DEPARTMENT OF PHARMACY
BANASTHALI VIDYAPITH

MINUTES OF MEETING OF BOARD OF STUDIES IN PHARMACY HELD ON 24th APRIL 2016 AT 10:30 A.M. AT DEPARTMENT OF PHARMACY, BANASTHALI VIDYAPITH

PRESENT

1.	Dr Ashutosh Pareek	Internal Member
2.	Mrs Bhawna Sati	Internal Member
3.	Dr (Mrs) Divya Yadav	Internal Member
4.	Dr (Mrs) Manu Sharma	Internal Member
5.	Mr Pankaj Kumar Jain	Internal Member
6.	Dr (Mrs) Rajani Chauhan	Internal Member
7.	Dr Rakesh Yadav	Internal Member
8.	Dr Sachdev Yadav	Internal Member
9.	Mrs Samriti Faujdar	Internal Member
10.	Mrs Sharda Sambhakar	Internal Member
11.	Mrs Sumitra Nain	Internal Member
12.	Dr Swapnil Sharma	Internal Member
13.	Dr Vivek Dave	Internal Member
14.	Mr Vivek Jain	Internal Member
15.	Dr (Mrs) Yashumati Ratan	Internal Member
16.	Ms Ashima Nagpal	Special Invitee
17.	Ms Easha Pandey	Special Invitee
18.	Ms Monika Chauhan	Special Invitee
19.	Mrs Monika Maan	Special Invitee
20.	Ms Reetika Rawat	Special Invitee
21.	Ms Suman Sharma	Special Invitee
22.	**Dr Sarvesh Kumar Paliwal**	**Convener**

ABSENT

Prof. Shubhini A. Saraf, **External member**

Dr Keshav Deo, **External member**

Dr Mohan Prasad, **External member**

Mrs Amrita Verma, **Internal member**

Before proceeding to discuss the agenda of the meeting, convener on the behalf of Department of Pharmacy, Banasthali Vidyapith accorded a pleasant welcome to all the members of the BOS.

1. BOS took up the confirmation of the minutes of last meeting of pharmacy held on 15th March, 2012 and as no comments were received from the members, the Board resolved that the minutes of its last meeting be confirmed.

2. BOS updated the existing panel of examiners in each paper of B.Pharm. and M.Pharm. (Pharmaceutical Chemistry/Pharmaceutics/Pharmacology) in accordance to the bye-laws of the Vidyapith dated 15.03.2002.

3. BOS reviewed the courses of study, curricula and scheme of examinations of the following undergraduate and postgraduate examinations:

(A) Bachelor of Pharmacy (B. Pharm.) Examination:

(i) First Semester Examination, December 2016
(ii) Second Semester Examination, April/May 2017
(iii) Third Semester Examination, December 2017
(iv) Fourth Semester Examination, April/May 2018
(v) Fifth Semester Examination, December 2018
(vi) Sixth Semester Examination, April/May 2019
(vii) Seventh Semester Examination, December 2019
(viii) Eighth Semester Examination, April/May 2020

(B) Master of Pharmacy (Pharmaceutical Chemistry/ Pharmaceutics/ Pharmacology) Examination:

(i) First Semester Examination, December 2016
(ii) Second Semester Examination, April/May 2017
(iii) Third Semester Examination, December 2017
(iv) Fourth Semester Examination, April/May 2018

Details of the changes made in the scheme of examinations and the syllabi of different courses are as follows:

(A) Bachelor of Pharmacy Examination:

B. Pharm.: Existing and modified **Scheme** of Semester Examinations (*Enclosed at pg. no. 8-9*)

B. Pharm.: Existing and modified **Syllabi** of Semester Examinations (*Enclosed at pg. no. 10-44*)

(B) Master of Pharmacy (Pharmaceutical Chemistry/Pharmaceutics/ Pharmacology Examination:

M. Pharm.: Pharmaceutical Chemistry/Pharmaceutics/Pharmacology (Existing **Scheme** of Semester Examinations) (*Enclosed at pg. no. 45-47*)

M. Pharm:. Pharmaceutical Chemistry/Pharmaceutics/ Pharmacology (Existing and Modified **Syllabi** of Semester Examinations) (*Enclosed at pg. no. 48-64*).

4. BOS appreciated the prepared road map for the next five years to strengthen the research activities of the department, particularly in terms of quality publications and patents along with the mobilization of the funds from different funding agencies viz. DST, UGC, ICMR, CSIR, DBT etc (*Enclosed at pg. no. 65-66*).

5. BOS also reviewed the Gazette notification for implementation of annual system in all pharmacy PG courses as per PCI norms. In context of annual system in M.Pharmacy programme it has been decided that the department should wait for one more year since most of the pharmacy colleges/university department have semester system and in view of this there is due pressure on PCI to allow them to continue with the prevailing semester system (*Enclosed at pg. no. 68-105*).

6. BOS reviewed the letter from UGC/PCI regarding ban on animal usage in UG/PG programmes. In light of latest guidelines on completes ban on experiments (UG & PG), the BOS decided not to use the animals in B.Pharmacy (I^{st} to IV^{th} year) and M.Pharmacy I^{st} year programme. However if any of the M. Pharm. IInd year student plans to undertake one full year research project where the animal usage is fully justified and helpful to the society, she may be allowed to apply for IAEC approval. It will be the sole discretion of IAEC whether to allow animal usage to such students or not (*Enclosed at pg. no. 106-108*).

7. BOS evaluated the reports of the examiners of various examinations of 2014-15 and observed that in most of the cases examiners are satisfied with the performances of the students.

8. BOS thoroughly analysed the quality of the last year's (year 2014-15) question papers keeping the following points in mind:
    (i) Percentage of analytical based questions.
    (ii) Percentage of descriptive questions
    (iii) Percentage of application based questions.
    (iv) Percentage of information based questions.
    (v) Time allotted to the question papers was appropriate or not.

In most of the papers, it has been found that more than 50% questions are descriptive type and rest are analytical, application and information based. So, it is recommended by the experts that the number of analytical, application and information based questions should be increased in the question papers. The outcome of the analysis of the papers of year 2014-15 is shown in the table (*Enclosed at pg. no. 109-115*).

The summary of the proceedings of the BOS regarding the courses and curriculum is given in the following table:

Bachelor of Pharmacy (B.Pharm.) Examination

Programme	Modification suggested by Board of Studies in			Page no.	Recommendation
	Scheme of Examination	Courses & Curricula	Modification in Section		
B. Pharm. First Year **First Semester (Dec.-2016)**	Change (Page No. 9)	**BPH-1.1:** Mathematics	A, B and C	11	Approved by BOS
		BPH-1.3: Pharmaceutical Chemistry –I (Pharmaceutical Inorganic Chem.)	A, B and C	12	
B. Pharm. First Year **Second Semester (May-2017)**	Change (Page No. 10)	**BPH-2.1:** Pharmaceutical Chemistry –II (Pharmaceutical Organic Chem.)	A, B and C	13	Approved by BOS
		BPH-2.1(P): Practical Pharmaceutical Chemistry –II (Pharmaceutical Organic Chem.)	Minor Changes	14	
		BPH-2.2: Pharmaceutical Analysis - I	A, B and C	15-16	
		BPH-2.2(P): Practical Pharmaceutical Analysis - I	Minor Changes	16	
		BPH-2.3: Human Anatomy, Physiology & Health Education – II	C	17	
		BPH-2.5: Remedial Biology	A, B and C	18	
B. Pharm. Second Year **Third Semester (Dec.-2017)**	No Change	**BPH-3.1:** Pharmaceutics – II (Unit Operation- I)	A, B	19	Approved by BOS
		BPH-3.2: Pharmaceutical Chemistry –III (Pharmaceutical Organic Chem.-II)	A	20	
		BPH-3.2(P): Practical Pharmaceutical Chemistry –III (Pharmaceutical Organic Chem.-II)	Minor Changes	20	
		BPH-3.4: Pharmaceutical Analysis – II	A, B and C	21	
		BPH-3.4: Practical Pharmaceutical Analysis – II	Minor Changes	22	

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Programme	Modification suggested by Board of Studies in			Page no.	Recommendation
	Scheme of Examination	Courses & Curricula	Modification in Section		
		BPH-3.5: Pharmaceutics –III (Dispensing and Community Pharmacy)	A	23	
B. Pharm. Second Year **Fourth Semester (May-2018)**	No Change	**BPH-4.1:** Pharmaceutics – IV (Unit Operation- II)	C	24	Approved by BOS
		BPH-4.2: Pharmaceutical Microbiology	B	25	
		BPH-4.3: Pharmacognosy -II	C	26	
		BPH-4.5: Pharmaceutical Jurisprudence and Ethics	Minor Changes	27	
B. Pharm. Third Year **Fifth Semester (Dec.-2018)**	No Change	**BPH-5.1:** Pharmaceutical Chemistry – IV (Biochemistry)	A, B and C	28	Approved by BOS
		BPH-5.2: Pharmaceutics- VI (Pharmaceutical Technology)	A and C	29	
		BPH-5.3 (P): Pharmacology – I- Practical	Minor Changes	30	
		BPH-5.5: Pharmaceutics – VII (Hospital Pharmacy)	A, B and C	31	
B. Pharm. Third Year **Sixth Semester (May-2019)**	No Change	**BPH-6.1:** Pharmaceutical Chemistry – V (Medicinal Chemistry – I)	A, B and C	32-33	Approved by BOS
		BPH-6.1(P): Practical Pharmaceutical Chemistry – V (Medicinal Chemistry – I)	Minor Changes	33	
		BPH-6.2: Pharmaceutics – VIII (Biopharmaceutics & Pharmacokinetics)	B and C	34	
		BPH-6.3: Pharmacology – II	A, B and C	35	
		BPH-6.3 (P): Pharmacology – II – Practical	Minor Changes	35	
		BPH-6.5: Drug Regulatory Affairs	A, B and C	36	
B. Pharm. Fourth Year **Seventh Semester (Dec.-2019)**	No Change	**BPH-7.1:** Pharmaceutical Analysis – III	A, B & C	37-38	Approved by BOS
		BPH-7.1(P): Practical Pharmaceutical Analysis – III	Minor Changes	38	
		BPH-7.2: Pharmaceutics – IX (Pharmaceutical Technology – II)	A, B & C	39	
		BPH-7.3: Pharmacology – III	B	40	
		BPH-7.3(P): Practical- Pharmacology – III	Minor Changes	40	
		BPH-7.4: Pharmaceutical Chemistry – VI (Medicinal Chemistry - II)	A, B & C	41	
		BPH-7.4: Practical Pharmaceutical Chemistry – VI (Medicinal Chemistry - II)	Minor Changes	42	
B. Pharm. Fourth Year	No Change	**BPH-8.2:** Practical Pharmacognosy – V (Natural Products)	Minor Changes	42	Approved by BOS

