CLO1, CLO3
5.	Endocrine and exocrine system: Basic idea about endocrine and exocrine glands, their functions and secretions. Knowledge of different hormones.	7	CLO1, CLO3
6.	**Mid Term Exam-I and II**	2	
7.	Contact Hour	12	
8.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Guyton: A Textbook of Medical Physiology, 2. W. F. Ganong: Review of Medical Physiology

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Course Title	Biostatistics			
Course Code	PHAR-2109		**Year**	Second Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on introductory information of biostatistics, modes of data collection and presentation, theoretical knowledge of data analysis, basic ideas of inferential statistics, probability distribution, correlation and regression analysis.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	gain introductory knowledge on Biostatistics
CLO2	know about the methods of data collection and data presentation
CLO3	Know about the sampling techniques
CLO4	gain theoretical knowledge of data analysis
CLO5	get basic information on inferential statistics and interpret results of data analysis

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1							1	3			
CLO2								3	3	1	
CLO3							1	3			
CLO4				1			1	3		2	
CLO5				1			1	3		2	

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction to biostatistics**: Definition, application of biostatistics in Pharmacy, common basic statistical terms, variables and their types.	3	CLO1
2.	**Collection and presentation of data**: Sources of data, Tabulation of data, Formation of frequency distribution, presenting of data -graphs, diagrams.	3	CLO2
3.	**Sampling**: Population, sample, purpose of sampling, methods of sampling, random number table, determination of sample size	2	CLO3
4.	Mid -Term exam I	0.5	
5.	**Measures of center tendency and dispersion**: Mean, median, mode, quantiles, range, interquartile range, mean deviation, variance, standard deviation	4	CLO4, CLO5
6.	**Probability distributions**: The normal, binominal and Poisson distribution, normal curve	3	CLO4, CLO5
7.	**Basic ideas of statistical inference**: Definition and types of hypothesis, Zone of acceptance and zone of rejection, P value, level of significance, type I error and type II error, two tailed and one tailed test, Sampling distribution, Standard error, standard deviation versus standard error, confidence interval, Simple significance tests based on the normal distribution (z- test, t- test,X^2-tests), Procedure of test of significance	8	CLO4, CLO5
8.	Mid-Term exam II	0.5	
9.	**Correlation of measurement:** Introduction to correlation and correlation coefficient.	2	CLO4, CLO5
10.	**Regression analysis:** Basic of regression, calculation of regression coefficient, Partial correlation and multiple regression with two and more than two independent variables, regression equation and line.	2	CLO4, CLO5
11.	**Semester final exam**	2	

Recommended Books: 1. S. P. Gupta: Statistical Methods. 2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics

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Course Title	History of Emergence of Independent Bangladesh			
Course Code	PHAR-2111		**Year**	Second Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description:

This course will focus on the history of independent Bangladesh, culture and heritage, the history of healthcare and drugs in Bangladesh.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	to know the demographics and language of Bangladesh, British rule, Bengali renaissance
CLO2	To learn about partition of Bengal (1947), language movement (1952), : election of 1954, the reign of Ayub Khan and Yahia Khan
CLO3	get knowledge and information about the liberation war.
CLO4	Know the historical background, the dawn of medicine and healthcare in Bangladesh

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1									3	1	1
CLO2									3	1	1
CLO3									3	1	1
CLO4									3	1	1

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Timeline of History-** Demographics and language of Bangladesh, British rule, Bengali renaissance, partition of Bengal (1947), language movement (1952): election of 1954, the reign of Ayub Khan and Yahia Khan.	9	CLO1, CLO2,
2.	**Midterm-I Exam**	1	
	Liberation war: 6-point, 11-point programs, 1970 election, liberation war and genocide in Bangladesh, Bangabandhu and independence of Bangladesh, ideological turn-around after murdering Bangabandhu and family.	10	CLO2, CLO3
3.	**Midterm-II Exam**	1	
4.	**Evolution of Healthcare in Independent Bangladesh-** Historical background, the dawn of medicine and healthcare in Bangladesh, ayurvedic medicine in Bengal: The common heritage, medical system in medieval age and British period, revival of indigenous medicine in colonial Bengal, medicine, healthcare and pharmaceuticals in Pakistan period, healthcare and pharmacy practice in independent Bangladesh.	7	CLO4
5.	**Final Exam**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Muntasir Mamun *et al.*: Histroty of Emergence of Independent Bangladesh, 2. Poonam Bala: Imperialism and Medicine in Bengal: A Socio-historical Perspective, 3. Md. Jagangir Alam: Traditional Medicine in Bangladesh, 4. Sheikh Mujibur Rahman: The Unfinished Memories,

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Course Title	Biochemistry and Molecular Biology			
Course Code	PHAT-2112		**Year**	Second Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will offer comprehensive idea about the biological system & molecules in human body.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	have the idea about structure, elements and functions of cell.
CLO2	learn basic knowledge on biological compounds, nature, bonding, synthesis & purification.
CLO3	achieve knowledge of mutations happening in the cell and their impacts on body.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	2						1		1	
CLO2	3	2		2				1		1	
CLO3	3	2				1		1		1	

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Cell and cell division:** Type and structure of cells, Cell development and differentiation. Principle of semi-permeability, active transport, endocytosis, exocytosis, bacterial, fungal and plant cell walls. Cell division and cell cycle, mitosis and meiosis, structure and function of chromosomes.	4	CLO1, CLO2
3.	**Central Dogma of Molecular Biology:** a) Nucleic acid: Introduction to nucleic acids. b) Replication: DNA replication, DNA polymerases, types of DNA replication, and inhibitors of replication. b) Transcription: RNA synthesis and mRNA processing (post-transnational modification of mRNA, promoters, enhancers and transcriptional factor) in bacteria and yeast, inhibitors of transcription. c) Genetic code: Features of genetic code, Wooble hypothesis with experimental evidence, initiation and termination codon. d) Translation: Structure of Ribosome, mechanism of translation, (protein synthesis), post-transnational modification, inhibitors of translation.	10	CLO1, CLO2
4.	**Mid Term Examination-I**	1	
5.	**Proteins**: Important functions of protein in biological system, importance of amino acid sequence in protein structure, different amino acids structures and functions, peptide bond. disulfide bridge in protein, rigidity of peptide bond, α helix, β pleated sheet, denaturation and renaturation, hydrogen-bonding potentiality, different structures based on architecture, conformational changes of a protein, gel electrophoresis (2D and 3D), purification processes of protein, synthesis of protein and sequencing.	6	CLO1, CLO2
7.	**Mid Term Examination-II**	1	
5.	**Mutation**: Types, molecular mechanism of mutation, site specific mutagenesis, mutation hot spot, DNA repair mechanism, inheritant mutation diseases.	3	CLO3
6.	**Enzymes:** Definition, features, activation energy, specificity, regulation, reaction equilibrium, kinetics, inhibition of enzymes; cofactors & coenzymes.	3	CLO1, CLO2
7.	**Assignment/Presentation**	2	
8.	Course review and contact hours	12	
9.	**Final Examination**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment/Presentation Midterm Exam Final Exam

References: 1. Leninger Biochemistry, 2. Berg, Tymoczko and Stryer, Freeman: Biochemistry.

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Course Title	Physical Pharmacy Lab-II			
Course Code	PHAL-2105		**Year**	Second Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course focuses on hands-on experiences in handling of chemicals, reagents, solvents and instruments. This course will also give experiences in determination of viscosity of pure liquids and liquid pharmaceutical preparations, determination of equilibrium constant, velocity constant.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	determine viscosity of pure liquids and liquid pharmaceutical preparations
CLO2	determine equilibrium constant, velocity constant
CLO3	determine solubility of a sparingly soluble salt in water

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		1		3	3		2	3			
CLO2		1		3	3		2	3			
CLO3		1		3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	(a) Determination of viscosity of pure liquids, like, glycerin, alcohol etc. (b) Determination of viscosity of syrup, emulsion suspension etc.	6	CLO1
2.	Determination of the equilibrium constant of the reaction KI+I2= KI3	6	CLO2
3.	Determination sedimentation volume with effect of different concentration of single suspending agent	6	CLO3
4.	Midterm Examinations	6	
5.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: A. Martin and J. Swarbrick: Physical Pharmacy

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Course Title	Pharmaceutical Microbiology Lab-I			
Course Code	PHAL-2106		**Year**	Second Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course focuses on hands-on experiences in laboratory, including handling of microorganisms, bacterial culture media, simple and differential staining methods.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	prepare specimens for microscopic observations of microorganisms.
CLO2	prepare different types of culture media and pure bacterial culture.
CLO3	execute identification and characterization of bacteria.
CLO4	differentiate between gram-positive and gram-negative bacteria.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3						1	3			
CLO2	3						1	3			
CLO3	3						1	3			
CLO4	3						1	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Study of compound microscope.	4	CLO1
2.	Preparation of culture media.	4	CLO2
3.	Preparation of pure culture, its identification.	4	CLO1, CLO2
4.	Identification of bacterial cells by gram staining.	3	CLO1, CLO3, CLO4
5.	Bacterial counts	3	CLO1
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Cooper and Gunn's Dispensing for Pharmaceutical Students- S. J Carter, Microbiology- Lachman and Whistriche.

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Course Title	Physiology Lab-I			
Course Code	PHAL-2107		**Year**	Second Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course focuses on hands-on experiences in handling and application of microscope for blood counts. Students will also learn the process for determination of hemoglobin, ESR, clotting and bleeding time.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Develop expertise on handling microscopes
CLO2	Determine several pathological parameters through diagnosis
CLO3	Interpret patient conditions through findings of the diagnostic results and gather blood transfusion-related knowledge

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3			2				2			
CLO2	3			2				2			
CLO3	3			2				2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	Study of compound microscope	4	CLO1
2.	Microscopic study of blood cells: R.B.C., W.B.C., and platelets	4	CLO1, CLO2, CLO3
3.	Total count of R.B.C. and W.B.C. including differential count of W.B.C.	4	CLO1, CLO2, CLO3
4.	Estimation of Hemoglobin	3	CLO2, CLO3
5.	Blood grouping, clotting and bleeding time, and ESR	3	CLO2, CLO3
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References:

1. Human Physiology: vol. I & II- Chandi Charan Chatterjee.
2. A Text Book of Medical Physiology- Arther C. Guyton, W. B. Sander's Company,

Supplementary readings.

1. Review of Medical Physiology- W.F. Ganong.

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---------- B.PHARM. (HONS.) SECOND YEAR SECOND SEMESTER ----------

Course Title	Physiology-II			
Course Code	PHAT-2201		**Year**	Second Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

The study of physiology is, in a sense, the study of life. It asks questions about the internal workings of organisms and how they interact with the world around them. Physiology tests how organs and systems within the body work, how they communicate, and how they combine their efforts to make conditions favorable for survival. In this course, we will visit some of the subsections of physiology, developing a brief overview of this huge subject.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	get a comprehensive idea about function of nervous, excretory, and reproductive system.
CLO2	know how a human body adjusts to external environment like, body temperature regulation.
CLO3	learn about different organs of reticulo-endothelial system.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3							1			
CLO2	3							1			
CLO3	3							1			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Nervous System**: Classifications, properties, components of reflex arc. CNS, PNS. Ascending and descending tracts of spinal cord. Somatic and autonomic nervous system, sympathetic and parasympathetic nervous system. Cranial and spinal nerves. Regulation of nervous system. Origin and propagation of nerve impulses across the nerve fibers, action potential.	6	CLO1
2.	**Excretory system**: Physiology of kidney. Regulation of renal circulation. Renal clearance and its importance. Counter current mechanism. Role of kidney in acid-base balance of blood and in maintenance of plasma volume.	6	CLO1
3.	**Reproductive system**: Male sex hormones and their functions; Spermatogenesis and its hormonal regulation. Menstruation cycle, different phases and its regulation. Oogenesis, ovulation and control. Pregnancy and lactation and their hormonal control.	6	CLO1
4.	**Regulation of body temperature**: Heat production and heat dissipation. Role of hypothalamus and other nerve factors in body temperature regulation. Abnormalities in body temperature regulation.	5	CLO2
5.	Reticulo-endothelial system: Spleen, tonsil, lymph node, bone marrow.	5	CLO3
6.	**Mid Term Exam-I and II**	2	
7.	Final Exam and Contact Hour	15	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Textbook: 1. W.F. Ganong: Review of Medical Physiology, **2.** Guyton: A Textbook of Medical Physiology

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Course Title	Pharmaceutical Microbiology-II			
Course Code	PHAT-2202		**Year**	Second Year
Credit	2		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description:

This course will focus on providing knowledge on immunology, immunological products, sterilization and microbiological assay of antibiotics. This will also enable students to understand about microbiological monitoring for pharmaceutical Industry.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	obtain knowledge on immunology and immunological products.
CLO2	acquire knowledge about sterilization, disinfection, antiseptics and preservation.
CLO3	understand the chemical and physical methods to control microbial contamination
CLO4	demonstrate methods for the evaluation of antimicrobial efficacy and factors.
CLO5	realize the principle of controlled environment, quality control and quality assurance.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3			1		2		2			
CLO2	3			1		2		2			
CLO3	3			1				2			
CLO4	3			1		3	2	2			
CLO5	3			1			2	2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Immunology:** Introduction, Types of immune systems: Nonspecific and specific components. Immune regulation and diversity. Types of immunity. Infections. Pathogen city and virulence immunity. Hypersensitivity. Inflammation. Autoimmunity. Active antigenic products, attenuated, attenuated, inactivated and extract, viral and bacterial. Passive products, gamma globulin.	5	CLO1
2.	**Midterm-1**	1	
3.	**Sterilization:** Sterilization by dry heat: principle, hot air oven, method of use, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heart, principle of sterilization by stem under pressure, sterilization by filtration, radiation and gas. Sterility testing and LAL testing method for pharmaceuticals.	5	CLO2
4.	**Midterm-2**	1	
5.	**Microbiological assay of antibiotics:** Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors	4	CLO2, CLO3,

	affecting diffusion assay Dose response curve, large plate assay using Latin square design, statistical interpretation if microbiological assay methods.		CLO4
6.	**Microbiological monitoring for Pharmaceutical Industry:** Different methods of microbial monitoring systems for environment in pharmaceutical industry.	2	CLO5
7.	**Disinfectants and antiseptics:** Introduction and Basic concepts.	2	CLO2
8.	**Presentation/ Assignment**	3	
9.	**Counseling**	5	
10.	**Final exam**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Tortora, Berdell R.Funkee & Case, Prentice-Hall.: Microbiology: An Introduction. 2. Russel and Hugo: Pharmaceutical Microbiology. 3. M.J. Pelczar, E.C.G. Chan and N.R. Kreig: Microbiology, 4. Lachman and Whistriche: Microbiology.

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Course Title	Pharmaceutical Technology-I			
Course Code	PHAT-2203		**Year**	2nd Year
Credit	3		**Semester**	2nd Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course discusses about the pre-formulation studies and pharmaceutical incompatibilities. This also focuses on the various liquid and semisolid dosage forms, like, solution, suspension, creams and ointment with their formulations and production technologies.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn chemical and physical incompatibilities and pharmaceutical pre-formulations
CLO2	Know about the importance and uses of pharmaceutical excipients
CLO3	Gather theoretical knowledge about liquid and semi-solid dosage dorms
CLO4	Learn about dispensing techniques of pharmaceuticals

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		2	1		3		3	2			3
CLO2			1		3			2			3
CLO3			1		3			2			
CLO4			1		3		3	2			1

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Pre-formulation:** Preliminary evaluation, molecular optimization, bulk characterization of material; crystallinity and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis, pK_a determination, pH-solubility profile, effect of	8	CLO1, CLO3

	temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability. Chemical, physical and therapeutic incompatibility of pharmaceuticals.		
3.	**Pharmaceutical excipients:** Chemistry and physical properties of essential pharmaceutical excipients.	3	CLO2, CLO4
4.	**Mid-term I**	1	
5.	**Liquid dosage forms**: Solution and Elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation consideration, manufacturing considerations, packaging of liquids, preservation and stability.	5	CLO2, CLO3
6.	**Dispersed system**: (a) Properties of dispersed systems: Theoretical aspects of suspension, emulsion and colloids, zeta potential, Inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence. (b) Suspension: Advantages and disadvantages, aggregated and dispersed system, formulation of suspension, Manufacturing of suspension, stability of suspension, Quality analysis of suspension, Rheological consideration, illustrative examples. (c) Emulsion: Definition, applications, advantages, disadvantages, theory of emulation, formation of emulsion, Classification of emulsifying agents, HLB values of surface active agents, formulation of emulsion, manufacturing of emulsion, stability of emulsion, Quality analysis of emulsion, Rheological considerations, examples.	8	CLO2, CLO3
7.	**Semisolids** (Ointments, paste, gels): Structure of skin, percutaneous absorption of drugs, definition and classification of semisolid preparations, classification of bases, formulation, manufacturing, consideration, evaluation and quality analysis of semisolids.	4	CLO2, CLO3
8.	**Mid-term II**	1	
9.	**Compounding and dispensing**: Weight, measures and units calculation for compounding and dispensing, fundamental operation in compounding, good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription, Labeling of dispensed medications.		CLO4
10.	**Course review, assessment and contact hour**	10	
11.	Assignment/Presentation	2	
12.	**Final examination**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. Lachman: The Theory and Practice of Industrial Pharmacy, 2. Aulton: Pharmaceutics, the Science of Dosage Form Design, 3. Carter: Cooper and Gunn's Dispensing for Pharmaceutical Students

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Course Title	Pharmacology-I			
Course Code	PHAT-2204		**Year**	Second Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course is designed to develop an understanding of the theoretical concepts about pharmacology, and pharmacotherapy. It gives specific information about the agents used in peptic ulcer, hematinic drug, autacoids, and others such as antihistamines etc. with classification, mode of action, pharmacological actions and their side effects.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	develop basic understanding of pharmacology
CLO2	learn fundamental concept of drug-receptor interactions and their kinetics.
CLO3	understand role of endogenous autacoids in both physiological and pathological conditions.
CLO4	explain pharmacokinetics, mechanism of actions, and side effects of hematinic & vitamins.
CLO5	describe the chemistry, pharmacokinetic parameters, classification, mechanism of actions and side effects of different drugs used in peptic ulcers.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3					3		2			
CLO2			2					2			
CLO3								2			
CLO4								2			
CLO5								2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction to pharmacology:** Introduction to drug, medicine, pro drug, pharmacokinetics, pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, teratogenicity, drug interaction, drug tolerance, drug abuse, idiosyncrasy, doses, dosage form, absorption, distribution, bioavailability, distribution, protein binding, metabolism and excretion, routes of drug administration.	7	CLO1
2.	**Basic concept of drug action:** Receptors, its nature, drug antagonism, specificity, SAR and drug design, Drugs interaction with receptors, Factors modifying drug actions, mechanism of drug action-GPCR, Ion channels, enzyme inhibition etc., relation between drug dose & clinical response.	5	CLO1, CLO2
	Midterm-I	1	
3.	**Drug for Peptic ulcer:** antacid, H2-receptor blocker, proton pump inhibitors, PG analogue, mucosal-protective agents, anti-helicobacter pylori.	5	CLO1, CLO5
4.	**Autacoids:** **Histamines:** Mode of action, action on cardiovascular system, smooth muscle, gastric secretion, anaphylactic shock, histamine-releasing drugs, allergic disorder. **Antihistamines:** Classification, pharmacological, uses, absorption, distributions, excretion, adverse reactions, etc. **Serotonin and serotonin antagonists:** Occurrence, pharmacological action, serotonin antagonist, prostaglandins, prostacyclin and thromboxane.	7	CLO1, CLO3
	Midterm-II	1	
5.	**Hematinic drugs:** Iron, vit B_{12}, folic acid (vit-B9) erythropoietin.	2	CLO1
6.	**Vitamin:** Water soluble and fat soluble vitamins.	2	CLO4
	Assignment/Presentation	2	
	Counselling	10	
	Final examination	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics.
References: 1. Pharmacology by Rang and Dales. 2. Pharmacology by Katzung.
3. Pharmacology by Lippincott.

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Course Title	Clinical Pathology			
Course Code	PHAT-2205		**Year**	Second Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:
This course will focus on providing students with essential concepts of disease processes and altered health states. The course looks in depth at a wide variety of common pathological conditions.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	understand the essential basic pathological processes including cell death and injury, inflammation, thrombosis, stroke, atherosclerosis and infectious diseases.
CLO2	relate essential basic pathological processes related to common diseases along with the related factors, causes, morphology and potential complications.
CLO3	understand how the knowledge of pathological processes can be utilized in the investigation, management and prevention of disease.
CLO4	learn the molecular and cellular pathogenesis from toxic exposure of chemicals.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3					2		3			
CLO2	3					2		3			
CLO3	3					3		3			
CLO4	3					3		3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Basics to pathology:** General concept of pathology and disease.	4	CLO1, CLO2,
2.	General adaptation, cell injury & cell death: Hyperplasia, hypertrophy, atrophy, metaplasia, necrosis, apoptosis, intracellular accumulation, pathological calcification.	5	CLO1, CLO2, CLO4,
3.	**Acute & chronic inflammation**: Vascular changes, leukocyte extravasation & phagocytosis, chemical mediators, causes of chronic inflammation	4	CLO1, CLO3, CLO4,
4.	**Hemodynamic disorders:** Edema, hyperemia, congestion, hemorrhage, hemostasis, thrombosis, embolism, shock.	4	CLO1, CLO2

5.	**Infections disease:** Diphtheria, whooping cough, tuberculosis, syphilis, clostridial infections, pneumonia.	4	CLO1, CLO2
6.	**Nutritional disease:** Marasmus, kwashiorkor, deficiency states of minerals & vitamins.	4	CLO2, CLO4,
7.	**Mid Term Exam-I**	1	
8.	**Mid Term Exam-II**	1	
9.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. R.S. Cotran, V. Kumar, T. Collins, S.L. Robbins: Pathological Basis of disease. 2. J.B Walter & M. S Israel: General Pathology.

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Course Title	Pharmaceutical Analysis-I			
Course Code	PHAT-2211		**Year**	Third Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will suggest basic separation techniques of known and unknown samples with their chemical properties like, affinity, solubility, polarity etc.

Course Learning outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	provide theoretical knowledge about separation techniques of unknown samples
CLO2	use available titration methods for compounds analysis.
CLO3	achieve knowledge of sample quantification methods

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		2		3				3			
CLO2		2		3				3			
CLO3		2		3				3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction of pharmaceutical analysis:** Quantitative Analysis-In pharmaceutical quality assurance, techniques of analysis, selection of samples, volumetric analysis, primary and secondary standards.	3	CLO1, CLO3
2.	**Aqueous acid-base titration:** Definition, distribution of acid-base species with PH of Medium, acid-based titrimetry for determining weak acidic and basic pharmaceuticals, Indicators- selection, applications.	4	CLO2, CLO3
3.	**Non aqueous acid-base titration**: Theoretical considerations and principles, Bronsted-lowery theory of acids and bases, non-aqueous solvents, titration of weak acids and weak bases, application and scope of non-aqueous titration.	4	CLO2, CLO3

4.	**Mid Term Examination-I**	1	
5.	**Oxidation-reduction titration**: Principles and concepts, determination involving potassium permanganate, potassium dichromate, lodiometric and iodiometric determination, miscellaneous oxidation and reduction titration, indicators.	4	CLO2, CLO3
6.	**Complexometric titration**: Introduction, complexes and chelates, stability of complex ions, titration based on complex formation types of complexometric titration, techniques employed in chemometric titration, methods of end-point detection, selectivity, masking reagents.	5	CLO1, CLO2, CLO3
7.	Mid Term Examination-II	1	
8.	**Potentiometric titration**: Introduction, theory & principles electrochemical cells, half–cells, electrodes, measurement of potential, applications.	3	CLO1, CLO3
9.	**Aquametry**: Principle, scope, Physical methods of water determination, chemical method of water determination, Karl-Fischer method - principle, methodology, equipment, end-point detection and limitation.	5	CLO2, CLO3
10.	Course review and contact hours	12	
11.	**Final Examination**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test /Quiz/Case study/Assignment/Presentation Midterm Exam Final Exam

Learning References: 1. K. A. Connors: A Textbook of Pharmaceutical Analysis. L.G. Chatten : Pharmaceutical Chemistry. M. S. Cooper: Quality Control in Pharmaceutical Industry.

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Course Title	Physiology Lab-II			
Course Code	PHAL-2206		**Year**	Second Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will focus on developing hands-on experiences in handling animal heart and effects of several parameters on heart functions. Understanding of the concepts will enable the students to correlate the experiments outcome with human heart actions.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Explain kymograph
CLO2	Learn the changes of heart condition due to temperature changes
CLO3	Learn the changes of heart condition due to effect of drugs and electrolytes

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3							2			
CLO2	3					2		2			
CLO3	3					2		2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Introduction to Kymograph	4	CLO1
2.	Demonstration of effects of temperature on toad heart	4	CLO2, CLO3
3.	Demonstration of effects of drugs on toad heart	5	CLO2, CLO3
4.	Demonstration of effects of Electrolyte (Na^+, K^+, Ca^{2+}) on heart	5	CLO3
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual	Attendance
Practical experiments	Midterm Exam
Scientific articles	Final Exam

References: 1. A Textbook of Medical Physiology- Arther C. Guyton, W.B. Sander's Company.
Supplementary readings 1. Review of Medical Physiology- W.F. Ganong.