DEPARTMENT OF PHARMACY
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Programme	Modification suggested by Board of Studies in			Page no.	Recommendation
	Scheme of Examination	Courses & Curricula	Modification in Section		
Eighth Semester (May-2020)		**BPH-8.3:** Pharmacology – IV (Clinical Pharmacy & Drug interactions)	A, B and C	43	
		BPH-8.4: Pharmaceutical Chemistry – VII (Medicinal Chemistry – III)	A, B and C	44	
		BPH-8.4(P): Practical Pharmaceutical Chemistry – VII (Medicinal Chemistry – III)	Minor Changes	45	
		BPH-8.5: Pharmaceutical Biotechnology	A, B and C	45	

Master of Pharmacy (Pharmaceutical Chemistry/Pharmaceutics/Pharmacology) Examination

Programme	Modification suggested by Board of Studies in			Page / Reference	Recommendation
	Scheme of Examination	Courses & Curricula	Modification in Section		
M. Pharm. (Pharm. Chem.) First Year **First Sem. (Dec.-2016)**	Change (Page no. 46)	**MPCH-1.1:** Modern Analytical Techniques – I	A, B and C	49-50	Approved by BOS
		MPCH-1.2: Product Development & Pharmacovigilance	A	50-51	
		MPCH-1.3: Quality Assurance	A, B and C	51-52	
		MPCH-1.4: Principles of Drug Design & Preclinical Evaluation	A, B and C	53-54	
		MPCH-1.5: Advance Organic Chemistry –I	A, B	54-55	
M. Pharm. (Pharm. Chem.) First Year **Second Sem. (May-2017)**	No Change	**MPCH-2.1:** Modern Analytical Techniques – II	A, B and C	56-57	Approved by BOS
		MPCH-2.2: Intellectual Property Rights & Drug Regulatory Affairs	A, B and C	57-58	
		MPCH-2.5: Advance Pharmaceutical Chemistry	A, B and C	59	
M. Pharm. (Pharmaceutics) First Year **First Sem. (Dec.-2016)**	Change (Page no. 47)	**MPCEU-1.1:** Modern Analytical Techniques – I	A, B and C	49-50	Approved by BOS
		MPCEU-1.2: Product Development & Pharmacovigilance	A, B and C	50-51	
		MPCEU-1.3: Quality Assurance	A, B and C	51-52	
		MPCEU-1.4: Biopharmaceutics and Advance Pharmacokinetics-I	B, C	60	
M. Pharm. (Pharmaceutics) First Year **Second Sem. (May-2017)**	No Change	**MPCEU-2.1:** Modern Analytical Techniques – II	A, B and C	56-57	Approved by BOS
		MPCEU-2.2: Intellectual Property Rights & Drug Regulatory Affairs	A, B and C	57-58	

DEPARTMENT OF PHARMACY
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Programme	Modification suggested by Board of Studies in			Page / Reference	Recommendation
	Scheme of Examination	Courses & Curricula	Modification in Section		
		MPCEU-2.4: Advance Drug Delivery System - II:	A, B and C	61-62	
M. Pharm. (Pharmacology) First Year **First Sem. (Dec.-2016)**	No Change (Page no. 48)	**MPCOL-1.1:** Modern Analytical Techniques – I	A, B and C	49-50	Approved by BOS
		MPCOL-1.2: Product Development & Pharmacovigilance	A, B and C	50-51	
		MPCOL-1.5: Principles of Drug Design & Preclinical Evaluation	A, B and C	53-54	
M. Pharm. (Pharmacology) First Year **Second Sem. (May-2017)**	No Change	**MPCOL-2.1:** Modern Analytical Techniques – II	A, B and C	56-57	Approved by BOS
		MPCOL-2.2: Intellectual Property Rights & Drug Regulatory Affairs	A, B and C	57-58	
		MPCOL-2.3: Clinical Pharmacology	A, C	62-63	
		MPCOL-2.5: Advance Pharmacology-II	A, B	64-65	

Verified

Offg. Secretary
Banasthali Vidyapith
P.O. Banasthali Vidyapith
Distt. Tonk (Raj.)-304022

Department of Pharmacy
Banasthali Vidyapith

Board of Studies in Pharmacy held on
27th December 2018 at 03:30 p.m. at Department of Pharmacy, Banasthali Vidyapith

Present

1.	Prof. S.K. Sharma	External Member
2.	Dr Ashutosh Pareek	Internal Member
3.	Dr Bhawna Sati	Internal Member
4.	Dr Divya Yadav	Internal Member
5.	Dr Manu Sharma	Internal Member
6.	Dr Pankaj Kumar Jain	Internal Member
7.	Dr Rajani Chauhan	Internal Member
8.	Dr Rakesh Yadav	Internal Member
9.	Dr Sachdev Yadav	Internal Member
10.	Dr Samriti Faujdar	Internal Member
11.	Dr Sharda Sambhakar	Internal Member
12.	Dr Sumitra Nain	Internal Member
13.	Dr Swapnil Sharma	Internal Member
14.	Dr Vivek Dave	Internal Member
15.	Dr Yashumati Ratan	Internal Member
16.	Mrs Aayushi Sharma	Special Invitee
17.	Ms Easha Pandey	Special Invitee
18.	Mrs Monika Maan	Special Invitee
19.	Ms Reetika Rawat	Special Invitee
20.	Ms Suman Sharma	Special Invitee
21.	Ms Kanika Verma	Special Invitee
22.	Ms Ritika Gururani	Special Invitee
23.	Ms Saraswati Patel	Special Invitee
24.	**Prof Sarvesh Kumar Paliwal**	**Convener**

Note: Prof. Shailendra Saraf, **External member,** Prof. A.K. Tiwary, **External member** and Mrs Monika Chauhan, **Internal member** could not attend the meeting.

Before proceeding to discuss the agenda of the meeting, convener on the behalf of Department of Pharmacy, Banasthali Vidyapith accorded a pleasant welcome to all the members of the BOS.

Department of Pharmacy
Banasthali Vidyapith

The meeting started with welcome of the members, by the convener of Board of Studies for Pharmacy Prof. Sarvesh Paliwal, Head, Department of Pharmacy, Banasthali Vidyapith, Rajasthan.

1. BOS took up the confirmation of the minutes of last meeting of pharmacy held on 24th April, 2016 and as no comments were received from the members, the Board resolved that the minutes of its last meeting be confirmed.
2. In urgency, the courses and scheme (UG & PG) with some modifications were implemented as per PCI regulations from the academic session 2017-18
3. In light of the stringent requirements of PCI, Board members agreed not to change the PCI prescribed syllabus and scheme of examination and resolved to adopt the PCI prescribed syllabus as it is from 2019-20. However changes with respect to content repetition in the PCI prescribed syllabus and some very minor corrections/modification, if required may be made.
4. The board reviewed the existing panel of examiners in each paper of B. Pharm. and M. Pharm. (Pharmaceutical Chemistry/Pharmaceutics/Pharmacology) in accordance to the bye-laws of the Vidyapith dated 15.03.2002 and suggested to update the address and phone numbers of the existing examiners for each examination up to and inclusive of all Master's degree examination keeping in view the by-law 15.03.02 of the Vidyapith. Updated panel is sent to the examination and secrecy section.
5. BOS reviewed the courses of study, curricula and scheme of examinations of the following undergraduate and postgraduate examinations:

5.1. Bachelor of Pharmacy (B. Pharm.) Examinations:

i.	First Semester Examination, December, 2019	Change [(a)]
ii.	Second Semester Examination, April/May, 2020	Change [(b)]
iii.	Third Semester Examination, December, 2020	Change [(c)]
iv.	Fourth Semester Examination, April/May, 2021	Change [(d)]
v.	Fifth Semester Examination, December, 2021	Change [(e)]
vi.	Sixth Semester Examination, April/May, 2022	Change [(f)]
vii.	Seventh Semester Examination, December 2022	Change [(g)]
viii.	Eighth Semester Examination, April/May 2023	Change [(h, i)]

The Board reviewed the objectives, syllabi, learning outcomes of the B. Pharm. programme.

(a) In B Pharmacy I semester, course *Remedial Mathematics* has been shifted from B Pharm II semester as per the recommendations of PCI. Board discussed the proposed syllabi and agreed to adopt the change. Board recommended implementation of the proposed syllabi from I Semester Examination, December, 2019.

(b) In B Pharmacy II semester, course *Remedial Mathematics* has been removed. In place of it, course *Pathophysiology* has been shifted from B Pharm III Semester as per the recommendations of PCI. Board discussed the proposed syllabi and agreed to adopt the change. Board recommended implementation of proposed syllabi from II Semester Examination, April/May, 2020.

(c) In B. Pharmacy III Semester, a new course *Pharmaceutical Physical Chemistry* was proposed. Board discussed the proposed syllabi and agreed upon the suggested change. Board also recommended implementation of the proposed revision in syllabi of *Pharmaceutical Physical Chemistry* from III Semester Examination, December, 2020.

(d) In B. Pharmacy IV semester, change in number of lecture hours and credit was proposed in view of course content and balancing the total credits of semester. Board discussed and agreed upon the suggested change. Board also recommended implementation of the proposed revision in scheme of *Physical Pharmaceutics-II* from IV Semester Examination, April/May, 2021.

(e) In B. Pharmacy V semester syllabus of *Industrial Pharmacy-I, Medicinal Chemistry-II, Pharmacology, Pharmacognosy and Phytochemistry-II, Pharmaceutical Jurisprudence* and practical syllabi *of Industrial Pharmacy-I Lab, Medicinal Chemistry-II Lab, Pharmacology-II Lab, Pharmacognosy and Phytochemistry-II Lab* was proposed as per the recommendation of PCI and same has been approved by the board. Board recommended implementation of the proposed syllabi from V Semester Examination, December, 2021.

(f) In B. Pharmacy VI semester syllabus of *Biopharmaceutics and Pharmacokinetics, Herbal Drug Technology, Medicinal Chemistry-III, Pharmacology-III, Pharmaceutical Biotechnology,* and practical syllabi of *Herbal Drug Technology Lab, Medicinal Chemistry-III Lab, Pharmacology-III Lab* was proposed as recommended by PCI and same was approved by board. Board recommended implementation of the proposed syllabi from VI Semester Examination, May, 2022.