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Course Title	Pharmaceutical Technology Lab-I			
Course Code	PHAL-2207		**Year**	Second Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:
This course will focus hands-on experiences in pharmaceutics laboratory and will enable students to formulate and prepare liquid dosage forms such as solutions, syrups and emulsions.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn the formulation and preparation of solution.
CLO2	Experience the formulation and preparation of syrups.
CLO3	Learn the formulation and preparation of suspensions.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3		1	1			3			3	
CLO2			1	1							
CLO3	3		1								

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Preparation of aromatic water and solutions.	3	CLO1
2.	Preparation of syrup and suspension with medicinal agents.	4	CLO2
3.	Preparation of pharmaceutical ointment.	4	CLO2
4.	a) Preparation of emulsion and identification of type of emulsion b) Preparation of primary emulsion.	4	CLO3
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Fishburn: An Introductory to Pharmaceutical Formulations

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Course Title	Pharmacology Lab-I			
Course Code	PHAL-2208		**Year**	Second Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will provide idea about basic laboratory experiments related to Pharmacology, such as, learn about different types of cardiac drugs on toad's heart; know the effect of CNS drugs on toad.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	know how digitalis, adrenaline, noradrenalin, isoprenaline act on toad's heart.
CLO2	realize the mechanism of action on CNS drugs on toad.
CLO3	Know effect of mydriatic and myotic drugs on rabbit eye

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	1					3	1	3			1
CLO2	1					3	1	3			1
CLO3	1					3	1	3			1

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Study of dose response on toad using CNS drugs.	4	CLO1,CLO2
2.	Effect of adrenaline, noradrenaline, etc. on toad heart.	3	CLO1
3.	Effect of local anesthetics on rat tail.	4	CLO2
4.	Effect of water on toad.	3	CLO1
5.	Study of mydriatic and myotic effect on rabbit eye.	4	CLO3
6.	Midterm Examinations	6	
8.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics.
Supplementary readings: 1. Pharmacology by Rang and Dales. 2. Pharmacology by Katzung.

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Course Title	Pharmaceutical Analysis Lab-I			
Course Code	PHAL-2212		**Year**	Third Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will give practical demonstration of different kinds of assay methods of API (Active Pharmaceutical Ingredients) and their corresponding formulated pharmaceutical products.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	get practical knowledge of pharmaceutical products analysis.
CLO2	learn about the assay methods of API.
CLO3	learn to assess and quantify ingredients other than API too.
CLO4	Quantify and compare content uniformity of marketed pharmaceutical products.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3	3		2	3			
CLO2		3		3	3		2	3			
CLO3		2		3	3		2	3			
CLO4		2		3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of potency of penicillin.	5	CLO1, CLO2
2.	Assay of marketed pharmaceutical products.	5	CLO2, CLO4
3.	Assay of magnesium and aluminum in antacids.	4	CLO1, CLO2
4.	Determining iodine value and saponification value.	4	CLO3
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1. Kennth A. Connors: A Textbook of Pharmaceutical Analysis.

Supplementary readings 1. D.L Pavia, G. M. Lampman. G.S., Krij: Introduction to Organic Laboratory Techniques-A Contemporary approach.

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Course Title	Viva Voce-II			
Course Code	PHAV-2210		**Year**	Second Year
Credit	1		**Semester**	Second Semester
Evaluations (30 marks)	Final Examination: 30			

Course Description: The students will sit for the oral assessment based on the total contents taught in second year.

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---------- **B.PHARM. (HONS.) 3rd YEAR 1st SEMESTER ----------**

Course Title	Pharmacology-II			
Course Code	PHAT-3102		**Year**	Third Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: The is to learn about introduction and uses of the Analgesic, antipyretic and anti-inflammatory drugs with their mechanism of action, dose, side effects, contraindication etc. Besides, the course will describe about the mechanism of action, dose, side effects, contraindication of antibacterial, antifungal and antitubercular agents. Also give information about local and general anesthetics.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	explain the chemistry, mode of action, pharmacokinetics, indications and contraindications of local and general anesthetics.
CLO2	get idea of classification, chemistry, mode of action, SAR, pharmacokinetics, indications and contraindications of different antibiotics and chemotherapeutic agents.
CLO3	get familiar with pathogenic mechanisms of infectious diseases
CLO4	learn the mechanism of action, side effects and toxicity of analgesic and antipyretics

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	1	2				3		3			
CLO2	1	2				3		3			
CLO3	1	2				3		3			
CLO4	1	2				3		3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Local anesthetics:** History, mechanism of action, SAR, pharmacological action of nitrous oxide, halothane, enflurane, isoflurane and sevoflurane.	6	CLO1
2.	**General anesthetics**: History, classification, mechanism of action, stages of anesthesia, pharmacological action of analgesics, complications.	6	CLO1
	Midterm-I	1	
3.	**Analgesic, antipyretic and anti-inflammatory drugs**: Non-narcotic analgesic - salicylates, pyrazolones, para-aminophenol, propionic acid derivatives. indomethacin sulindac. tolmetin, diclofenac: Narcotic analgesic-opium alkaloids morphine antagonist synthetic & Semi synthetic opiate.	6	CLO4
	Midterm-II	1	
4.	**Antibacterial agents**: Drugs in folate synthesis: Sulfonamide, trimethoprim; **β-lactam antibiotics**: Penicillin, cephalosporin. **Drugs affecting protein synthesis**: Tetracycline, chloramphenicol, macrolides, aminoglycosides. **Drugs for Topoisomerase-I enzyme**: Fluoroquinolones; Glycopeptide, polymyxin, bacitracin & nitrofurantoin antibiotics, Antibiotic resistance.	9	CLO2
5.	**Antifungal drugs:** Amphotericin B. Flucytosine, itraconazole, ketoconazole, fluconazole, nystatin, griseofulvin.	3	CLO3
6.	**Antitubercular drugs**: (a) Chemotherapeutics: INH, para-amino salicylic acid, ethambutol, pyrazinamide. (b) Antibiotics: gentamicin, rifampicin, streptomycin, etc.	3	CLO3
7.	Consultation and Revision	7	
8.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics. 2. Pharmacology by Rang and Dales. 2. Pharmacology by Katzung. 3. Pharmacology by Lippincott.

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Course Title	Pharmaceutical Technology-II			
Course Code	PHAT-3103		**Year**	Third Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: The aim of this course is to develop knowledge on formulation, manufacturing procedure and related aspects of various solid dosage forms.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn formulation, manufacturing of tablet, capsule and suppository
CLO2	Know about formulation and manufacturing problems and solutions
CLO3	Learn about coating techniques
CLO4	Know about formulation and quality control of hormonal drugs

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3		1	2			1
CLO2					3		1	2			1
CLO3					3		1	2			
CLO4			1	3	3		1	2			2

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Formulation and manufacturing of tablets**: Manufacturing of tablets by wet granulation, dry granulation and by direct compression. Granulation of powders for tableting, advantages and disadvantages of different process, processing machineries used in tablet manufacturing.	6	CLO1
2.	**Common tableting problems and evaluation of tablets**: Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, in process quality control methods in tablet manufacturing, study of common tableting problems.	3	CLO1, CLO2
3.	**Mid-term I**	1	
4.	**Tablet coating**: Coating, advantages and disadvantages of coated tablets, different methods of coating: different stages of sugar coating, problems of sugar coating; film coating, film formers, plasticizer, solvents, other excipients; aqueous film coating techniques, modern film coating materials and coating formulations, problems of organic and aqueous film coating.	3	CLO1, CLO3
5.	**Hard gelatin capsules**: Definition and classification, advantages and limitations of hard gelatin capsule, manufacturing process for capsule shells;	4	CLO1

	formulation, filling machines, manufacturing problems, quality control methods and packaging.		
6.	**Soft gelatin capsules**: Definitions and classifications, advantages and limitations, properties, formulation and manufacturing of soft capsules; problems in soft capsule manufacturing, quality control methods and packaging of soft capsules.	4	CLO1
7.	**Microencapsulation technology**: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.	4	CLO3
8.	**Mid-term II**	1	
9.	**Suppositories**: Drug absorption from colon, classification of suppositories, merits and demerits of suppository, suppository bases, formulation, manufacturing and testing of suppositories.	4	CLO1
10.	**Hormonal Products**: Classifications, merits and demerits of hormonal products, formulation, manufacturing, quality control of hormonal products.	3	CLO4
11.	Course review, assessment and contact hour	12	
12.	**Final Examination**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. L. Lachman: The Theory and Practice of Industrial Pharmacy, 2. M. E. Aulton: Pharmaceutics, the Science of Dosage Form Design

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Course Title	Biopharmaceutics and Pharmacokinetics-I			
Course Code	PHAT-3104		**Year**	Third Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course will focus on building knowledge on absorption, distribution, and excretion of a pharmaceutical product with bioavailability pattern.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	have basic knowledge on biopharmaceutics and pharmacokinetics.
CLO2	gain an idea of the bioavailability and bioequivalence.
CLO3	understand drug protein binding and pharmacokinetic profile.
CLO4	calculate pharmacokinetic parameters (ADME).
CLO5	design drug product by considering biopharmaceutical factors.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1			3				1	3			
CLO2			3				1	3			
CLO3	1		3				1	3			
CLO4			3				1	3			
CLO5			3				1	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction to biopharmaceutics**: Definition and fundamental principles, role in formulation development and clinical setting.	2	CLO1
2.	**Gastrointestinal absorption of drugs:** Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.; pK_a and gastrointestinal absorption, pH-partition theory and other physicochemical factors. Dosage form aspects: Role of different dosage form.	6	CLO1, CLO4
3.	**Midterm-1**	1	
4.	**Distribution of drugs**: Pharmacokinetic parameters, Interpretation of Drug-plasma level curve, kinetics of protein binding.	5	CLO3, CLO4
5.	**Drug clearance:** Theoretic aspects of drug elimination, excretion and biotransformation, Renal and Hepatic elimination, drug biotransformation, pharmacokinetics of drugs and metabolites (Michelis Menten Equation), First pass effect, Relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, Hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance); Biliary excretion of drugs.	3	CLO1, CLO4
6.	**Midterm-2**	1	
7.	**Bioavailability and bioequivalence:** Definitions, bioavailability; purpose of bioavailability, relative and absolute bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies.	6	CLO1, CLO2
8.	**Biopharmaceutic considerations in drug product design:** Rate-limiting steps in drug absorption, pharmaceutic factors in bioavailability, physicochemical nature of drug, formulation factors affecting drug dissolution, in vitro dissolution testing, compendial methods of dissolution, methods for testing enteric-coated products, meeting dissolution requirements, problem of variable control in dissolution test, in vitro-in vivo correlation of dissolution.	3	CLO1, CLO2, CLO5
9.	**Presentation/ Assignment**	3	
10.	Counseling	12	
11.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Leon Shargel & Andrew B.C. Yu: Applied Biopharmaceutics and Pharmacokinetics 2. Milo Gibaldi: Biopharmaceutics and Clinical Pharmacokinetics

Supplementary readings Donald E. Cadwallader: Biopharmaceutics & Drug Interactions.