(g) In B Pharmacy VII semester, new courses namely, *Instrumental Methods of Analysis, Industrial Pharmacy-II, Novel Drug Delivery System, Dosage Form Design, Pharmacy Practice, Instrumental Methods of Analysis Lab, Dosage Form Design Lab, Practice School* was proposed as per the recommendation of PCI. The Board discussed the proposed syllabus of all the courses and agreed upon the suggested changes. Board also recommended implementation of the proposed

revision in syllabi of *Instrumental Methods of Analysis*, *Industrial Pharmacy-II*, Novel *Drug Delivery System*, *Dosage Form Design*, *Pharmacy Practice, Instrumental Methods of Analysis Lab, Dosage Form Design Lab, and Practice School* from VII Semester Examination, December 2022.

(h) In B Pharmacy VIII semester, new courses namely, *Biostatistics and Research Methodology*, *Social and Preventive Pharmacy* were proposed as per the recommendation of PCI. The Board discussed the proposed syllabus of all the courses and agreed upon the suggested changes. Board also recommend implementation of the proposed syllabi of *Biostatistics and Research Methodology*, *Social and Preventive Pharmacy and Project Work* from VIII Semester Examination, April/May 2023.

(i) In B Pharmacy VIII semester, Board has approved following electives as per the recommendation of PCI. *Advanced Instrumentation Techniques, Cosmetic Science, Quality Control and Standardization of Herbals, Pharmaceutical Marketing, Pharmaceutical Regulatory, Pharmacovigilance*

Programme specific outcomes and the list of courses of the B. Pharmacy programme is attached and marked as **Annexure-Ia**

The revised syllabus, learning outcomes, list of suggested books and e-learning material of the B. Pharmacy programme is attached and marked as **Annexure-IIa.**

(B) Master of Pharmacy (Pharmaceutical Chemistry/ Pharmaceutics/ Pharmacology) Examination:

i.	First Semester Examination, December, 2019	Change [a, b, c, d, e]
ii.	Second Semester Examination, April/May, 2020	Change [f, g. h]
iii.	Third Semester Examination, December, 2020	Change[i]
iv.	Fourth Semester Examination, April/May, 2021	Change[j]

(a) In M Pharm Pharmacology I semester, title of course *Pharmacological And Toxicological Screening Methods* has been changed to *Pharmacological And Toxicological Screening Methods-I* and content of course has been modified as per recommendations of PCI and same has been approved by Board. Board also recommended implementation of the proposed revision in syllabi of *Pharmacological and Toxicological Screening Methods-I* Semester Examination from December, 2019.

(b) In M Pharm Pharmacology I semester, title of course *Principle of Drug Discovery* has been changed to *Principles of Medicinal Chemistry* and shifted to discipline elective. It has been approved by Board.

(c) In M Pharm Pharmaceutics I semester, minor changes in content of course *Modern Pharmaceutics* has been proposed, such as reshuffling of content between the sections just to match the nature of content and to adjust the work hours. Removal of some duplication in content has also been proposed. The changes in the content have been approved by the Board. Board also recommended implementation of the proposed revision in syllabi of *Modern Pharmaceutics* I Semester Examination from December, 2019.

(d) In M Pharm Pharmaceutical Chemistry, Pharmaceutics I semester, Discipline elective namely, *Pharmacological and Toxicological Screening Methods, Herbal Cosmetics, Advanced Pharmaceutical Biotechnology, Intellectual Property Rights, Regulatory Aspects Food and Nutraceuticals, Regulatory Aspects of Medical Devices* was proposed and same was approved by Board.

(e) In M Pharm Pharmacology I semester, Discipline elective namely, *Principle of Medicinal Chemistry, Herbal Cosmetics, Advanced Pharmaceutical Biotechnology, Intellectual Property Rights, Regulatory Aspects Food and Nutraceuticals, Regulatory Aspects of Medical Devices* was proposed and same was approved by Board.

(f) In M Pharm Pharmaceutics II semester, minor changes in content of course *Advanced Biopharmaceutics & Pharmacokinetics* has been proposed, such as removal of some duplication in content. The changes in the content have been approved by the Board. Board also recommended implementation of the proposed revision in syllabi of *Advanced Biopharmaceutics & Pharmacokinetics* from II Semester Examination, April/May, 2020.

(g) In M Pharm Pharmacology II semester, title of course *Computer Aided Drug Design* has been changed to *Principles of Drug Discovery* as per recommendations of PCI and same has been approved by Board.

(h) In M Pharm Pharmaceutical Chemistry, Pharmaceutics, Pharmacology II semester, open elective was proposed and approved by Board.

(i) In M Pharm Pharmaceutical Chemistry, Pharmaceutics, Pharmacology III semester, reading elective namely, *Pharmacovigilance, Nutraceuticals, Toxicology, Pharmaceutical Industrial Management, Product development, Molecular basis of*

drug discovery, Pharmaceutical Quality Assurance was proposed and approved by BOS.

(j) In M Pharm Pharmaceutical Chemistry, Pharmaceutics, Pharmacology IV semester, reading elective namely, *Pharmacovigilance, Nutraceuticals, Toxicology, Pharmaceutical Industrial Management, Product development, Molecular basis of drug discovery, Pharmaceutical Quality Assurance* was proposed and approved by Board.

Programme specific outcomes and the list of courses of the M. Pharm. programme is attached and marked as **Annexure-Ib**

The revised syllabus, learning outcomes, list of suggested books and e-learning material of the M. Pharm. programme is attached and marked as **Annexure-IIb.**

6. BOS evaluated the reports of the examiners of various examinations of 2016-17 & 2017-18, and observed that in most of the cases examiners are satisfied with the performances of the students.

7. BOS thoroughly analysed the quality of the last year's (2016-17 & 2017-18) question papers keeping the following points in mind:
   (i) Percentage of analytical based questions.
   (ii) Percentage of descriptive questions
   (iii) Percentage of application based questions.
   (iv) Percentage of information based questions.
   (v) Time allotted to the question papers was appropriate or not.

   In most of the papers, it has been found that more than 50% questions are descriptive type and rest are analytical, application and information based. So, it is recommended by the experts that the number of analytical, application and information based questions should be increased in the question papers. The outcome of the analysis of the papers of year 2016-17 & 2017-18 are presented in graphical form.

The summary of the proceedings of the BOS regarding the courses and curriculum is given in the following table:

Bachelor of Pharmacy (B.Pharm.) Examination

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		

Department of Pharmacy
Banasthali Vidyapith

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	**Course code**	**Course Name**	**Modification in Section**		
B. Pharm. First Year **First Semester (Dec.-2019)**	Changes as per PCI regulations (Page No. 13)	PHAR 102	Human Anatomy and Physiology- I	No		Approved by BOS
		PHAR 102L	Human Anatomy and Physiology- I Lab	No		
		PHAR 104	Pharmaceutical Analysis- I	No		
		PHAR 104L	Pharmaceutical Analysis- I Lab	No		
		PHAR 105	Pharmaceutical Inorganic Chemistry	No		
		PHAR 105L	Pharmaceutical Inorganic Chemistry Lab	No		
		PHAR 107	Pharmaceutics- I	No		
		PHAR 107L	Pharmaceutics- I Lab	No		
		PHAR 108	Remedial Biology*	No		
		MATH 110	Remedial Mathematics	No		
B. Pharm. First Year **Second Semester (May-2020)**	Changes as per PCI regulations (Page No. 14)	CS 102	Computer Applications in Pharmacy	No		Approved by BOS
		CS 102L	Computer Applications in Pharmacy Lab	No		
		PHAR 101	Biochemistry	No		
		PHAR 101L	Biochemistry Lab	No		
		PHAR 103	Human Anatomy and Physiology- II	No		
		PHAR 103L	Human Anatomy and Physiology- II Lab	No		
		PHAR 106	Pharmaceutical Organic Chemistry-I	No		
		PHAR 106L	Pharmaceutical Organic Chemistry-I Lab	No		
		PHAR	Pathophysiology	No		
B. Pharm. Second Year **Third Semester (Dec.-2020)**	Changes as per PCI regulations (Page No. 15)	PHAR 204	Pharmaceutical Microbiology	No		Approved by BOS
		PHAR 204L	Pharmaceutical Microbiology Lab	No		
		PHAR 205	Pharmaceutical Organic Chemistry-II	No		
		PHAR 205L	Pharmaceutical Organic Chemistry-II Lab	No		
		PHAR 213	Pharmaceutical Engineering	No		
		PHAR 213L	Pharmaceutical Engineering Lab	No		
		PHAR 217	Physical Pharmaceutics-I	No		

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		
		PHAR 217L	Physical Pharmaceutics-I Lab	No		
		PHAR	Pharmaceutical Physical Chemistry	No		
B. Pharm. Second Year **Fourth Semester (May-2021)**	Changes (Page No. 16)	PHAR 211	Medicinal Chemistry-I	No		Approved by BOS
		PHAR 211L	Medicinal Chemistry-I Lab	No		
		PHAR 214	Pharmaceutical Organic Chemistry-III	No		
		PHAR 215	Pharmacognosy and Phytochemistry-I	No		
		PHAR 215L	Pharmacognosy and Phytochemistry-I Lab	No		
		PHAR 216	Pharmacology-I	No		
		PHAR 216L	Pharmacology-I Lab	No		
		PHAR 218	Physical Pharmaceutics-II	No		
		PHAR 218L	Physical Pharmaceutics-II Lab	No		
B. Pharm. Third Year **Fifth Semester (Dec.-2021)**	Changes as per PCI regulations (Page no. 17)	PHAR	Industrial Pharmacy-I	No		Approved by BOS
		PHAR	Industrial Pharmacy-I Lab	No		
		PHAR	Medicinal Chemistry-II	No		
		PHAR	Medicinal Chemistry-II Lab	No		
		PHAR	Pharmacology-II	No		
		PHAR	Pharmacology-II Lab	No		
		PHAR	Pharmacognosy and Phytochemistry-II	No		
		PHAR	Pharmacognosy and Phytochemistry-II Lab	No		
		PHAR	Pharmaceutical Jurisprudence	No		
B. Pharm. Third Year **Sixth Semester (May-2022)**	Changes as per PCI regulations (Page no. 18)	PHAR	Biopharmaceutics and Pharmacokinetics	No		Approved by BOS
		PHAR	Herbal Drug Technology	No		
		PHAR	Herbal Drug Technology Lab	No		
		PHAR	Medicinal Chemistry-III	No		
		PHAR	Medicinal Chemistry-III Lab	No		
		PHAR	Pharmacology-III	No		