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Course Title	Medicinal Chemistry-I			
Course Code	PHAT-3105		**Year**	Third Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course deals with stereochemistry of drug, synthesis of drugs from nature and in the laboratory, how a small organic molecule interacts with cellular components of the human and, how chemical nature of the small molecules influence or exhibit biological activities, structure activity relationship (SAR), toxicity study of parent molecules.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	learn about stereochemistry and its importance in drug action.
CLO2	To know the chemistry, SAR, synthesis of heterocyclic compounds.
CLO3	understand Chemistry, SAR, and synthesis of some drugs (e.g., Hypnotics and sedatives, Antihistamines, Analgesics and anti-inflammatory agents, Cardiovascular agents, Diuretics); Natural products and secondary metabolites as drugs
CLO4	To learn about the toxicity studies of drugs

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	1	3				3	2	3			
CLO2	1	3				3	2	3			
CLO3	1	3				3	2	3			
CLO4	1	3				3	2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Stereochemistry**: Different types of isomerism; Geometric isomerism of alkenes and cyclic compounds, Cis, trans and (E)-(Z) systems of nomenclature; Conformational isomers: conformation of open chain and cyclic compounds; Chirality of molecules: enantiomer, diastereomer, racemic modification, meso compound, R-and S-configuration, sequence rule, optical rotation; Asymmetric synthesis: preparation of enantiomer by asymmetric synthesis and optical resolution method; stereoselective and stereospecific reaction; Pharmaceutical importance of studying stereochemistry.	9	CLO1
2.	**Heterocyclic chemistry**: 5-membered heterocyclic compounds: Pyrrole, Furan, Thiophen, Pyrazole, Imidazole, Oxazole, Isoxazole, Thiazole, and Isothiazole: preparations, reactions and pharmaceutical importance; 6-membered heterocyclic compounds: Pyridine, Piperidine, Pyrimidine, Pyridazine, pyrazine and Triazine: preparation, reaction and pharmaceutical importance; Benzofused 5-membered heteroaromatic compounds: Indole, Benzofuran, Pentathiophene and Carbazole: chemistry, synthesis and pharmaceutical importance; Benzo fused 6-membered heteroatomic: Quinoline Isoquinoline: chemistry, synthesis and pharmaceutical importance.	9	CLO1, CLO2, CLO3
3.	**Midterm-I Exam**	1	
4.	**Chemistry, SAR, mode of action and synthesis of following groups of drugs**: Hypnotics and sedatives, Antihistamines, Analgesics and anti-inflammatory agents, Cardiovascular agents, Diuretics	10	CLO1, CLO2, CLO3
5.	**Natural products and secondary metabolites as drugs**: Vitamins: The clinical aspects of the vitamins and their effects on free radicals, synthesis of the vitamins such as vit-B_1, vit-C, nicotinamide, pyridoxine, mechanism of action of vitamins; Alkaloids: Alkaloids as pharmaceutical raw materials, opium and analogues of opium, synthesis of papaverine and ephedrine, clinical comparison of ephedrine and epinephrine; Glycosides: Chemical and clinical aspects of digoxin and other digitalis glycosides.	8	CLO1, CLO2, CLO3
6.	**Midterm-II Exam**	1	
7.	Toxicity studies of drugs.	4	CLO4
8.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Learning References: 1. Eliel: Stereochemistry of Carbon Compounds, 2. David A. Williams and Thomas L. Lemke: Foye's Principles of Medicinal Chemistry, 3. Alfred Burger: Medicinal Chemistry Vol. I & II

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Course Title	Pharmaceutical Analysis-II			
Course Code	PHAT-3111		**Year**	Third Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course deals with the sophisticated techniques regarding analysis, separation, purification and identification of chemical compounds.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	learn about the separation of molecules from mixture of compounds.
CLO2	know techniques of compound identification, purification, and structure determination.
CLO3	achieve knowledge of sample quantification.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3			2	3			
CLO2				3			2	3			
CLO3				3			2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Visible and ultraviolet spectrophotometry**: Electromagnetic radiation, units, electromagnetic spectra and absorption of radiation, Lamberts and Beer's law and deviations, instrumentation, chromophores and auxochromes, absorption and intensity shifts, applications of Ultraviolet and visible spectroscopy in analysis of drugs.	7	CLO1, CLO2, CLO3
2.	**Infrared spectrophotometry:** Introduction, principle, instrumentation, application in pharmaceutical analysis, FTIR.	5	CLO2, CLO3
3.	**Mid Term Examination-I**	1	
4.	**Fluorometry**: Principle, fluorescence and structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and spectrophotometry, applications of fluorometry in pharmaceuticals.	4	CLO1, CLO2, CLO3
5.	**Thin layer chromatography:** Introduction, principles and theories, preparation, method of detection, applications.	4	CLO1, CLO3
6.	**Ion exchange chromatograph:** Introduction, principles and theories, preparation, method of detection, applications.	4	CLO1, CLO2
7.	**Column chromatography:** Introduction, principles and theories, preparation, method of detection, applications.	4	CLO2, CLO3
8.	**High performance liquid chromatography:** Principles, instrumentation, characteristics of stationary and mobile phases, reversed phase high performance liquid chromatography applications.	4	CLO1, CLO2, CLO3
9.	**Gas Chromatography:** Principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.	4	CLO1, CLO3
10.	**Mid Term Examination-II**	1	
11.	Course review and contact hours	4	
12.	**Final Examination**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/ Assignment/ Midterm Exam Final Exam

Learning References: 1. D. L. Pavia, G. M. Lampman and G.S. Kriz : Introduction to Spectroscopy. 2. Kennth A. Connors: A Textbook of Pharmaceutical Analysis.

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Course Title	Pharmacology Lab-II			
Course Code	PHAL-3107		**Year**	Third Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will enable students to determine blood glucose, uric acid and paracetamol concentration after oral administration. They will also be able to know about different routes of administration as well as generate standard curve.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Perform enzymatic and chemical method for estimating blood glucose and uric acid
CLO2	Estimate paracetamol concentration by UV-Vis spectrophotometer
CLO3	Generate standard curve for analysis
CLO4	handle of experimental animal and provide an idea of different routes of administration.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2			3		3		3			
CLO2	2			3		3		3			
CLO3	2			3		3		3			
CLO4	2			3		3		3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Generation of standard curve.	4	CLO1
2.	Estimation of blood uric acid level.	4	CLO1
3.	Estimation of orally given common drugs.	4	CLO2
4.	Estimation of blood glucose level.	3	CLO3
5.	Exercising drug administration by different routes (viz. P.O., IV, IM, SC, ID, IP and IO) in animal (mice/rat) model.	3	CLO4
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics. 2. Pharmacology by Rang and Dales. 3. Pharmacology by Katzung. 4. Pharmacology by Lippincott.

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Course Title	Pharmaceutical Technology Lab-II			
Course Code	PHAL-3108		**Year**	Third Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will focus hands-on experiences in pharmaceutics laboratory and will enable students to formulate and prepare dispersing systems such as suspensions and acquire a practical experience of formulation and manufacturing of tablets.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Learn the formulation and preparation of suspensions.
CLO2	Experience the formulation and preparation of tablets.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3	3		3	3			
CLO2				3	3		3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	Formulation and filling capsules.	4	CLO1
2.	Preparation of suppository.	4	CLO1
3.	Formulation, manufacturing and quality control test of dispersible tablet.	5	CLO2
4.	Formulation and manufacturing of tablets.	5	CLO2
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Fishburn: An Introductory to Pharmaceutical Formulations.

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Course Title	Biopharmaceutics and Pharmacokinetics Lab-I			
Course Code	PHAL-3109		**Year**	Third Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in laboratory, including handling of dosage forms such as tablets, capsules, etc.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	find out variations of weight for tablets and capsules.
CLO2	test friability, hardness, and disintegration of tablet.
CLO3	do packaging leak test for tablets and capsules.
CLO4	look on partition coefficient and its change.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1			3		3		2	3			
CLO2			3		3		2	3			
CLO3			3		3		2	3			
CLO4			3		3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of plasma concentration vs time curve after oral administration	4	CLO1
2.	Tablet hardness test and friability test.	3	CLO1
3.	Tablet disintegration test.	5	CLO2
4.	Determination of drug release pattern from solid or semisolid dosage forms	3	CLO3
5.	Observation of Partition coefficient and changes due to changes in pH	3	CLO4
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Biopharmaceutics & Clinical Pharmacokinetics - Milo Gibaldi, Le & Febiger.

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Course Title	Medicinal Chemistry Lab-I			
Course Code	PHAL-3110		**Year**	Third Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will focus hands-on experiences in Chemical laboratory, including handling of chemicals, reagents and solvents. This course will also give experiences in synthesis of drug and drug intermediates.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	gain knowledge on synthesis of various drugs
CLO2	synthesize of drug intermediates

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		2			1	3			
CLO2		3		2			1	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Recrystallization of given sample acetanilide/sample	3	CLO1, CLO2
2.	Synthesis of Methyl salicylate (wintergreen oil)	3	CLO1, CLO2
3.	Synthesis of Aspirin	4	CLO1, CLO2
4.	Synthesis of benzocaine	4	CLO1, CLO2
5.	Synthesis of acetanilide	4	CLO1, CLO2
3.	Midterm Examinations	6	
4.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References:

1. Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry.
2. Burger's Medicinal Chemistry and Drug Discovery

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Course Title	Pharmaceutical Analysis Lab-II			
Course Code	PHAL-3112		Year	Third Year
Credit	1		Semester	Second
Credit Hours	30		Final Examination	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will give practical demonstration of different kinds of assay methods of API (Active Pharmaceutical Ingredients) and Vitamins along with their corresponding pharmaceutical formulations.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	get practical knowledge of pharmaceutical products analysis.
CLO2	learn about the assay methods of API.
CLO3	learn to use determination process for chemical compounds.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3			3	3			
CLO2				3			3	3			
CLO3				3			3	3			
CLO4				3			3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Assay of acetyl salicylic acid in aspirin tablets	5	CLO1, CLO2
2.	Non-aqueous assay of phenobarbitone tablets	5	CLO1, CLO2,
3.	Assay of promethazine hydrochloride	4	CLO1, CLO2
4.	Determination of vitamin B1 and B2	4	CLO3
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1.A.H. Backett and J.B. Stenlake: Practical pharmaceutical chemistry, 2. Kennth A. Connors: A Textbook of Pharmaceutical Analysis.

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---------- B.PHARM. (HONS.) THIRD YEAR SECOND SEMESTER ----------

Course Title	Medicinal Chemistry-II			
Course Code	PHAT-3202		**Year**	Third Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will focus on the source of drug molecule, drug discovery processes of several classes of drugs, basic concept & methods of drug designing and metabolism process of drug.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	know about drug metabolism and concept of pro-drugs.
CLO2	know about various stages involved in drug discovery and tools of drug designing
CLO3	understand chemistry, SAR and synthesis of Antibiotics, Anticancer drugs, Antihypertensives, H_2-blockers, Psychotropic drugs and antidepressants, Antidiabetics, Oral contraceptives, steroidal hormones etc., drug synthesis using combinatorial chemistry.
CLO4	To learn about some case study of specific drug design

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3				2		3			
CLO2		3				3		3			
CLO3	3	3				2		3			
CLO4		3				2		3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Drugs metabolism**: Pathways of drugs metabolism, metabolism of various groups of drugs, factors affecting drugs metabolism, methods of studying drug metabolism, new aspect of drug metabolism, metabolic products of common drugs, concept of prodrug.	9	CLO1
2.	**Drug discovery and design**: Source and development of drugs, genesis of drugs; i) Serendipity ii) Random Screening iii) Extraction iv) Molecular modification (general process, special process-ring closure or opening, formation of lower or higher homologues, removal or replacement of bulky groups, isosteric substitution, introduction of alkylating moieties. Methods of lead optimization (Topliss sequential method), sequential complex optimization (v) Selection or synthesis of soft drugs, soft analogues, activated soft compounds, natural soft drugs, soft drugs based on the active metabolite approach, soft drug based on inactive metabolite approach (vi) Prodrugs (vii) Rational drugs design, enzyme inhibitors.	10	CLO1, CLO2, CLO3
3.	**Midterm-I Exam**	1	
4.	**Chemistry, SAR, mode of action and synthesis**: Semisynthetic penicillin's, Cephalosporins, Quinolone derivatives, Antihypertensive, H_2-blockers, Psychotropic drugs and antidepressants, Antidiabetic drugs, Oral contraceptives and steroidal hormones, Anticancer drugs.	9	CLO1, CLO2, CLO3
5.	**Combinatorial chemistry**: Combinatorial synthesis and drug discovery, Library synthesis - solid phase chemistry, resin beads, peptide synthesis, mix and split library synthesis; Solution phase, indexed combinatorial libraries, template-based libraries, liquid phase combinatorial synthesis; Encoded combinatorial synthesis-encoded requirements. Examples of tagged libraries; Types and chemistry of linkers; Combinatorial chemistry: applications and impact on drug discovery.	8	CLO1, CLO2, CLO3

6.	**Midterm-II Exam**	1	
7.	**Case history of specific drug design**: (a) Antihypertensive (β blocker) (b) H_2 –blocker (c) Semisynthetic Penicillin (d) Cephalosporins (e) Quinolone derivatives (f) Antidiabetic drugs	4	CLO2, CLO3, CLO4
8.	**Final Exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Wilson and Gisvolds: Textbook of Organic, Medicinal and Pharmaceutical Chemistry, 2. Graham L. Patrick: An Introduction to Medicinal Chemistry, 3. Alfred Burger: Medicinal Chemistry, 4. Essentials of Medicinal Chemistry. Andrejus Korolkovas.