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	**Course code**	**Course Name**	**Modification in Section**		
		PHAR	Pharmacology-III Lab	No		
		PHAR	Pharmaceutical Biotechnology	No		
		PHAR	Quality Assurance	No		
B. Pharm. Fourth Year **Seventh Semester (Dec.-2022)**	Changes as per PCI regulations (Page no. 19)	PHAR	Instrumental Methods of Analysis	No		Approved by BOS
		PHAR	Instrumental Methods of Analysis Lab	No		
		PHAR	Industrial Pharmacy-II	No		
		PHAR	Novel Drug Delivery System	No		
		PHAR	Dosage Form Design	No		
		PHAR	Dosage Form Design Lab	No		
		PHAR	Pharmacy Practice	No		
		PHAR	Practice School	No		
B. Pharm. Fourth Year **Eighth Semester (May-2023)**	Changes as per PCI regulations (Page no. 20)	PHAR	Biostatistics and Research Methodology	No		Approved by BOS
		PHAR	Social and Preventive Pharmacy	No		
		PHAR	Discipline Elective -1	No		
		PHAR	Discipline Elective -2	No		
		PHAR	Open Elective	No		
		PHAR	Project Work [Social and Preventive Pharmacy Project Lab Quality Control and Standardization of Herbals Project Lab Cosmetic Science Project Lab Advanced Instrumentation Techniques Project Lab]	No		

Department of Pharmacy
Banasthali Vidyapith

Master of Pharmacy (Pharmaceutical Chemistry) Examination

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		
M. Pharm. (Pharm. Chem.) First Year **First Sem. (Dec.-2019)**	Yes (Page no. 88)	PHAR 503	Advanced Medicinal Chemistry	No		Approved by BOS
		PHAR 504	Advanced Organic Chemistry – I	No		
		PHAR 509	Chemistry of Natural Products	No		
		PHAR 516	Modern Pharmaceutical Analytical Techniques	No		
		PHAR 519L	Pharmaceutical Chemistry Lab– I	No		
		PHAR	Discipline Elective	Yes		
M. Pharm. (Pharm. Chem.) First Year **Second Sem. (May-2020)**	Yes (Page no. 88)	PHAR 501	Advance Organic Chemistry-II	No		Approved by BOS
		PHAR 507	Advanced Spectral Analysis	No		
		PHAR 511	Computer Aided Drug Design	No		
		PHAR 521	Pharmaceutical Process Chemistry	No		
		PHAR 520L	Pharmaceutical Chemistry Lab – II	No		
		PHAR	Open Elective	Yes		

Master of Pharmacy (Pharmaceutics) Examination

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		
M. Pharm. (Pharmaceutics) First Year **First Sem. (Dec.-2019)**	Yes (Page no. 89)	PHAR 514	Drug Delivery Systems	No		Approved by BOS
		PHAR 516	Modern Pharmaceutical Analytical Techniques	No		
		PHAR 517	Modern Pharmaceutics	Yes	114-115	
		PHAR 522L	Pharmaceutics Lab- I	No		
		PHAR 529	Regulatory Affairs	No		
		PHAR	Discipline Elective	Yes		
M. Pharm. (Pharmaceutics) First Year **Second Sem. (May-2020)**	Yes (Page no. 89)	PHAR 502	Advanced Biopharmaceutics & Pharmacokinetics	Yes	125	Approved by BOS
		PHAR 512	Computer Aided Drug Development	No		
		PHAR 513	Cosmetics And Cosmeceuticals	No		
		PHAR 518	Molecular Pharmaceutics	No		

		PHAR 523L	Pharmaceutics Lab – II	No		
		PHAR	Open Elective	Yes		

Master of Pharmacy (Pharmacology) Examination

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		
M. Pharm. (Pharmacology) First Year **First Sem. (Dec.-2019)**	Changes as per PCI regulation (Page no. 90)	PHAR 505	Advanced Pharmacology – I	No		Approved by BOS
		PHAR 508	Cellular And Molecular Pharmacology	No		
		PHAR 516	Modern Pharmaceutical Analytical Techniques	No		
		PHAR	Pharmacological And Toxicological Screening Methods-I	Yes	134-135	
		PHAR 526L	Pharmacology Lab – I	No		
		PHAR	Discipline Elective	Yes		
M. Pharm. (Pharmacology) First Year **Second Sem. (May-2020)**	Changes as per PCI regulation (Page no. 90)	PHAR 506	Advanced Pharmacology - II	No		Approved by BOS
		PHAR 510	Clinical Research And Pharmacovigilance	No		
		PHAR	Principles of Drug Discovery	Yes	148	
		PHAR 525	Pharmacological And Toxicological Screening Methods-II	No		
		PHAR 527L	Pharmacology Practical – II	No		
		PHAR	Open Elective	Yes		

Master of Pharmacy (Pharmaceutical Chemistry, Pharmaceutics, Pharmacology) Examination

Programme	Modification suggested by Board of Studies in				Page no.	Recommendation
	Scheme of Examination	Course code	Course Name	Modification in Section		
M Pharm. (Pharma. Chemistry, Pharmaceutics, Pharmacology) Second Year **Third & (Dec.-2021) Fourth Sem. (May-2022)**	**Yes** (Page no. 91)	PHAR 601P	Project (Part-I)	No		Approved by BOS
			Reading Elective -1	Yes	**151-158**	
		PHAR 602P	Project (Part-II)	No		
			Reading Elective -2	Yes	**151-158**	

Annexure-IA

Programme and Course Format for BOS minutes

Name of Programme: Bachelor of Pharmacy

Programme Educational Objectives: Pharmacy programme deals with various aspects of modern drug design, drug development, production and quality assurance that are the basis for expertise in all domains of medicine. Pharmacy professionals being a member of healthcare team are unique in their detailed and comprehensive understanding of physical, chemical and biological interactions on the outcomes of drug therapy. They require an understanding of drug entities chemistry, delivery characteristics of dosage formulations, physiological and pharmacological outcomes of drug interactions. Pharmacy curriculum incorporate components of problem solving, case study and project work in the areas of specialization. The main objectives of the Pharmacy programme are:

- To provide exemplary education in a stimulating environment where delivery of pharmaceutical knowledge is integrated with nationally and internationally recognized research to conduct and publish cutting-edge multidisciplinary research in the discovery, utilization and evaluation of therapeutic agents.
- To prepare competent pharmacists at various levels for India.
- To raise sensitivity to professional ethical codes of conduct and social values.
- To prepare globally recognized pharmacy professionals.
- To demonstrate standards of digital literacy that would support professional needs in manufacture, patient care, hospital administration etc.
- To create awareness in society for rationale usage of medicines.
- To create awareness about environmental hazards in relation to GMP & GLP.
- To develop gender-neutral attitudes and practices; respect for all races, nations, religions, cultures, languages and traditions.
- To nurture a temperament that would enable individuals to set and work towards self-driven performance-goals, entrepreneurial ventures and overall leadership.

Programme Outcomes:

PO1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical science and technology; behavioral, social, and administrative pharmaceutical sciences; and manufacturing practices.

PO2: Planning abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decision during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizen or leadership roles when appropriate to facilitate improvement in health and well-being.

PO6: Professional Identity: Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO7: Pharmaceutical Ethics: Honor personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective, make effective presentations and documentation, and give and receive clear instructions.

PO9: The Pharmacist and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO10: Environment and sustainability: Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO11: Life- long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self access and use feedback effectively from others to identify learning needs and to satisfy theses needs on an ongoing basis.

Programme and Course Format for BOS minutes

Programme Scheme: First Year
Semester: First

Changes as per PCI regulations

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
BVF 002	Environment Studies	2	0	0	2
PHAR 102	Human Anatomy and Physiology- I	4	0	0	4
PHAR 102L	Human Anatomy and Physiology- I Lab	0	0	4	2
PHAR 104	Pharmaceutical Analysis- I	4	0	0	4
PHAR 104L	Pharmaceutical Analysis- I Lab	0	0	4	2
PHAR 105	Pharmaceutical Inorganic Chemistry	4	0	0	4
PHAR 105L	Pharmaceutical Inorganic Chemistry Lab	0	0	4	2
PHAR 107	Pharmaceutics- I	4	0	0	4
PHAR 107L	Pharmaceutics- I Lab	0	0	4	2
PHAR 108	Remedial Biology	3	0	0	3
	Semester wise total:	**21**	**0**	**16**	**29**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	General English/General Hindi	2	0	0	2
	Core Foundation Course-I	2	0	0	2
PHAR 102	Human Anatomy and Physiology- I	4	0	0	4
PHAR 104	Pharmaceutical Analysis- I	4	0	0	4
PHAR 105	Pharmaceutical Inorganic Chemistry	4	0	0	4
PHAR 107	Pharmaceutics- I	4	0	0	4
PHAR 108	Remedial Biology*	3	0	0	3
MATH 110	Remedial Mathematics	3	0	0	3
PHAR 102L	Human Anatomy and Physiology- I Lab	0	0	4	2
PHAR 104L	Pharmaceutical Analysis- I Lab	0	0	4	2
PHAR 105L	Pharmaceutical Inorganic Chemistry Lab	0	0	4	2
PHAR 107L	Pharmaceutics- I Lab	0	0	4	2
	Semester wise total:	**23**	**0**	**16**	**31**

***Only for candidates, who are from Mathematics background.**
Remedial Mathematics course (MATH 110) has been shifted from Second to First semester to align the scheme as per PCI norms.

Programme and Course Format for BOS minutes

Programme Scheme: First Year
Semester: Second

Changes as per PCI regulations

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
BVF 003	Indian Heritage	2	0	0	2
CS 102	Computer Applications in Pharmacy	3	0	0	3
CS 102L	Computer Applications in Pharmacy Lab	0	0	4	2
MATH 110	Remedial Mathematics	3	0	0	3
PHAR 101	Biochemistry	4	0	0	4
PHAR 101L	Biochemistry Lab	0	0	4	2
PHAR 103	Human Anatomy and Physiology- II	4	0	0	4
PHAR 103L	Human Anatomy and Physiology- II Lab	0	0	4	2
PHAR 106	Pharmaceutical Organic Chemistry-I	4	0	0	4
PHAR 106L	Pharmaceutical Organic Chemistry-I Lab	0	0	4	2
	Semester wise total:	**20**	**0**	**16**	**28**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	General English/General Hindi	2	0	0	2
	Core Foundation Course-II	2	0	0	2
CS 102	Computer Applications in Pharmacy	3	0	0	3
PHAR 101	Biochemistry	4	0	0	4
PHAR 103	Human Anatomy and Physiology- II	4	0	0	4
PHAR 106	Pharmaceutical Organic Chemistry-I	4	0	0	4
	Pathophysiology	4	0	0	4
CS 102L	Computer Applications in Pharmacy Lab	0	0	4	2
PHAR 101L	Biochemistry Lab	0	0	4	2
PHAR 103L	Human Anatomy and Physiology- II Lab	0	0	4	2
PHAR 106L	Pharmaceutical Organic Chemistry-I Lab	0	0	4	2
	Semester wise total:	**23**	**0**	**16**	**31**

Remedial Mathematics course (MATH 110) has been shifted to first semester; Pathophysiology course (PHAR 212) has been shifted from third to second semester for aligning the course scheme as per PCI norms.

Programme and Course Format for BOS minutes

Programme Scheme: Second Year
Semester: Third

Changes as per PCI regulations

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
BVF 007R	Selected Writings for Self Study-I	2	0	0	2
PHAR 204	Pharmaceutical Microbiology	4	0	0	4
PHAR 204L	Pharmaceutical Microbiology Lab	0	0	4	2
PHAR 205	Pharmaceutical Organic Chemistry-II	4	0	0	4
PHAR 205L	Pharmaceutical Organic Chemistry-II Lab	0	0	4	2
PHAR 212	Pathophysiology	4	0	0	4
PHAR 213	Pharmaceutical Engineering	4	0	0	4
PHAR 213L	Pharmaceutical Engineering Lab	0	0	4	2
PHAR 217	Physical Pharmaceutics-I	4	0	0	4
PHAR 217L	Physical Pharmaceutics-I Lab	0	0	4	2
	Semester wise total:	**22**	**0**	**16**	**30**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Core Foundation Course-III	2	0	0	2
	Elective Foundation Course-I	2	0	0	2
PHAR 204	Pharmaceutical Microbiology	4	0	0	4
PHAR 205	Pharmaceutical Organic Chemistry-II	4	0	0	4
PHAR 213	Pharmaceutical Engineering	4	0	0	4
PHAR 217	Physical Pharmaceutics-I	4	0	0	4
	Pharmaceutical Physical Chemistry	3	0	0	3
PHAR 204L	Pharmaceutical Microbiology Lab	0	0	4	2
PHAR 205L	Pharmaceutical Organic Chemistry-II Lab	0	0	4	2
PHAR 213L	Pharmaceutical Engineering Lab	0	0	4	2
PHAR 217L	Physical Pharmaceutics-I Lab	0	0	4	2
	Semester wise total:	**23**	**0**	**16**	**31**

Pathophysiology course (PHAR 212) has been shifted to second semester to align the scheme as per PCI norms.
Pharmaceutical Physical Chemistry course has been introduced in the third semester to balance the semester load and the course is also important in prospect of GPAT examination.

Programme and Course Format for BOS minutes

Programme Scheme: Second Year
Semester: Fourth

Minor Changes in lecture hours and credit of Physical Pharmaceutics-II

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
BVF 008R	Selected Writings for Self Study-II	2	0	0	2
PHAR 211	Medicinal Chemistry-I	4	0	0	4
PHAR 211L	Medicinal Chemistry-I Lab	0	0	4	2
PHAR 214	Pharmaceutical Organic Chemistry-III	4	0	0	4
PHAR 215	Pharmacognosy and Phytochemistry-I	4	0	0	4
PHAR 215L	Pharmacognosy and Phytochemistry-I Lab	0	0	4	2
PHAR 216	Pharmacology-I	4	0	0	4
PHAR 216L	Pharmacology-I Lab	0	0	4	2
PHAR 218	Physical Pharmaceutics-I	4	0	0	4
PHAR 218L	Physical Pharmaceutics-I Lab	0	0	4	2
	Semester wise total:	**22**	**5**	**16**	**30**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Core Foundation Course-IV	2	0	0	2
	Elective Foundation Course-II	2	0	0	2
PHAR 211	Medicinal Chemistry-I	4	0	0	4
PHAR 214	Pharmaceutical Organic Chemistry-III	4	0	0	4
PHAR 215	Pharmacognosy and Phytochemistry-I	4	0	0	4
PHAR 216	Pharmacology-I	4	0	0	4
PHAR 218	Physical Pharmaceutics-II	3	0	0	3
PHAR 211L	Medicinal Chemistry-I Lab	0	0	4	2
PHAR 215L	Pharmacognosy and Phytochemistry-I Lab	0	0	4	2
PHAR 216L	Pharmacology-I Lab	0	0	4	2
PHAR 218L	Physical Pharmaceutics-II Lab	0	0	4	2
	Semester wise total:	**23**	**0**	**16**	**31**

Programme and Course Format for BOS minutes

Programme Scheme: Third Year
Semester: Fifth

Changes as per PCI regulations

Existing scheme (Old regulations)

Course code	Course Name	L	T	P	C
	Foundation Course-I	3	0	0	3
BPH-5.1	Biochemistry-V	4	0	0	4
	Biochemistry-V Lab	0	0	4	2
BPH-5.2	Hospital Pharmacy	3	0	0	3
BPH-5.3	Pharmaceutical Technology	3	0	0	3
	Pharmaceutical Technology Lab	0	0	4	2
BPH-5.4	Pharmacognosy-III	3	0	0	3
	Pharmacognosy-III Lab	0	0	4	2
BPH-5.5	Pharmacology-I	3	0	0	3
	Pharmacology-I Lab	0	0	4	2
	Semester wise total:	**19**	**0**	**16**	**27**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Vocational Course-I	2	0	0	2
	Core Foundation Course-V / Elective Foundation Course-III	2	0	0	2
	Industrial Pharmacy-I	4	0	0	4
	Medicinal Chemistry-II	4	0	0	4
	Pharmacology-II	4	0	0	4
	Pharmacognosy and Phytochemistry-II	4	0	0	4
	Pharmaceutical Jurisprudence	4	0	0	4
	Industrial Pharmacy-I Lab	0	0	4	2
	Pharmacology-II Lab	0	0	4	2
	Pharmacognosy and Phytochemistry-II Lab	0	0	4	2
	Semester wise total:	**24**	**0**	**12**	**30**

Course scheme modified as per PCI norms

Programme and Course Format for BOS minutes

Programme Scheme: Third Year
Semester: Sixth

Changes as per PCI regulations

Existing scheme (Old regulations)

Course code	Course Name	L	T	P	C
	Foundation Course-II	3	0	0	3
BPH-6.1	Biopharmaceutics and Pharmacokinetics	3	0	0	3
	Biopharmaceutics and Pharmacokinetics Lab	0	0	4	2
BPH-6.2	Drug Regulatory Affairs	3	0	0	3
BPH-6.3	Medicinal Chemistry-I	3	0	0	3
	Medicinal Chemistry-I Lab	0	0	4	2
BPH-6.4	Pharmacognosy-IV	3	0	0	3
	Pharmacognosy-IV Lab	0	0	4	2
BPH-6.5	Pharmacology-II	3	0	0	3
	Pharmacology-II Lab	0	0	4	2
	Semester wise total:	**18**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Vocational Course-II	2	0	0	2
	Elective Foundation Course-III / Core Foundation Course-V	2	0	0	2
	Biopharmaceutics and Pharmacokinetics	4	0	0	4
	Herbal Drug Technology	3	0	0	3
	Medicinal Chemistry-III	4	0	0	4
	Pharmacology-III	4	0	0	4
	Pharmaceutical Biotechnology	3	0	0	3
	Quality Assurance	3	0	0	3
	Herbal Drug Technology Lab	0	0	4	2
	Medicinal Chemistry-III Lab	0	0	4	2
	Pharmacology-III Lab	0	0	4	2
	Semester wise total:	**25**	**0**	**12**	**31**

Course scheme modified as per PCI norms

Programme and Course Format for BOS minutes

Programme Scheme: Fourth Year
Semester: Seventh

Changes as per PCI regulations

Existing scheme (Old regulations)

Course code	Course Name	L	T	P	C
BPH-7.1	Medicinal Chemistry-II	3	0	0	3
	Medicinal Chemistry-II Lab	0	0	4	2
BPH-7.2	Pharmaceutical Analysis-III	3	0	0	3
	Pharmaceutical Analysis-III Lab	0	0	4	2
BPH-7.3	Pharmaceutical Industrial Management	3	0	0	3
BPH-7.4	Pharmaceutical Technology-II	3	0	0	3
	Pharmaceutical Technology-II Lab	0	0	4	2
BPH-7.5	Pharmacology-III	3	0	0	3
	Pharmacology-III Lab	0	0	4	2
	Semester wise total:	**15**	**0**	**16**	**23**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Instrumental Methods of Analysis	4	0	0	4
	Industrial Pharmacy-II	4	0	0	4
	Novel Drug Delivery System	4	0	0	4
	Dosage Form Design	4	0	0	4
	Pharmacy Practice	4	0	0	4
	Instrumental Methods of Analysis Lab	0	0	4	2
	Dosage Form Design Lab	0	0	4	2
	Practice School	0	0	8	4
	Semester wise total:	**20**	**0**	**16**	**30**

Course scheme modified as per PCI norms

Programme and Course Format for BOS minutes

Programme Scheme: Fourth Year
Semester: Eighth

Changes as per PCI regulations

Existing scheme (Old regulations)

Course code	Course Name	L	T	P	C
BPH-8.1	Clinical Pharmacology and Toxicology	3	0	0	3
BPH-8.2	Dosage Form Design	3	0	0	3
	Dosage Form Design Lab	0	0	4	2
BPH-8.3	Medicinal Chemistry-III	3	0	0	3
	Medicinal Chemistry-III Lab	0	0	4	2
BPH-8.4	Natural Products	3	0	0	3
	Natural Products Lab	0	0	4	2
BPH-8.5	Pharmaceutical Biotechnology	3	0	0	3
	Semester wise total:	**15**	**0**	**12**	**21**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
	Biostatistics and Research Methodology	4	0	0	4
	Social and Preventive Pharmacy	4	0	0	4
	Discipline Elective -1	4	0	0	4
	Discipline Elective -2	4	0	0	4
	*Open Elective	4	0	0	4
	Project Work [Social and Preventive Pharmacy Project Lab Quality Control and Standardization of Herbals Project Lab Cosmetic Science Project Lab Advanced Instrumentation Techniques Project Lab]	0	0	16	8
	Semester wise total:	**20**	**0**	**16**	**28**

Course scheme modified as per PCI norms

***List of Discipline elective:**

Course code	Course Name	L	T	P	C
	Advanced Instrumentation Techniques	4	0	0	4
	Pharmaceutical Regulatory Science	4	0	0	4
	Quality Control and Standardization of Herbals	4	0	0	4
	Pharmacovigilance	4	0	0	4
	Cosmetic Science	4	0	0	4
	Pharmaceutical Marketing	4	0	0	4

Programme and Course Format for BOS minutes

List of Core Foundation Course				
Environment Studies	2	0	0	2
Indian Heritage/Indial Cultural Heritage	2	0	0	2
Selected Writings of Great Authors - I	2	0	0	2
Women in Indian Society	2	0	0	2
Parenthood and Family Relation	2	0	0	2