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Course Title	Pharmaceutical Engineering-I			
Course Code	PHAT-3203		**Year**	Third Year
Credit	2		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description: The aim of this course is to develop knowledge on different pharmaceutical unit operation and processes.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Gather knowledge about unit operations and process, scientific foundations in unit operation
CLO2	Learn conveying, size reduction, size separation, filtration, centrifugal operation techniques
CLO3	Know on solid-solid, paste and liquid mixing techniques

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3		2	3			
CLO2					3		2	3			
CLO3					3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Industrial Processing and Basic Principles:** Unit Operations & unit processes, scientific foundations, operations, dimensions, units, systems and inter-conversions, dimensions-formulae, equations and analysis, stoichiometry equations-balancing.	3	CLO1
2.	**Flow of fluids and transportation of fluids**: Importance of the flow of fluid, fluid statics, fluid dynamics, Bernoulli's theorem, measurement of rate of flow of fluids, types of valves and pumps.	3	CLO1
3.	**Mid-term I**	1	
4.	**Conveying**: Efficient & effective conveying, objectives & advantage, different types of conveyors.	3	CLO2
5.	**Size reduction, size separation and filtration**: Definitions, principles of size reduction, objectives of size reduction, factors affecting size reduction;	5	CLO2

	principles, laws and factors affecting energy requirements, different methods of size reduction, study of hammer mill, fluid energy mill and disintegrator; various methods and equipments employed for size separation e.g., sieving, sedimentation, centrifugal elutriation, microscopic methods, definition and importance of filtration, difference with expression, sedimentation and drying, theory of filtration, classification of filters.		
6.	**Centrifugation and mixing:** Principles of centrifugation, sedimentation and filtering centrifugals, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, costs, selection of centrifugal separators, types of mixing, machines for solid-solid mixing, paste mixing and liquid mixing, different types of mixers, tanks, impellers and turbines.	5	CLO2, CLO3
7.	**Mid-term II**	1	
8.	Course review, assessment and contact hour	6	
9.	**Final Examination**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1.S. J. Carter: Cooper and Gunn's Tutorial Pharmacy
2. L. Lachman, et al.: The Theory and Practice of Industrial Pharmacy
3. M. E. Aulton: Pharmaceutics, the Science of Dosage Form Design

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Course Title	Cosmetology			
Course Code	PHAT-3204		**Year**	Third Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course focuses on building knowledge of dermatological and cosmeceutical science, with regards to raw materials, formulation, manufacturing and related quality control issues.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	develop basic knowledge on dermatological and cosmeceutical science.
CLO2	obtain knowledge about raw materials used for different cosmeceutical preparations
CLO3	Learn formulation and manufacturing issues of different cosmeceutical preparations
CLO4	understand about quality control tests of different cosmeceutical preparations

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3		2	3			
CLO2		2			3		2	3			
CLO3					3		2	3			
CLO4				3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Skin disorders:** Epidermis, dermis, sense organs, exocrine sweat gland, hair follicles, sebaceous glands, apocrine glands, skin disorders.	4	CLO1
2.	**Raw materials for cosmetic preparations**: Surfactants, humectants, antiseptics, preservatives, antioxidants, herbal materials, perfumes, colors.	3	CLO2
3.	**Midterm-1 examination**	1	
4.	**Manufacturing and formulation of cosmetics**: Mixing and manufacturing bulk cosmetics, solid-solid mixing, manufacture of pigmented power products, mixing of fluids, general principles of fluid mixing, mixing equipment's for fluids, solid-liquid mixing, suspension of solids in agitated tanks, liquid-liquid mixing, immiscible liquid.	5	CLO1, CLO2, CLO4
5.	**Skin Preparations**: Classification, cold cream, cleansing cream, night and massage cream, moisturizing, vanishing and foundation cream, foundation creams, hand creams and hand-and-body creams, all-purpose creams.	4	CLO3
6.	**Shaving preparations**: Introduction, Lather shaving cream, brush less or non-lathering cream, aerosol shaving foams, after-shave preparations.	3	CLO2, CLO3
7.	**Midterm-2 examination**	1	
8.	**Dental preparations**: Introduction, formulation and manufacturing of toothpastes and tooth powers, mouth wash.	3	CLO2, CLO3
7.	**Hair preparations**: Introduction shampoos, hair setting lotions, hair tonics and conditioners.	3	CLO2, CLO3
8.	**Insect Repellents** : Introduction, repellent materials, formulation and manufacturing issues	3	CLO2, CLO3
9.	Assignment	2	
10.	Counselling	10	
11.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. J.B. Wilkinson & R.J. Moore: Harry's Cosmetology.

1. Williams, Schmitt: Chemistry and Technology of the Cosmetics and Toiletries Industry.

Course Title	Pharmaceutical Biotechnology-I			
Course Code	PHAT-3205		**Year**	Third Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course offers basic knowledge of practices, principles & applications of Biotechnology in the field of recombinant DNA, fermentation technology, immunology, enzyme technology and gene therapy.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Explain the foundation of necessity of biotechnology in pharmaceutical sciences
CLO2	Understand tools of genetic engineering and recombinant DNA technology
CLO3	Have basic knowledge on immunology and immunological products
CLO4	Recognize different types of gene therapy methods and their clinical implications
CLO5	get idea about significance of application of biotechnology in pharmaceutical productions

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3				3	2	1	2			
CLO2	3				3	2	1	2			
CLO3	3				3	3	1	2			
CLO4	3				3	3	1	2			
CLO5	3				3	2	1	2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Introduction to biotechnology:** Introduction, cell, gene expression, specific DNA techniques and the application of biotechnology in medicine, foods, forensic science, microbial and plant genetics; different dimension of biotechnology and pharmaceutical biotechnology.	4	CLO1
2.	**Recombinant DNA technology:** Basic principle of genetic recombination, cloning, gene expression, restriction endonuclease, ligase and other enzymes used in gene cloning. Cloning vectors, transfection method, knock out and transgenic animals, PCR. Upstream and downstream processing, production and purification techniques of recombinant proteins.	9	CLO1, CLO2
3.	**Immunology and antibody technology:** Immune system, immunity, type of immunity, immunization and immunization method, antigens and haptens, immunological tolerance, antigen-antibody reactions and their applications. Manufacturing and standardization of vaccines of bacterial, viral and rickettsial origin. Production of vaccine (BCG vaccine and other); Production of sera and immunoglobulin from viral origin, polio, rabbis, yellow fever and hepatitis; production and purification method of tetanus, diphtheria toxoids; maintenance of seed strains.	9	CLO1, CLO3
4.	**Fermentation technology:** definition, principle of fermentation, types of fermentation, surface culture, solid state fermentations, microbial transformation, preparation of alcohol penicillin, streptomycin and riboflavin. microbial transformation, preparation of alcohol penicillin, streptomycin and riboflavin.	4	CLO1, CLO5
5.	**Enzyme technology:** Introduction to enzyme, commercial uses of enzyme, immobilization of enzymes, application of immobilized enzymes in manufacturing and preparation of streptokinase, urokinase, hyaluronidase.	4	CLO1, CLO5
6.	**Gene therapy:** Ex vivo versus in vivo gene therapy, potential target diseases for gene therapy, gene transfer methods, non-viral gene transfer, Antisense therapy	4	CLO1, CLO4
7.	Content revision and consultation	6	
8.	**Mid term-1**	1	
9.	**Mid term-2**	1	
10.	**Final exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Biopharmaceuticals: Biochemistry and Biotechnology, Gary Walsh, 2. Pharmaceutical Biotechnology, K. Sambamurthy and A. Kar

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Course Title	Pharmacology-III			
Course Code	PHAT-3211		**Year**	Third Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

The course introduces cardiovascular drugs with mechanism of action, dose, side effects, contraindication etc. Besides, the course will describe about diabetes, different types of diabetes and antidiabetic drugs, drugs affecting the kidney function and study on ophthalmology.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	understand the basics of drugs for cardiovascular disorders, blood related disorders
CLO2	learn the pharmacology ocular drugs
CLO3	know about causes of diabetes and effect of antidiabetic drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	1				3	2	3			1
CLO2	3	1				3	2	3			1
CLO3	3	1				3	2	3			1

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Antihypertensives** – Hypertension, classification of antihypertensives, centrally acting drugs, adrenergic neuron blocking agents, Adrenoreceptor antagonists - alpha and beta blockers, vasodilators, calcium channel blockers, angiotensin converting enzyme inhibitor, angiotensin receptor blocker etc.	4	
2.	**Diuretics** - introduction, renal tubule transport mechanism, classification, carbonic anhydrase inhibitors, loop diuretics, thiazide diuretics, potassium sparing diuretics, osmotic diuretics, ADH antagonists, diuretics combinations.	4	
3.	**Heart failure drugs** - control of normal contractility, pathophysiology of heart failure, Digitalis, positive ionotropic agents, drugs without positive ionotropic agents, management of acute and chronic heart failure.	4	
4.	**Anti-arrhythmics** - Electrophysiology of cardiac rhythm, arrythmias, drugs classification, sodium channel blockers, beta adrenergic receptor blockers, drugs prolonging effective refractive periods, calcium channel blockers, etc.	4	
5.	**Anti-ang**inal - pathophysiology, nitrates and nitrites, other vasodilators	2	CLO1
6.	**Midterm-I**	1	
7.	**Antidiabetics**: Introduction, classification, causes, complications, treatment of diabetes. Hypoglycemia, stroke and diabetes, Types of antihyperglycemic agents with structures, mechanisms, uses, toxicity. Insulin resistance, manageme4nt of diabetes. Glucagon structure, mechanism and uses.	6	CLO3
8.	**Midterm-II**	1	
9.	**Anticoagulants**: Heparin, calcium complexing agents, oral anticoagulants.	3	CLO1
10.	**Ophthalmology**-**Anatomical consideration**, corneal grafting, cataract formation, contact lens, drugs used in the treatment of eye disorders	6	CLO2
11.	Consultation & revision	7	
12.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Presentation Midterm Exam Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics. 2. Pharmacology by Rang and Dales. 2. Pharmacology by Katzung. 3. Pharmacology by Lippincott.

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Course Title	Pharmaceutical Marketing			
Course Code	PHAT-3212		**Year**	Fourth Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will provide an overview of pharmaceutical marketing, including principles of marketing, marketing planning, consumer buying behavior, target marketing, market segmentation and marketing positioning strategies. This course also focuses on product promotional techniques, advertising and strategies, product management, brand building, brand management, pricing methods and strategies.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Analyze and explain specific issues within pharmaceutical marketing
CLO2	Capable to understand customer's buying behavior, identify target markets and utilize drug promotional methods including marketing mix.
CLO3	Execute product promotional and pricing strategies

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1									3	2	2
CLO2									3	2	2
CLO3									3	2	2

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Principles of marketing**: Concepts of marketing and market, steps in the marketing process. differences between pharmaceutical marketing and FMCG, marketing mix and its impact, social responsibility of business	3	CLO1
2.	Market segmentation, target marketing and marketing positioning strategies: Identifying market segments, factors for segmenting.	3	CLO2
3.	Market segmentation, target marketing and marketing positioning strategies: Choosing a target marketing strategy, market positioning for maximum competitive advantages.	3	CLO2
4.	Strategic marketing planning: Strategic planning process, resources and opportunities affecting the planning process, effective marketing plan and implementation process.	3	CLO2
5.	Product management: Concept of a product, classification of products, product line and product mix.	3	CLO2

6.	Product management: Products planning and development, PLC, marketing strategies along the product life cycle, brand building and brand management.	3	CLO2
7.	Product promotion: Elements in the communication process, promotions mix (advertising, personal selling, sales promotion, public relation, direct marketing)	3	CLO2
8.	Product promotion: Roles of promotions mix in Integrated Marketing Communication (IMC), the promotions message and executions style, media choice, promotional objectives.	3	CLO3
9.	Product pricing: Basic factors influencing pricing decision, break-event analysis, pricing methods and strategies,	3	CLO3
10.	Pricing: Price elasticity of demand, elements of pricing process.	3	CLO3
11.	Marketing in global marketplace: Global marketing environment, challenges and considerations for entering global market.	3	CLO1, CLO3
12.	Revision and consultation	7	
13.	Mid term-1	1	
14.	Mid term-2	1	
15.	Final exam	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. Principles of Marketing by Philip Kotler and Gary Armstrong, 2. Marketing Strategy: A Global Perspective by Vernon R. Stauble, 3. Principles of Marketing by Stanton.

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Course Title	Medicinal Chemistry Lab-II			
Course Code	PHAL-3207		**Year**	Third Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in Chemical laboratory, including handling of chemicals, reagents, solvents and instruments. This course will also give experiences in synthesis and characterization of different compounds of medicinal importance

Course Learning Outcomes (CLOs):

CLO	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	gain knowledge on synthesis and characterization of different medicinal agents

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3			1	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	Synthesis and characterization of Paracetamol	4	CLO1
2.	Synthesis of acetanilide in laboratory	4	CLO1

3.	Synthesis by microwave oven	4	CLO1
4.	Synthesis of sulfanilamide	3	CLO1
5.	Synthesis of benzimidazole	3	CLO1
6.	**Midterm Examinations**	6	
7.	**Final examination**	6	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1. Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 2. Burger's Medicinal Chemistry & Drug Discovery-Donald J. Abraham, John Wiley & Sons. 3. Foye's Principles of Medicinal Chemistry- David A. Williams and Thomas

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Course Title	Cosmetology Lab			
Course Code	PHAL-3208		**Year**	Third Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description:

This course will focus on building basic knowledge of dermatological and cosmeceutical science, preparation and quality control issues of several cosmeceutical preparations

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	develop fundamental knowledge on cosmetology.
CLO2	Preparation of different cosmeceutical preparations
CLO3	Quality control tests of different cosmeceutical preparations

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3	3		2	3			
CLO2				3	3		2	3			
CLO3				3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	Preparation and quality control tests for skin preparations (cold cream, vanishing cream, moisturizing cream etc.)	4	CLO1, CLO2, CLO3
2.	Preparation and quality control tests for hair preparations (shampoo, conditioner and hair cream etc.)	5	CLO1, CLO2, CLO3
3.	Preparation and quality control of shaving preparations (shaving cream, after shave lotion etc.)	4	CLO1, CLO2, CLO3
4.	Preparation and quality control tests for Oro-dental preparations (tooth paste, tooth powders, mouthwash)	5	CLO1, CLO2, CLO3
	Midterm examination	6	
5.	**Final exam**	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: 1. J.B. Wilkinson & R.J. Moore: Harry's Cosmetology. 2. Williams, Schmitt: Chemistry and Technology of the Cosmetics and Toiletries Industry.

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Course Code	Viva Voce-III			
Course Title	PHAV-3209		**Year**	Third Year
Credit	1		**Semester**	Second Semester
Evaluations (30 marks)	Final Examination: 30			

Course Description: Students will sit for oral assessment based on total taught contents in third year.

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---------- B.PHARM. (HONS.) FOURTH YEAR FIRST SEMESTER ----------

Course Title	Pharmaceutical Technology-III		
Course Code	PHAT-4101	**Year**	Fourth Year
Credit	3	**Semester**	First Semester
Credit Hours	45	**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)		

Course Description: This course will provide knowledge on productions and quality control of modified release dosage forms, aerosols, parenterals, ophthalmics, blood products and learn on clean room and packaging technology.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn about production of modified release dosage forms, parenteral, ophthalmic products, aerosols and blood products.
CLO2	Learn about quality control of modified release dosage forms, parenteral, ophthalmic products, aerosols and blood products.
CLO3	Gain knowledge on design and operation of clean rooms.
CLO4	Learn in details on pharmaceutical packaging.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3		2	3			
CLO2	1			3	3		2	3			
CLO3					3		2	3			
CLO4					3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Modified release drug delivery systems:** Sustained release, delayed release and modified release formulations, formulation, manufacturing of sustained matrix and extended release tablets.	5	CLO1, CLO2
2.	**Aerosol science and technology:** Introduction to aerosols, propellants for aerosol, aerosol formulations, containers and valves for aerosols, metered dose delivery of aerosols, manufacturing and quality control of aerosols	3	CLO1, CLO2
3.	**Mid-term I**	1	
4.	**Parenteral products:** Classification, formulation considerations, vehicles and additives, containers, manufacturing, raw materials, quality controls.	4	CLO1, CLO2
5.	**Ophthalmic products:** Absorption of drugs in the eye, classification of ophthalmics, safety considerations, formulation, vehicles and additives, manufacturing, manufacturing techniques, quality control and packaging.	4	CLO1, CLO2
6.	**Blood product and plasma substitutes:** Collection, processing & storage of whole human blood, concentrated human RBC, dried human plasma, human plasma protein fraction, dried human serum fibrinogen, human normal immunoglobulin, fibrin foam, dextran, PVP.	3	CLO1, CLO2
8.	**Mid-term II**	1	
9.	**Design and operation of clean rooms:** Source of contamination, classification of clean rooms, airflow systems- conventional flow, unidirectional flow, laminar airflow units; air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction, use, personnel, protective clothing, cleaning, disinfection, tests of clean and aseptic room, operation of clean and aseptic rooms, Key factors.	4	CLO3

10.	**Packaging technology:** Purpose, properties of packaging materials, factors influencing choice of package, glass and glass containers, metal and metal containers, plastic and plastic containers, films, foils and laminates, rubber-based materials, closures, temper resistant packaging, testing and quality assurance of packaging materials, packaging machines and accessories, packaging line, labeling.	5	CLO4
11.	Course review, assessment and contact hour	12	
12.	**Final Examination**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. L. Lachman: The Theory and Practice of Industrial Pharmacy
2. M.E. Aulton: Pharmaceutics, the Science of Dosage Form Design

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Course Title	Pharmaceutical Engineering-II			
Course Code	PHAT-4102		**Year**	Fourth Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description: The aim of this course is to provide the techniques of drying, crystallization, evaporation, temperature and humidity controlling in pharmaceutical industry, industrial hazard and pollution management systems.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Gather knowledge about drying, crystallization and evaporation techniques
CLO2	Learn about importance of humidity control in the industry and HVAC system
CLO3	Learn and become aware of the industrial hazard management systems

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3			3			
CLO2					3			3			
CLO3					3			3	2		

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Drying:** Importance of drying, theory and fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content, direct, indirect, radiation, batch and continuous, dielectric, types of beds static, moving, fluidized, pneumatic bed systems; Different equipments, construction, operation, merits, demerits of drying; Freeze drying: definition, application, basic principles, and basic elements.	6	CLO1
2.	**Crystallization:** Crystals, factors affecting, super saturation theory and its limitations, nucleation mechanisms, crystal growth, study of various types of crystallizer, tanks, agitated batch, Swenson Walker, single vacuum, circulating magma and crystal crystallizer, caking of crystals and its prevention.	6	CLO1

3.	**Mid-term I**	1	
4.	**Evaporation:** Applications, factors influencing evaporation, classification of evaporators, steam jacketed kettle, forced circulation evaporator, climbing film evaporator, falling film evaporator, multiple effect evaporator.	6	CLO1
5.	**Humidity control:** Humidity- Determination methods of increasing and decreasing humidity, importance of humidity control in pharmaceutical industries. Fundamentals of HVAC systems in Pharmaceutical industry.	6	CLO2 , CLO3
6.	**Industrial hazards and safety:** Environmental requirements and pollution control for pharmaceutical industry, fire management for pharmaceutical industry, waste water other material management.	5	CLO3
7.	**Mid-term II**	2	
8.	Course review, assessment and contact hour	10	
9.	Final Examination	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Carter: Cooper and Gunn's Tutorial Pharmacy, 2. Pharmaceutical Engineering - C.V.S. Subrahmanym, Setty, 3. Introduction to Chemical Engineering - Walter L. Badger and J.T. Banchero,

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Course Title	Pharmaceutical Biotechnology-II			
Course Code	PHAT-4103		**Year**	Fourth Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description: This course is carefully designed to offer concepts on formulation, dispensing and analysis of biotech products as well as understand the challenges and their overcoming strategies for successfully formulating biotech products.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Have a knowledge about formulation of target specific delivery of biopharmaceuticals
CLO2	Have knowledge on advancement of the field of biotechnology and biotechnological products
CLO3	Develop concept for analyzing biotech products

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2			3	3		2	3			
CLO2	2			3	3		2	3			
CLO3	2			3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Formulation and delivery of biotech products:** Microbiological considerations, excipients used in parenteral biotech products, routes of administration and absorption enhancement. Delivery of proteinous drugs, approaches for rate controlled and target site specific delivery.	6	CLO1

2.	**Current biotech products:** Interleukins and interferons, insulin, Vaccines, Monoclonal antibody-based pharmaceuticals, follicle stimulating hormone (FSH) etc.	6	CLO2
3.	**Dispensing biotech products:** Storage temperature requirements, storage in dosing and administration devices, light protection, handling, mixing and shaking, travel requirements, preparation & administration.	4	CLO1
4.	**Biotech Product Analysis:** Pharmacodynamics & pharmacokinetic of biotech drugs, bioanalytical methods for biotech drugs.	4	CLO3
5.	**Content revision and consultation**	6	
6.	Mid term-1	1	
7.	Mid term-2	1	
8.	Final exam	2	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: **1.** Biopharmaceuticals: Biochemistry and Biotechnology
2. Pharmaceutical Biotechnology: Antroduction for Pharmacists and Pharmaceutical Scientists

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Course Title	Biopharmaceutics and Pharmacokinetics-II			
Course Code	PHAT-4104		**Year**	Fourth Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:
This course will focus on providing knowledge on compartmental models, multiple dosage regimen, compartmental and non-compartmental analysis.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	acquire knowledge about compartmental and non-compartmental analysis.
CLO2	know the absorption kinetics of drugs.
CLO3	Calculate doses for different conditions.
CLO4	know about various dosage forms.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2		3				3	3			
CLO2	1		3				3	3			
CLO3	3		3				3	3			
CLO4			3		3			3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	**Contents of Course**	**Credit Hours**	**CLOs met**
1.	**Compartment models:** (a) One-compartment model, determination of plasma concentration, elimination rate constant, apparent volume of	5	CLO1

	distribution, calculation from urinary data. (b) Multiple Compartment Models: (i) Two-compartment open model (ii) Three compartment open model.		
2.	**Pharmacokinetics of drug absorption:** Zero-order absorption model, first-order absorption model, determination of absorption rate constant from oral absorption data.	3	CLO2
3.	**Midterm-1**	1	
4.	**Multiple dosage regimen (MDR):** Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bioequivalence from MDR.	5	CLO4
5.	**Intravenous infusion:** One-compartment model drugs, two-compartment model drugs, infusion plus loading dose.	3	CLO4
6.	**Midterm-2**	1	
7.	**Dosage adjustment in renal and hepatic disease:** (a) Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance dose adjustment based on the elimination rate constant, measurement of glomerular filtration rate (GFR) calculation of creatinine, clearance from serum creatinine concentration, dose adjustment based on nomogram, Giusti-Hayton method, Wagner method. (b) Extracorporeal removal of drugs.	6	CLO3
8.	**Non-compartmental analysis:** Physiologic-pharmacokinetic models, statistical moment, mean residence time.	3	CLO1
9.	**Presentation/ Assignment**	3	
10.	Counseling	12	
11.	**Final exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes Question-Answer session E-learning/ audio visual tools Scientific articles	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. Donald E. Cadwallader: Biopharmaceutics & Drug Interactions, 2. Leon Shargel and Andrew B.C. Yu: Applied Biopharmaceutics and Pharmacokinetics

Course Title	Toxicology			
Course Code	PHAT-4106		**Year**	Fourth Year
Credit	2		**Semester**	First Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description: Toxicology course covers the principles of body's response to drugs and toxic substances. Students will learn fundamentals of toxicology and mechanisms of toxic actions from acute and chronic exposure of xenobiotics derived from environmental, dietary, occupational and pharmaceutical sources.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	Understand basics of toxic responses of xenobiotics or poisons
CLO2	Learn the process for removal of toxins from the body
CLO3	Identify the intermediate metabolites of several drugs having toxic responses

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3					3		2			1
CLO2	3					3		2			1
CLO3	3			2		3		2			1

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Basics of toxicology:** Overview, assessment of toxic substances, impact on health and target organs, introduction to toxicology, toxicity testing.	5	CLO1
2.	**Toxic responses to drugs and chemicals:** Classification of responses according to the biochemical basis and manifestation of toxic effect, mechanism of genotoxicity and nongenotoxic carcinogens.	5	CLO2
3.	**The biotransformation of toxins, their inactivation and removal from the body:** An introduction to biotransformation, cytochrome p450 system-its function, mechanism of action and regulation; glutathione and glutathione-S-transferase - function, mechanism of action and regulation.	5	CLO2, CLO3
4.	**The mechanism of toxin action:** DNA damage and repair, mutagenicity and carcinogenicity, cell death, apoptosis, nuclear hormone receptor mediated toxicity, peroxisome proliferators, environmental estrogens, neurotoxicity, intracellular free radicals, risk assessment, toxicity testing.	6	CLO1
5.	**Reactive intermediates:** Types of metabolically generated reactive intermediates and their role in drug toxicity. Epoxidation and drug toxicity, N-oxidation and drug toxicity, toxicity and sulphur xenobiotics.	5	CLO3
6.	**Mid term-1**	1	
7.	**Mid term-2**	1	
8.	**Final exam**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Learning References: 1. Casarett and Doull's Toxicology: The Basic Science of Poisons: Curtis D. Klaassen,

2. Handbook of Toxicology: Michael J. Derelanko, Mannfred A. Hollinger

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Course Title	Pharmacology-IV			
Course Code	PHAT-4111		**Year**	Fourth Year
Credit	3		**Semester**	First Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