List of Elective Foundation Course				
Science of Happiness	2	0	0	2
Human Anatomy and Physiology	2	0	0	2
Design Thinking	2	0	0	2
Basic Human Values	2	0	0	2
Selected Writings of Great Authors - II	2	0	0	2

List of Vocational Course				
Basic Dress Making	0	0	4	2
Dress Designing	0	0	4	2
Entrepreneurship - I	2	0	0	2
Entrepreneurship - II	2	0	0	2
Radio Production - I	2	0	0	2
Radio Production - II	2	0	0	2
Web Designing & Internet Technology-I	1	0	2	2
Web Designing & Internet Technology-II	1	0	2	2
Library Science - I	1	0	2	2
Library Science - II	1	0	2	2
Photography - I	2	0	0	2
Photography - II	2	0	0	2

Every Student shall also opt for:
Five Fold Education: Physical Education I, Physical Education II,
Five Fold Education: Aesthetic Education I, Aesthetic Education II,
Five Fold Education: Practical Education I, Practical Education II
doing one each semester

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Credits	31	31	31	31	30	31	30	28
Total credits	**243**							

Name of Programme: Bachelor of Pharmacy
Course details: First Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 102 **Course name** Human Anatomy and Physiology-I	Upon completion of this course student will have an understanding of: • gross morphology, structure and functions of cell, skeletal, muscular, lymphatic cardiovascular system of the human body • various homeostatic mechanisms and their imbalances • different types of bones and joints in human body • various tissues of different systems of human body • various experimental techniques related to physiology • various techniques like blood group determination, blood pressure measurement, blood cells counting. • structure and functions of special senses and PNS	**Section-A** **Introduction to human body:** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **Cellular level of organization:** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine **Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues. **Section-B** **Integumentary system:** Structure and functions of skin **Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. **Joints:** Structural and functional classification, types of joints movements and its articulation **Body fluids and blood:** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. **Lymphatic system:** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system **Section-C** **Peripheral nervous system:** Classification of peripheral nervous system, Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses:** Structure and functions of eye, ear, nose and tongue and their disorders. **Cardiovascular system:** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart. **Books recommended (Latest Editions):** 1. Sembulingam K, Sembulingam P, *Essentials of Medical Physiology, Jaypee brothers medical publishers*, New Delhi: 6th edi, 2012. 2. Kathleen JW, *Anatomy and Physiology in Health and Illness, Churchill Livingstone*, New York: 7th edi, 1992 3. Tandon OP, Tripathi Y, *Physiological basis of Medical Practice*, Best and Tailor, Williams & Wilkins Co, USA: 2011 4. Guyton AC, Hall JE, *Text book of Medical Physiology*, Miamisburg, U.S.A: 11th Edi 2006. 5. Tortora GJ, Grabowski SR, *Principles of Anatomy and Physiology*, Palmetto, GA, U.S.A: 2003 6. Singh I, *Textbook of Human Histology*, Jaypee brother's medical publishers, New Delhi, 6th edi: 2011. 7. Ghai CL, *Textbook of Practical Physiology*, Jaypee brother's medical publishers, New Delhi, 8th edi: 2013 8. Srinageswari K, Sharma R, *Practical workbook of Human Physiology*, Jaypee brother's medical publishers, New Delhi, 2015	**Section-A** **Introduction to human body:** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **Cellular level of organization:** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine **Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues. **Section-B** **Integumentary system:** Structure and functions of skin **Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. **Joints:** Structural and functional classification, types of joints movements and its articulation **Body fluids and blood:** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. **Lymphatic system:** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system **Section-C** **Peripheral nervous system:** Classification of peripheral nervous system, Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses:** Structure and functions of eye, ear, nose and tongue and their disorders. **Cardiovascular system:** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart. **Recommended Books (Latest Edition):** 1. Sembulingam, K. Sembulingam, P. (2012). *Essentials of Medical Physiology,* 6th Ed., New Delhi: Jaypee brothers medical publisher. 2. Kathleen, J.W.(1992). *Anatomy and Physiology in Health and Illness*, 7th Ed., New York: Churchill Livingstone. 3. Tandon, O.P. Tripathi, Y. (2011). *Physiological basis of Medical Practice*, Best and Tailor, Williams & Wilkins Co. 4. Guyton, A.C. Hall, J.E. (2006). *Text book of Medical Physiology*, 11th Ed., Miamisburg. 5. Tortora, G.J. (2003). Grabowski SR, *Principles of Anatomy and Physiology*, Palmetto, GA **.** 6. Singh, I. (2011). *Textbook of Human Histology*, 6th Ed., New Delhi: Jaypee brother's medical publishers. 7. Ghai, C.L. (2013). *Textbook of Practical Physiology*, 8th Ed., New Delhi: Jaypee brother's medical publishers. 8. Srinageswari, K. Sharma, R. (2015). *Practical workbook of Human Physiology*, New Delhi: Jaypee brother's medical publishers.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		9. Chatterrje CC, *Human Physiology*, vol 1-2, New Delhi: Academic Publishers Kolkata, 2005. **Reference Books (Latest Editions):** 1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview, MI USA 2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A. 3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata	9. Chatterrje, C.C. (2005). *Human Physiology*, vol 1-2. Kolkatta: Academic Publishers. **Suggested e-material:** 1. www.opentextbc.ca 2. www.study.com 3. www.getbodysmart.com 4. www.kenhub.com	
Course code PHAR 104 **Course name** Pharmaceutical Analysis -I	Upon completion of the course, the student shall be able to know • Different types of analysis. • Principles, instrumentaion and applications of various types of titration • Impurities in medicinal agents	**Section-A** **Pharmaceutical analysis-** Definition and scope, Different techniques of analysis, Methods of expressing concentration, Primary and secondary standards, Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate. **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures. Pharmacopoeia, sources of impurities in medicinal agents, limit tests. **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl **Section-B** **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic principles, methods and application of diazotisation titration. **Redox titrations:** Concepts of oxidation and reduction, types of redox titrations (Principles and applications), cerimetry, iodimetry, iodometry, bromatometry, dichrometry, titration with potassium iodate **Section-C** **Conductometry:** Introduction, conductivity cell, conductometric titrations, applications. **Potentiometry:** Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography:** Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications **Recommended Books: (Latest Editions)** 1. Beckett AH, Stenlake's JB, *Practical Pharmaceutical Chemistry*, vol I-II, Stahlone Press of University of London, 4th edi: 1962 2. Mendham, Vogel,s AI- *Text Book of Quantitative Inorganic*	**Section-A** **Pharmaceutical analysis-** Definition and scope, Different techniques of analysis, Methods of expressing concentration, Primary and secondary standards, Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate. **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures. Pharmacopoeia, sources of impurities in medicinal agents, limit tests. **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl **Section-B** **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic principles, methods and application of diazotisation titration. **Redox titrations:** Concepts of oxidation and reduction, types of redox titrations (Principles and applications), cerimetry, iodimetry, iodometry, bromatometry, dichrometry, titration with potassium iodate **Section-C** **Conductometry:** Introduction, conductivity cell, conductometric titrations, applications. **Potentiometry:** Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography:** Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications **Recommended Books (Latest Edition):** 1. Beckett, A.H. Stenlake, J.B. (1962). *Practical Pharmaceutical Chemistry*, 4th Ed., vol I-II. London: Stahlone Press of University of London. 2. Mendham, (2019). Vogel,s AI- *Text Book of Quantitative Inorganic*	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		analysis, pearson, 6th edi: 2019. 3. Rao PG, *Inorganic Pharmaceutical Chemistry*, pharma med press: 3rd edi, 2006. 4. Atherden LM, *Bentley and Driver's Textbook of Pharmaceutical Chemistry*, Oxford University Press: 2004. 5. Kennedy JK, *Analytical chemistry principles*, Brooks/Cole: 3rd Revised edition, 1990. 6. Indian Pharmacopoeia, 2014, addendum 2016.	*analysis,* 6th Ed., pearson. 3. Rao, P.G. (2006). *Inorganic Pharmaceutical Chemistry*, 3rd Ed., pharma med press. 4. Atherden, L.M. (2004). *Bentley and Driver's Textbook of Pharmaceutical Chemistry*, Oxford University Press. 5. Kennedy, J.K. (1990). *Analytical chemistry principles*, 3rd Ed., Brooks/Cole . 6. *Indian Pharmacopoeia*, (2014). addendum 2016. . **Suggested e-material:** 1. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118695425.ch10 2. https://www.researchgate.net/publication/280224434_Handbook_of_Inorganic_Impurities_in_Pharmaceuticals 3. http://www.rroij.com/open-access/a-review-on-impurity-profile-in-pharmaceutical-substances.php?aid=34989 4. https://www.scribd.com/doc/101354608/Chapter-5-Gastrointestinal-Agents-Reviewer 5. https://www.who.int/medicines/publications/pharmacopoeia/Radgenmono	
Course code PHAR 105 **Course name** Pharmaceutical Inorganic Chemistry	Upon completion of the course, the student shall be able to know • Principles of limit tests • Preparation, assay, properties and medicinal uses different inorganic compounds • Identification of different anions, cations and different inorganic pharmaceuticals. • Sources of impurities and methods to determine the impurities in pharmaceuticals	**Section-A** **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate. *General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes.* **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. **Section-B** **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement. **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite **Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations **Section-C** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite **Astringents:** Zinc Sulphate, Potash Alum **Radiopharmaceuticals:** Radio activity, Measurement of radioactivity,	**Section-A** **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate. *General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes.* **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. **Section-B** **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement. **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite **Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations **Section-C** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite **Astringents:** Zinc Sulphate, Potash Alum **Radiopharmaceuticals:** Radio activity, Measurement of radioactivity,	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances. **Recommended Books (Latest Editions)** 1. Beckett AH, Stenlake's JB, *Practical Pharmaceutical Chemistry*, vol I-II, Stahlone Press of University of London, 4th edi: 1962 2 Mendham, Vogel,s AI- *Text Book of Quantitative Inorganic analysis*, pearson, 6th edi: 2019. 3. Rao PG, *Inorganic Pharmaceutical Chemistry*, pharma med press: 3rd edi, 2006. 4. Schroff ML, *Inorganic Pharmaceutical Chemistry*, national book centre Calcutta: 1968. 5. Atherden LM, *Bentley and Driver's Textbook of Pharmaceutical Chemistry*, Oxford University Press: 2004. 6. Chatwal GR, *Pharmaceutical Chemistry Inorganic*, Himalaya Publishing House: 2010 7. Indian Pharmacopoeia, 2014, addendum 2016.	Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances. **Recommended Books (Latest Edition):** 1. Beckett, A.H. Stenlake, J.B. (1962). *Practical Pharmaceutical Chemistry,* 4th Ed., vol I-II. London: Stahlone Press. 2. Mendham, (2019). Vogel,s AI- *Text Book of Quantitative Inorganic Analysis*, 6th Ed., Pearson. 3. Rao, P.G. (2006). *Inorganic Pharmaceutical Chemistry*, 3rd Ed., pharma med press. 4. Schroff, M.L. (1968). *Inorganic Pharmaceutical Chemistry*, Calcutta: National book centre. 5. Atherden, L.M. (2004). *Bentley and Driver's Textbook of Pharmaceutical Chemistry,* Oxford University Press. 6. Chatwal, G.R. (2010) *Pharmaceutical Chemistry Inorganic*, Himalaya Publishing House. 7. Indian Pharmacopoeia, (2014). Addendum 2016. **Suggested e-material:** 1. http://www.sciencedirect.com/science/book/9780123851109 2. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118695425.ch10 3. https://www.researchgate.net/publication/280224434_Handbook_of_Inorganic_Impurities_in_Pharmaceuticals 4. http://www.rroij.com/open-access/a-review-on-impurity-profile-in-pharmaceutical-substances.php?aid=34989 5. https://www.scribd.com/doc/101354608/Chapter-5-Gastrointestinal-Agents-Reviewer 6. https://www.who.int/medicines/publications/pharmacopoeia/Radgenmono	
Course code PHAR 107 **Course name** Pharmaceutics-I	Upon completion of the course, the student shall be able to know • Importance of IP, BP, USP and Extra Pharmacopoeia. • Definition, preparation, classification, advantages and disadvantages of different dosage forms • Pharmaceutical incompatibilities and calculations. • Professional handling of prescription.	**Section-A** **Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area. **Pharmaceutical calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Section-B** **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility	**Section-A** **Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area. **Pharmaceutical calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Section-B** **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups,	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		enhancement techniques **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. **Section-C** **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. **Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples. **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms **Recommended Books: (Latest Editions)** 1. Allen IV, Popovich JNG, Ansel HC, *Ansel's Pharmaceutical Dosage Form and Drug Delivery System,* Lippincott Williams andWalkins, New Delhi: 8th edi 2005, 2. Carter SJ, *Cooper and Gunn's-Dispensing for Pharmaceutical Students,* CBS publishers, New Delhi: 12th edi, 2008. 3. Aulton ME, *Pharmaceutics, The Science& Dosage Form Design*, Churchill Livingstone, Edinburgh: 2nd edi, 2002. 4. Indian Pharmacopoeia, 2014, addendum 2016. 5. British pharmacopoeia, 2019. 6. Lachmann, *Theory and Practice of Industrial Pharmacy*, Lea and Febiger Publisher, The University of Michigan: 2009. 7. Remington ARG, *The Science and Practice of Pharmacy*, Lippincott Williams and willikins, New Delhi: 21st edi, 2005 8. *Cooper and Gunn's. Tutorial Pharmacy*, CBS Publications, New Delhi: edited by Carter SJ. 9. *Bentley's Text Book of Pharmaceutics*, English Language Book Society, Elsevier Health Sciences, USA, edited by Rawlins EA: 2010. 10. Dekker M, *Pharmaceutical Pelletization Technology*,INC, New York:edited by Isaac Ghebre Sellassie, 1989 11. Pareekh DM, Dekker M, *Handbook of Pharmaceutical Granulation Technology*, INC, New York: 2nd edi, 2005. 12. Nieloud F and Mestres GM, Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York: 2000.	Elixirs, Liniments and Lotions. **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. **Section-C** **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. **Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples. **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms **Recommended Books (Latest Edition):** 1. Allen, I.V., Popovich, J.N.G. Ansel, H.C. (2005) *Ansel's Pharmaceutical Dosage Form and Drug Delivery System*, 8th Ed., New Delhi: Lippincott Williams andWalkins. 2. Carter, S.J. (2008). *Cooper and Gunn's-Dispensing for Pharmaceutical Students*,12th Ed., New Delhi: CBS publishers. 3. Aulton, M.E. (2002) *Pharmaceutics, The Science& Dosage Form Design*, 2nd Ed., Edinbrg:Churchill Livingstone. 4. *Indian Pharmacopoeia*, (2014). Addendum 2016. 5. *British pharmacopoeia*, (2019). 6. Lachmann, L., Lieberman, H.A., Kaing, J.L., (2009). *Theory and Practice of Industrial Pharmacy, Lea and Febiger Publisher*. 7. Remington, J.P., Gennaro, A.R., Remington, A.R.G. (2005). *The Science and Practice of Pharmacy*, 21st Ed., New Delhi: Lippincott Williams and willikins. 8. Carter, S.J. (2005). *Cooper and Gunn's-Dispensing for Pharmaceutical Students*,12th Ed., New Delhi: CBS publishers. 9. Rawlins, (2010). *Bentley's Text Book of Pharmaceutics*, Elsevier Health Sciences,. 10. Bodmier, R., (1089). *Pharmaceutical Pelletization Technology,* INC, New York: Marcel Dekker. 11. Pareekh, D.M. (2005). *Handbook of Pharmaceutical Granulation Technology,* 2nd Ed., New York: INC. 12. Nieloud, F. Mestres, G.M., (2000) Pharmaceutical Emulsions and Suspensions, New York: Marcel Dekker, INC. **Suggested e-material:** 1. https://health.sbmu.ac.ir/uploads/Remington_Essentials_of_Pharmaceutics_-_Felton,_Linda.pdf 2. http://gmpua.com/Process/EncyclopediaPT.pdf 3. http://pharmacentral.in/wp-content/uploads/2018/05/INDIAN%20PHARMACOPOEIA%202007.pdf 4. https://www.pdfdrive.com/pharmacy-calculations-for-pharmacy-technicians-d58957811.html 5. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-6-1-fasttrac-g.pdf	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 108 **Course name** Remedial Biology	Upon completion of this course student will have an understanding of: ▪ Evolutionary biology and behaviour. ▪ Anatomy, physiology and regulation of various body system ▪ Plant physiology	**Section-A** **Living world:** • Definition and characters of living organisms • Diversity in the living world • Binomial nomenclature • Five kingdoms of life and basis of classification. Salient features of Monera, • Potista, Fungi, Animalia and Plantae, Virus. **Morphology of Flowering plants:** • Morphology of different parts of flowering plants – Root, stem, inflorescence, • Flower, leaf, fruit, seed. • General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones. **Body fluids and circulation** • Composition of blood, blood groups, coagulation of blood • Composition and functions of lymph • Human circulatory system • Structure of human heart and blood vessels • Cardiac cycle, cardiac output and ECG **Digestion and Absorption** • Human alimentary canal and digestive glands • Role of digestive enzymes • Digestion, absorption and assimilation of digested food **Section-B** **Breathing and respiration** • Human respiratory system • Mechanism of breathing and its regulation • Exchange of gases, transport of gases and regulation of respiration • Respiratory volumes **Excretory products and their elimination** • Modes of excretion • Human excretory system- structure and function • Urine formation • Rennin angiotensin system **Neural control and coordination** • Definition and classification of nervous system • Structure of a neuron • Generation and conduction of nerve impulse • Structure of brain and spinal cord • Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata **Chemical coordination and regulation** • Endocrine glands and their secretions • Functions of hormones secreted by endocrine glands **Section-C** **Human reproduction** • Parts of female reproductive system • Parts of male reproductive system • Spermatogenesis and Oogenesis • Menstrual cycle **Plants and mineral nutrition:** • Essential mineral, macro and micronutrients • Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis**	**Section-A** **Living world:** Definition and characters of living organisms, Diversity in the living world, Binomial nomenclature, Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus. **Morphology of Flowering plants:** Morphology of different parts of flowering plants – Root, stem, inflorescence, Flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones. **Body fluids and circulation:** Composition of blood, blood groups, coagulation of blood, Composition and functions of lymph, Human circulatory system, Structure of human heart and blood vessels, Cardiac cycle, cardiac output and ECG. **Digestion and Absorption:** Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food **Section-B** **Breathing and respiration:** Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes. **Excretory products and their elimination:** Modes of excretion, Human excretory system- structure and function, Urine formation, Rennin angiotensin system. **Neural control and coordination:** Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse, Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata. **Chemical coordination and regulation:** Endocrine glands and their secretions, Functions of hormones secreted by endocrine glands. **Section-C** **Human reproduction:** Parts of female reproductive system, Parts of male reproductive system, Spermatogenesis and Oogenesis, Menstrual cycle. **Plants and mineral nutrition:** Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis:** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis. **Plant respiration:** Respiration, glycolysis, fermentation (anaerobic). Plant growth and development, Phases and rate of plant growth, Condition of growth,Introduction to plant growth regulators **Cell - The unit of life:** Structure and functions of cell and cell organelles. Cell division **Tissues:** Definition, types of tissues, location and functions. **Recommended Books (Latest Edition):** **1.** Gokhale, S.B., Kokate, C.K., Bidarkar, D.S., (2007). Pharmaceutical Biology, 5th Ed., Nirali Prakashan. **2.** Thulajappa, Y., Seetaram, P.I., (2005). New Expert Biology, vol2, Expert educational publisher.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis. **Plant respiration:** Respiration, glycolysis, fermentation (anaerobic). Plant growth and development • Phases and rate of plant growth, Condition of growth,Introduction to plant growth regulators **Cell - The unit of life** • Structure and functions of cell and cell organelles. Cell division **Tissues** • Definition, types of tissues, location and functions. **Text Books** a. Text book of Biology by S. B. Gokhale b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram. **Reference Books** 1. Gokhale SB, kokate CC, Bidarkar DS, *Text book of Pharmaceutical Biology*, Nirali Prakashan: 5th edi, 2007. 2. Thulajappa Y, Seetaram PI, *New expert biology*: vol 2, 2008. 3. Ayyer ME, Viswanathan S, Ananthakrishnan TN, *Outlines of Zoology*, Madras: 1992.	**Suggested e-material:** 1. www.opentextbc.ca 2. www.study.com 3. www.getbodysmart.com 4. www.kenhub.com 5. www.apchute.com 6. www.openstax.cnx.org	
Course code MATH 110 **Course name** Remedial Mathematics	**Learning outcomes** Upon completion of the course, the student shall be able to know • Mathematical concepts and principles to perform various calculations in Pharmacy • mathematical expressions and mathematical relationships • Abstract mathematical reasoning	**Section-A** **Partial fraction:** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms:** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function**: Real Valued function, Classification of real valued functions. **Limits and continuity**: Introduction, Limit of a function, Definition of limit of a function (- definition), lim $x\ a\ x^n\ a^n/x\text{-}a\ na^{n\ 1}$, lim 0 sin 1, **Section-B** **Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations **Differentiation**: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of *xn w.r.t*x,where *n* is any rational number, Derivative of *ex,*, Derivative of loge *x ,* Derivative of *ax* ,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. **Section-C** **Analytical Geometry** **Introduction:** Signs of the Coordinates, Distance formula, **Straight Line** : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line	**Section-A** **Partial fraction:** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms:** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function**: Real Valued function, Classification of real valued functions. **Limits and continuity**: Introduction, Limit of a function, Definition of limit of a function (- definition), lim $x\ a\ x^n\ a^n/x\text{-}a\ na^{n\ 1}$, lim 0 sin 1, **Section-B** **Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations **Differentiation**: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of *xn w.r.t.* x,where *n* is any rational number, Derivative of *ex,*, Derivative of loge *x ,* Derivative of *ax* ,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. **Section-C** **Analytical Geometry** **Introduction:** Signs of the Coordinates, Distance formula. **Straight Line**: Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application **Differential Equations**: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations **Laplace Transform**: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations**,** Application in solving Chemical kinetics and Pharmacokinetics equations **Books recommended:** 1. Narayan S, Mittal PK, *Differential Calculus,* S Chand: 2005 2. Panchaksharappa G, DH, *Pharmaceutical Mathematics with application to Pharmacy,* 2014. 3. Narayan S, *Integral Calculus*, S Chand: 2005. ***4.*** Grewal BS, *Higher Engineering Mathematics*, Khanna Publisher: edi 36, 2001.	**Integration:** Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application **Differential Equations**: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations **Laplace Transform**: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations**,** Application in solving Chemical kinetics and Pharmacokinetics equations **Recommended Books (Latest Edition):** 1. Narayan, S. Mittal, P.K. (2005). *Differential Calculus*, S Chand. 2. Panchaksharappa, G.D.H. (2014). *Pharmaceutical Mathematics with application to Pharmacy*, new delhi: CBS Publishers and Distributors. 3. Narayan, S. (2005). *Integral Calculus*, S Chand **4.** 4. Grewal, B.S. (2001). *Higher Engineering Mathematics*, 36th edi., Khanna Publisher. **Suggested e-material:** 1. www.openculture.com/free-math-textbooks 2. E-Books | mathematics.library.cornell.edu	
Course code PHAR 102L **Course name** Human Anatomy and Physiology-I Lab		Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject. 1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) count 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of hemoglobin content 12. Determination of blood group. 13. Determination of erythrocyte sedimentation rate (ESR). 14. Determination of heart rate and pulse rate. 15. Recording of blood pressure.	Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject. 1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) count 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of hemoglobin content 12. Determination of blood group. 13. Determination of erythrocyte sedimentation rate (ESR). 14. Determination of heart rate and pulse rate. 15. Recording of blood pressure.	
Course code PHAR 104L **Course name** Pharmaceutical Analysis-I Lab		**I Limit Test of the following** (1) Chloride (2) Sulphate (3) Iron (4) Arsenic **II Preparation and standardization of** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate **III Assay of the following compounds along with Standardization of Titrant** (1) Ammonium chloride by acid base titration	**I Limit Test of the following** (1) Chloride (2) Sulphate (3) Iron (4) Arsenic **II Preparation and standardization of** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate **III Assay of the following compounds along with Standardization of Titrant** (1) Ammonium chloride by acid base titration	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		(2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration **IV Determination of Normality by electro-analytical methods** (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base	(2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration **IV Determination of Normality by electro-analytical methods** (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base	
Course code PHAR 105L **Course name** Pharmaceutical Inorganic Chemistry Lab		**I Limit tests for following ions** Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic **II Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate **III Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide **IV Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate	**I Limit tests for following ions** Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic **II Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate **III Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide **IV Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate	
Course code PHAR 107L **Course name** Pharmaceutics-I Lab		**1 . Syrups** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 **2. Elixirs** a) Piperazine citrate elixir b) Paracetamol pediatric elixir **3.Linctus** a) Terpin Hydrate Linctus IP'66 b) Iodine Throat Paint (Mandles Paint) **4. Solutions** a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution **5. Suspensions** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel **6. Emulsions** a) Turpentine Liniment b) Liquid paraffin emulsion **7. Powders and Granules** a) ORS powder (WHO) b) Effervescent granules c)Dusting powder	**1 . Syrups** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 **2. Elixirs** a) Piperazine citrate elixir b) Paracetamol pediatric elixir **3.Linctus** a) Terpin Hydrate Linctus IP'66 b) Iodine Throat Paint (Mandles Paint) **4. Solutions** a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution **5. Suspensions** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel **6. Emulsions** a) Turpentine Liniment b) Liquid paraffin emulsion **7. Powders and Granules** a) ORS powder (WHO) b) Effervescent granules c)Dusting powder	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		d)Divded powders **8. Suppositories** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository **9. Semisolids** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel **10. Gargles and Mouthwashes** a) Iodine gargle b) Chlorhexidine mouthwash	d)Divded powders **8. Suppositories** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository **9. Semisolids** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel **10. Gargles and Mouthwashes** a) Iodine gargle b) Chlorhexidine mouthwash	