The course covers classification of chemotherapeutics with mechanism of action, dose, side effects, contraindication etc. This also covers cellular and molecular reasons of neoplastic disorder and treatment options. Also provide details information of drugs that act on central and autonomic nervous system.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	get familiar with pathogenic mechanisms of infectious diseases caused by virus
CLO2	learn the molecular and cellular mechanisms of antineoplastic agents.
CLO3	explain the chemistry and pharmacology of drugs acting on nervous system.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2					3	2	3			
CLO2	2					3	2	3			
CLO3	2					3	2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Anti-psychotics:** first generation, second-generation antipsychotic drugs.	2	CLO3
2.	**Antidepressants**: serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, atypical antidepressants, tricyclic antidepressants, monoamine oxidase inhibitors.	3	CLO3
3.	**Anxiolytic and Hypnotic Agents**: benzodiazepines, benzodiazepine antagonist, other anxiolytic, barbiturates and other hypnotic drugs.	3	CLO3
4.	**Antiepileptic drugs**: benzodiazepines, carbamazepine, eslicarbazepine, ethosuximide, gabapentin, lacosamide, lamotrigine, phenytoin, pregabalin, tiagabine, valproic acid, vigabatrin.	2	CLO3
5.	**CNS Stimulants**: methylxanthines, nicotine, amphetamine, cocaine, methylphenidate. Drugs for Neurodegenerative disorders: Anti-Parkinson drugs, anti-Alzheimer drugs,	3	CLO3
6.	**Opioids**: agonists and antagonists.	2	CLO3
7.	**Midterm-I**	1	
8.	**Drugs affecting ANS:** Drugs for Cholinergic System: cholinergic agonists, antimuscarinic agents, ganglionic blockers, neuromuscular blockers. Drugs for Adrenergic System: adrenergic agonists and antagonists. Drugs for Urological Disorders: phosphodiesterase-5 inhibitors, α_1 adrenergic blockers, 5-α reductase inhibitors.	6	CLO3
9.	**Midterm-II**	1	
10.	**Antivirals**: Viral life cycle, classifications, anti-herpes virus, antiretroviral, anti-influenza virus, nonselective antiviral drugs, recent for AIDS treatment.	6	CLO1
11.	**Antineoplastic agents:** Introduction of neoplastic disorders, causes of cancer, role of thymidylate synthase, p53 gene mutations, alkylating agents, antimetabolites, vinca alkaloids, Taxanes antibiotics, cisplatin, carboplatin, etoposide, monoclonal antibody, tyrosine kinase inhibitors, cytokines etc.	6	CLO2
12.	**Consultation and revision**	7	
13.	**Final exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

Text books: 1. Goodman's and Gillman's: The Pharmacological basis of Therapeutics.

Supplementary readings: 1. Pharmacology by Rang and Dales. 2. Pharmacology by Katzung.

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Course Title	Pharmaceutical Engineering Lab			
Course Code	PHAL-4108		**Year**	Fourth Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in pharmaceutical technology laboratory to understand the physical factors and conditions required for production of a drug product. The laboratory techniques covered in the course will help to understand basic processes such as viscosity, humidity control, particle size measurement and filtration.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn to calculate viscosity of a liquid dosage form.
CLO2	Understand and gain hands-on experience on humidity control and measurement techniques.
CLO3	Carry out the particle size determination and filtration.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3	3		2	2			
CLO2				3	3		2	2			
CLO3				3	3		2	2			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of viscosity of oil.	5	CLO1
2.	Determination of humidity of Air.	5	CLO2
3.	Particle size measurement for power materials.	4	CLO3
4.	Effect of Filter Aids on Rate of Filtration	4	CLO3
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Pharmaceutical Engineering: Sudhakara Reddy, Chandrasekhar

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Course Title	Pharmaceutical Technology Lab-III			
Course Code	PHAL-4109		**Year**	Fourth Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will focus hands-on experiences in pharmaceutics laboratory and will enable students to formulate and prepare semi-solids such as ointments and solids such as capsules. This course will also focus on ophthalmic product formulation and preparation.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Learn the formulation and preparation of ointments.
CLO2	Experience the formulation and preparation of ophthalmic products.
CLO3	Learn the formulation and preparation of capsules.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				2	3		2	3			
CLO2				2	3		2	3			
CLO3				2	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Preparation of paraffin ointment.	5	CLO1
2.	Preparation of ophthalmic ointment and solution.	4	CLO2
3.	Formulation and manufacturing of hard gelatin capsules.	5	CLO3
4.	Formulation and manufacturing of soft gelatin capsules.	4	CLO3
6.	Midterm Examinations	6	
7.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Fishburn: An Introductory to Pharmaceutical Formulations.

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Course Title	Biopharmaceutics and Pharmacokinetics Lab-II			
Course Code	PHAL-4110		**Year**	Fourth Year
Credit	1		**Semester**	First Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course focuses on hands-on experiences in handling of chemicals, reagents, solvents and pharmaceutical dosage forms. This course will focus on dissolution study and bioavailability assay.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	calculate dissolution time, dissolution rate.
CLO2	do in vitro dissolution study.
CLO3	determine bioavailability of marketed drug products.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1			3	3	3		2	3			
CLO2			3	3	3		2	3			
CLO3			3	3	3		2	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

SL.	Contents of Course	Credit Hours	CLOs met
1.	Determination of the dissolution time and dissolution rate of the enteric coated diclofenac sodium tablet.	6	CLO1
2.	In vitro dissolution study of SR tablet.	4	CLO2
3.	In vitro dissolution study of TR or CR capsule.	4	CLO2
4.	Determination of bioavailability by plasma concentration.	4	CLO3
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: Biopharmaceutics & Clinical Pharmacokinetics- Milo Gibaldi, Le & Febiger. Pharmacokinetics- M. Gibaldi & D. Perrier.

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Course Title	Pharmacology Lab-III			
Course Code	PHAL-4113		Year	Fourth Year
Credit	1		Semester	First Semester
Credit Hours	30		Final Examination	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course deals with practical demonstration of Estimation of drug concentration in blood after oral administration of medicines. Estimation of paracetamol concentration in blood after administration. Development of knowledge of neuropharmacological screening techniques for pharmaceuticals.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	know how aspirin works and its pharmacological effect.
CLO2	learn the mechanism of action of paracetamol, indication, side effects, etc.
CLO3	Determine cholesterol level in blood.
CLO4	gain knowledge about different neuropharmacological screening techniques.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2			2		3	3	3			
CLO2	2			2		3	3	3			
CLO3	2			2		3	3	3			
CLO4	2			2		3	3	3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Determination of paracetamol and aspirin in blood by colorimetric method.	4	CLO1, CLO2
2.	Estimation of cholesterol in human blood by enzymatic method.	4	CLO3
3.	**Experimental models for the assessment of -** Antinociceptive effect: Hot plate method; Tail-flick method; Writhing test. Anxiolytic effect: Open field test; Elevated plus maze; Light-dark exploration test; Social interaction test. Antidepressant effect: Tail suspension test (TST); Forced swim test (FST); Assessment of learning and memory: Novel object recognition; Morris water maze; Radial-arm Maze. Abuse and addiction test: Condition place preference.	10	CLO4
4.	**Midterm Examinations**	6	
6.	**Final examination**	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Text book:

1. Goodman and Gilman's The Pharmacological Basis of Therapeutics

Supplementary readings:

1. Lippincott Illustrated Reviews: Pharmacology
2. Rang & Dale's Pharmacology

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---------- B.PHARM. (HONS.) FOURTH YEAR SECOND SEMESTER ----------

Course Title	Hospital and Community Pharmacy			
Course Code	PHAT-4204		**Year**	Fourth Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description:

This course deals with developing knowledge of hospital/community pharmacist to make him capable of administering and monitoring, as well as a supplying. He will serve to ensure proper procurement, storage, distribution, inventory control, and quality assurance.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	understand the essential basic of hospital pharmacy practice and role of a pharmacist in hospital and community pharmacy
CLO2	learn about organizational and administrative structure of a hospital pharmacy service.
CLO3	relate this essential knowledge to serve the in- and out-patients in the hospital as well as in community pharmacy settlement.
CLO4	acquire knowledge on antibiotic policy development process and special classes of drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1						3	1	2	3	2	3
CLO2						3	1	2	3	2	3
CLO3						3	1	2	3	2	3
CLO4						3	1	2	3	2	3

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Introduction to hospital pharmacy**: Goals, standards, abilities required for a hospital pharmacist, hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in hospital, personnel, education, job description.	5	CLO1, CLO2, CLO3,
2.	**Pharmacy and therapeutics committee**: description and purpose, membership and functions, Hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, investigational use of drugs, classification, control, identification, role of hospital pharmacist, advisory committee.	4	CLO1, CLO2, CLO3,
3.	**Purchasing and inventory control**: Purchasing agent, purchasing procedure, control on purchase, storage, perishable inventory, physical inventory, perpetual inventory.	4	CLO1, CLO2, CLO4
4.	**Control of special drugs**: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols, narcotics and their control, classes. Procurement, execution of order forms, dispensing, hospital narcotic regulations, floor stock drugs, charge and non-charge, labeling, narcotics regulations, inspection of nursing drug cabinets.	4	CLO1, CLO2,
5.	**Dispensing to in-and out-patients**: Drug distribution systems, dispensing of charge, non-floor stock drugs, mobile dispensing unit, unit dose dispensing, out-patients dispensing, locality of out-patient dispensing area, dispensing routine, record keeping, dispensing during off-hours, use	4	CLO1, CLO2, CLO4

	of nursing supervisors, emergency boxes, night drug cabinets, pharmacist-on-call drug charges in hospitals, pricing, break-even point pricing.		
6.	**Community pharmacy**: Concept and needs of community of pharmacy, implementation of accredited drug sellers as Model Pharmacy, level of healthcare systems, elements and principle of primary healthcare, Role in communicable disease control, nutritional problem, sanitation, indigenous systems of medicine, Infrastructure of community pharmacy, role of NGO's.	3	CLO1,
7.	**Antibiotic Policy**: Choice of antibiotics, antibiotics in clean cut surgery, antibiotics in intra-operative surgery, prophylaxis, Antibiotic usage guidelines in Bangladeshi hospitals, role of pharmacists and physicians in developing antibiotic policy for different hospitals.	4	CLO1, CLO2, CLO4
8.	**Mid Term Exam-I**	1	
9.	**Mid Term Exam-II**	1	
10.	Contact Hour	12	
11.	**Final Exam**	3	

Teaching-Learning Approach	**Assessment Strategy**
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

References: 1. Hospital Pharmacy-William E Hassan, Published by Lea & Febiger, Philadelphia, USA, 2. Hospital Pharmacy- Martin Stephens, Second edition, Pharmaceutical Press from UK, 3. Hospital and Clinical Pharmacy- N. Narayanan and S. Balasubramanian, 4. Hospital and Clinical Pharmacy- Pratibha Nand and Roop K Khar, Birla Publication, India

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Course Title	Regulatory Affairs			
Course Code	PHAT-4205		**Year**	Fourth Year
Credit	2		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description:

This course deals with the regulatory affairs related to pharmaceutical products according to government health policy.

Course Learning Outcomes (CLOs):

CLOs	**Expected Course Outcomes**
	Upon completion of this course, the students will be able to:
CLO1	know about the rules and regulation related to pharmaceutical products
CLO2	Know about the essential drug list, OTC medicines and prescription only medicine.
CLO3	understand ethics of pharmacists and regulation related to export & import of medicines.
CLO4	get updated knowledge on pharmacy practices in Bangladesh.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1									2	3	3
CLO2									2	3	3
CLO3									2	3	3
CLO4									2	3	3

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**General consideration**: Definition, scope, maintenance of licensure, legal relationship and dealings.	2	CLO1, CLO4
2.	**Commercial laws:** Business law, Laws of contract 1872, regulations and laws governing the practices of pharmacy (The Pharmacy Ordinance1976).	3	CLO1, CLO3
3.	**Mid Term Examination-I**	1	
4.	Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons: The Drug Policy 1982, 2005, and 2016. Essential drug list, The Drug Act 1940, The Drug (Control) Ordinance 1982, The Narcotics (Control) Act 1990, The Poisons Act 1919 and related amendments thereof. Patented and trade-marked medicine, proprietary medicine, schedules of drugs and poisons, poisons control.	9	CLO1, CLO2, CLO3
5.	Professional characteristics and ethical norms, relationship of trust, ethical considerations during pharmacy practice, deficiencies and adherence of self-regulation, The Pharmacist's code of ethics. Code of ethics of pharmaceutical marketing in perspective of Bangladesh.	4	CLO3, CLO4
6.	**Mid Term Examination-II**	1	
7.	Drug administration and pharmacy council of Bangladesh-their scope and functions. Government Health policy.	2	CLO1, CLO4
8.	Course review and contact hours	6	
9.	**Final Examination**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes	Attendance Midterm Exam Final Exam

Learning References: Pharmaceutical Regulatory Affairs and Standards by Md. Shah Amran.

Supplementary readings 1. The Pharmacy Ordinance, 1976, Ministry of law and parliamentary Affairs, Bangladesh Government, 2. The Drugs (Control) Ordinance, 1982, Ministry of law and land reforms, Bangladesh Government. 3. Pharmacists' Code of Ethics, Pharmacy Council of Bangladesh, Dhaka

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Course Title	Pharmaceutical Analysis-III			
Course Code	PHAT-4212		**Year**	Fourth Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: Providing advanced techniques for characterization of the organic pure chemicals, at the same time the course will focus on the quantitative analysis of the inorganic commonly used medicinal agents.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Understand the basic principles of proton NMR spectroscopy.
CLO2	Have idea about the carbon NMR and its application in pharmaceutical sciences
CLO3	Apply the mass spectroscopy in structure determination.
CLO4	Analyze metallic elements by using atomic absorption spectroscopy

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		3		3				3			
CLO2		3		3				3			
CLO3		3		3				3			

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**^{1}H-NMR spectroscopy**: Theory, relaxation, instrumentation, chemical shift, spin-spin coupling, coupling constants, long range coupling; Two dimensional NMR spectroscopy, nuclear over hauser effect, 2D correlated (COSY) and 2D Nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC.	8	CLO1
2.	**^{13}C NMR spectroscopy:** Principle, chemical shift, spin-spin coupling,	6	CLO2
3.	**Mass spectroscopy:** Introduction, theory, the mass spectrum, determination of molecular formula, ionization technique, recognition of molecular ion, fragmentation process, application.	8	CLO3
4.	**Atomic absorption spectroscopy:** Theory, instrumentation and application in quantitative analysis.	4	CLO4
5.	**Mid Term Examination-I and II**	2	
6.	**Polarimetry**: Introduction, origin of optical rotation, molecular requirements for optical rotatory power, methods used in polarimetry, instrumentation and applications.	3	CLO1, CLO2, CLO3
7.	Course review and contact hours	10	
8.	**Final Examination**	4	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. D. L. Pavia, G. M. Lampman and G.S. Kriz : Introduction to Spectroscopy. 2. L.G. Chatten: Pharmaceutical Chemistry Vol. I & II

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Course Title	Quality Control and Quality Assurance			
Course Code	PHAT-4213		**Year**	Fourth Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: To provide idea about the quality control, quality assurance and regulatory affairs of pharmaceutical products to ensure GMP (Good Manufacturing Practices) and GDP (Good Documentation Practices).

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	know the specifications of quality, good practice, and regulatory affairs of finished products.
CLO2	achieve knowledge on API and validation techniques.
CLO3	understand good documentation practices and its significance.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1				3			3	3	1	2	3
CLO2				3			3	3	1	2	2
CLO3				3			3	3	1	2	2

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Quality assurance**: Theory and basic concepts of GMP, cGMP, ISO 9000, ISO 9001, TQM, quality review and documentation. GMP-requirements of GMP in a pharmaceutical company with emphasize on premises, equipments, documentation and GMP training. GLP- basics	7	CLO1, CLO3
2.	Regulatory control, Regulatory drug analysis, analytical data interpretation.	4	CLO1
3.	**Mid Term Examination-I**	1	
4.	Basic concept on qualification and validation. Introduction to basic concepts of process validation (IQ, OQ & PQ) procedures.	5	CLO2
5.	Process, equipment and analytical instruments validation.	3	CLO2
6.	**Mid Term Examination-II**	1	
7.	Validation of water & thermal systems, including HVAC and facilities.	4	CLO2
8.	Validation of active pharmaceutical ingredients (API) & aseptic processes. Validation of non-sterile processes for manufacturing of solids, liquids & semi-solid dosage forms).	5	CLO1, CLO2
9.	Course review and contact hours	12	
10.	**Final Examination**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes Question-Answer session PowerPoint lecture notes E-learning/ audio visual tools	Attendance Class test/Quiz/Case study/Assignment Midterm Exam Final Exam

Learning References: 1. Quality Control in Pharmaceutical Industry- Murray S. Cooper, Academic Press. 2. Analytical Methods Validation, Combo-Institute of Validation Technology. 3. Introduction to Organic Laboratory Techniques - Pavia, Lampman

Course Title	Clinical Pharmacy			
Course Code	PHAT-4214		**Year**	Fourth Year
Credit	3		**Semester**	Second Semester
Credit Hours	45		**Final Examination**	3 hours
Evaluations (100 marks)	Final Examination: 60, Continuous Assessment: 40 (Class Attendance-10, Two Mid-Semester Exams-20, Quiz/Case Study/Assignment/Class Performance-10)			

Course Description: This course will focus on educating students about clinical knowledge in optimizing drug therapy and developing problem-solving skills in healthcare practice. This course comprises seven chapters, a mix of clinical, applied practice, public health and research units, giving students the knowledge and skills to be an excellent clinical pharmacist.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	learn the general aspects in the practice of clinical pharmacy
CLO2	know the poisoning and toxicological aspects in clinical pharmacy, ADRs.
CLO3	learn clinical considerations for specialized patients including pediatric, geriatric and critical patients.
CLO4	know how clinical management of OTC products.
CLO5	learn about some lab test related considerations

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	2			2		3		3	3		2
CLO2	2			2		3		3	3		2
CLO3	2			2		3		3	3		2
CLO4	2			2		3		3	3		2
CLO5	2			2		3		3	3		2

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**General consideration**: Scope, importance, application of clinical pharmacy, clinical hematology, blood bank techniques etc., organ function tests, clinical pathology and manifestation of diseases, drug or hospital acquired diseases, cautionary and advisory notes on therapy.	3	CLO1, CLO2, CLO5,
2.	**Guidance for special clinical practice**: Neonates, Pediatric, geriatric care, liver disease, renal impairment, pregnancy and lactating mothers.	6	CLO1, CLO3,
3.	**Clinical pharmacy for OTC preparation**: Antacids, anti-flatulence, antidiarrheals, laxatives, emetics, antiemetics, antihistamines, analgesics, contraceptives, ENT preparations, dermatologicals.	2	CLO1, CLO4
4.	Clinical toxicology: Role of poison centers, adverse reactions and poisoning incidences, analysis of poisoning situations, poison information sources, assessment of poison exposure.	5	CLO1, CLO2,
5.	**Clinical signs, symptoms and management of poisoning**: Case with pesticides, fumigants, solvents vapors, gases, food toxins, cyanides poison, cosmetics, toxins of animal origin, and over-doses of drugs.	5	CLO1, CLO2,
6.	**Basic concepts of pharmacotherapy**: Clinical pharmacokinetics and individualization of dosage regimen. Drug induced diseases and adverse drug interaction	4	CLO1, CLO2,
7.	**Mid Term Exam-I and II**	2	
8.	Contact Hour	12	
9.	**Final Exam**	3	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

References: 1. Atkinson: Principle of Clinical pharmacology. 2. Lloyd: Handbook of Clinical Research.

Learning References: 1. Roger Walker: Clinical Pharmacy and Therapeutics.

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Course Title	Pharmaceutical Management			
Course Code	PHAT-4215		**Year**	Fourth Year
Credit	2		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	2 hours
Evaluations (50 marks)	Final Examination: 30, Continuous Assessment: 20 (Class Attendance-5, Two Mid-Semester Exams-10, Quiz/Case Study/Assignment/Class Performance-5)			

Course Description:

The pharmaceutical management course has been developed to build up the leadership and management capability of pharmacists in their professional life. This course includes principles of management, style of management, structures of organization, management of personnel, inventory control and purchasing.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	integrate different managerial roles and responsibilities.
CLO2	understand the importance, principles, methods of personnel management.
CLO3	describe supply chain, inventory management, inventory models, buying policies.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1					3				3	2	2
CLO2					3				3	2	2
CLO3					3				3	2	2

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	**Nature and principles of management:** Style of management, The MBO system and improving decision-making.	3	CLO1
2.	**Organization structures:** Social and legal organization, sole proprietorship, general partnership, private and public limited companies,	3	CLO1
3.	**Organization structures:** Relative advantages and disadvantages of different types of organization. Planning, organizing, staffing, landing & controlling of pharmaceutical organizations.	3	CLO1
4.	**Personnel management:** Importance, principles, methods, motivation, staff requirements.	3	CLO2
5.	**Personnel management:** Types of selling, role of pharmaceutical sales force, territory management, selling skills representatives.	3	CLO2
6.	**Supply chain and inventory management:** Functions of supply chain department, types of supplier, various discount methods,	3	CLO3
7.	**Supply chain and inventory management:** Perpetual inventory, open-to-buy, stock, record card, economic order quality, selection of optimum methods, effect of inventory control.	3	CLO3
8.	**Purchasing:** Formulating effective buying policies, needs and desires, selecting sources of supply, determining terms of purchase, receiving marking and stocking of goods.	3	CLO3
9.	Revision/Assignment/Presentation/Counseling	3	
10.	**Mid term-1**	0.5	
11.	**Mid term-2**	0.5	
12.	**Final exam**	2	

Teaching-Learning Approach	Assessment Strategy
Discussion of lecture notes	Attendance
Question-Answer session	Class test/Quiz/Case study/Assignment
PowerPoint lecture notes	Presentation
E-learning/ audio visual tools	Midterm Exam
Scientific articles	Final Exam

References: 1. Marketing, Management by Philip Kotler, 2. Principles of Management by Davis.

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Course Title	Quality Control and Quality Assurance Lab			
Course Code	PHAL-4216		**Year**	Fourth Year
Credit	1		**Semester**	Second Semester
Credit Hours	30		**Final Examination**	6 hours
Evaluations (30 marks)	Semester end Practical Examination/Thesis/Project/Research report evaluation: 18 Continuous Assessment: 12 (Laboratory performance/Assignment/Oral or written test on Laboratory work/Fieldwork/Internship/Project/ Research/ Presentation/Internship process record: 6, Attendance: 3, Laboratory Note Book on experiment/Performance: 3)			

Course Description: This course will provide idea about analyzing pharmaceutical finished products in quality control department and calibration of different kinds of instruments used for the analytical purposes along with their corresponding documentation to ensure quality assurance.

Course Learning Outcomes (CLOs):

CLOs	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	get knowledge about calibration of different kinds of analytical instruments.
CLO2	learn about the data interpretation from UV and IR spectrum.
CLO3	learn to prepare documentation to meet quality assurance criteria.
CLO4	learn to prepare SOP for pharmaceutical analysis

Mapping of Course Learning Outcomes to Program Learning Outcomes:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1		2		3	2		3	3		1	
CLO2		2		3	2		3	3		1	
CLO3		2		3	2		3	3		1	
CLO4		2		3	2		3	3		1	

Correlation: Strong-3, Medium-2 and Low-1

Course Plan:

Sl.	Contents of Course	Credit Hours	CLOs met
1.	Calibration of pH meter and UV spectrometer.	5	CLO1
2.	Analysis of UV absorption spectrum and IR spectrum.	5	CLO2
3.	Preparation of Master Control Procedure (MCP) for the analysis and quality assurance of finished dosage forms.	4	CLO3
4.	Preparation of Standard operating procedures (SOP) for pharmaceutical analysis.	4	CLO4
5.	Midterm Examinations	6	
6.	Final examination	6	

Teaching-Learning Approach	Assessment Strategy
Discussion of Laboratory manual Practical experiments Scientific articles	Attendance Midterm Exam Final Exam

Learning References: A Textbook of Pharmaceutical Analysis. Kennth A. Connors,

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Course Title	Research Project			
Course Code	PHAP-4209		**Year**	Fourth Year
Credit	3		**Semester**	Second Semester
Evaluations (30 marks)	Final Examination: 30			

Course Description:
The students will run a short project and submit project report for subsequent assessment.

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Course Title	Viva Voce-IV			
Course Code	PHAV-4210		**Year**	Fourth Year
Credit	1		**Semester**	Second Semester
Evaluations (30 marks)	Final Examination: 30			

Course Description:
The students will sit for the oral assessment based on the total contents taught in fourth year.

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Course Title	Internship			
Course Code	PHAI-4217		**Year**	Fourth Year
Credit	1		**Semester**	Second Semester
Evaluations	Final Examination: 30			

Course Description:
The students will undergo the internship program for 4 to 6 weeks in pharmaceutical industries or relevant areas. After completion of the training program successfully the students will have to submit a report to the department for evaluation.

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Convener, Syllabus Committee
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