Name of Programme: Bachelor of Pharmacy
Course details: Second semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code CS 102 **Course name** Computer Applications in Pharmacy	Upon completion of the course, the student shall be able to know • Mathematics and computing fundamentals used in pharmaceutical applications • Analyzing pharmaceutical problems using computers. • Integration and application of contemporary IT tools in Pharmaceutical related activities. • Ethics, social, cultural and regulations with regard to Pharmacy.	**Section-A** **Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project **Section-B** **Web technologies:** Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database **Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring. Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System. **Section-C** **Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery **Computers as data analysis in Preclinical development:** Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS) **Recommended books (Latest edition):** 1. Fassett WE, Lea, Febiger, *Computer Application in Pharmacy,* 600 South Washington Square, USA: 2015, 922-1330. 2. Ekins S, *Computer Application in Pharmaceutical Research and*	**Section-A** **Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project **Section-B** **Web technologies:** Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database **Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring. Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System. **Section-C** **Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery **Computers as data analysis in Preclinical development:** Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS) **Recommended Books (Latest edition):** 1. Fassett, W.E. Lea, Febiger, (2015). *Computer Application in Pharmacy,* pg: 922-1330, 600 South Washington Square. 2. Ekins, S. (2006). *Computer Application in Pharmaceutical Research and Development*, Wiley-Interscience, A John Willey and	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Development, Wiley-Interscience, A John Willey and Sons, INC., Publication, USA: 2006. 3. Rastogi SC, *Bioinformatics (Concept, Skills and Applications)*, CBS Publishers and Distributors, New Delhi: 2006 4. Prague CN, *Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath*, Wiley Dreamtech India (P) Ltd, New Delhi: 2003	Sons, INC. 3. Rastogi, S.C. (2006). *Bioinformatics (Concept, Skills and Applications)*, New Delhi: CBS Publishers and Distributors. 4. Prague, C.N. (2003). *Microsoft office Access - 2003, Application Development Using VBA*, *SQL Server, DAP and Infopath*, New Delhi: Wiley Dreamtech India (P) Ltd. **Suggested e-material:** 1. https://www.ebooks.com/subjects/computers 2. https://bookboon.com/en/it-programming-ebooks	
Course code PHAR 212 **Course name** Pathophysiology	Upon completion of the course, the student shall be able to know • Basic principles of cell injury and adaptation • Etiology and pathogenesis of the various disease • Signs, symptoms and complications of various diseases	**Section-A** **Basic principles of cell injury and adaptation:** Introduction, definitions, homeostasis, components and types of feedback systems, causes of cellular injury, pathogenesis (cell membrane damage, mitochondrial damage, ribosome damage, nuclear damage), morphology of cell injury – Adaptive changes (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia), cell swelling, iIntra cellular accumulation, calcification, enzyme leakage and cell death acidosis & alkalosis, electrolyte imbalance. **Basic mechanism involved in the process of inflammation and repair:** Introduction, clinical signs of inflammation, different types of inflammation, mechanism of inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, mediators of inflammation, basic principles of wound healing in the skin. **Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, chronic obstructive airways diseases. **Renal system:** Acute and chronic renal failure. **Section-B** **Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Section-C** **Gastrointestinal system:** Peptic ulcer, inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout. **Principles of cancer:** Classification, etiology and pathogenesis of cancer. **Infectious diseases:** Meningitis, typhoid, leprosy, tuberculosis, urinary tract infections **Sexually transmitted diseases:** AIDS, syphilis, gonorrhea. **Recommended Books (Latest Editions)** 1. Kumar V, Abas AK, Aster JC, *Robbins &Cotran Pathologic Basis of Disease*, South Asia edition, India, Elsevier: 2014. 2. Mohan H, *Text book of Pathology*, Jaypee Publications: 6th edi, 2010. 3. Laurence B, Bruce C, Bjorn K, *Goodman Gilman's The Pharmacological Basis of Therapeutics,* New York, McGraw-Hill: edi 12th, 2011. 4. Herbert C, Taylor, Burke N, *Best and Taylor's Physiological basis*	**Section-A** **Basic principles of cell injury and adaptation:** Introduction, definitions, homeostasis, components and types of feedback systems, causes of cellular injury, pathogenesis (cell membrane damage, mitochondrial damage, ribosome damage, nuclear damage), morphology of cell injury – Adaptive changes (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia), cell swelling, iIntra cellular accumulation, calcification, enzyme leakage and cell death acidosis & alkalosis, electrolyte imbalance. **Basic mechanism involved in the process of inflammation and repair:** Introduction, clinical signs of inflammation, different types of inflammation, mechanism of inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, mediators of inflammation, basic principles of wound healing in the skin. **Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, chronic obstructive airways diseases. **Renal system:** Acute and chronic renal failure. **Section-B** **Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Section-C** **Gastrointestinal system:** Peptic ulcer, inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout. **Principles of cancer:** Classification, etiology and pathogenesis of cancer. **Infectious diseases:** Meningitis, typhoid, leprosy, tuberculosis, urinary tract infections **Sexually transmitted diseases:** AIDS, syphilis, gonorrhea. **Recommended Books (Latest Edition):** 1. Kumar, V. Abas, A.K. Aster, J.C. (2014). Robbins &Cotran Pathologic Basis of Disease, South Asia edition, Elsevier. 2. Mohan, H. (2010). *Text book of Pathology*, 6th Ed., Jaypee Publications. 3. Laurence, B. Bruce, C. Bjorn, K. (2011). *Goodman Gilman's The Pharmacological Basis of Therapeutics*, 12th Ed., New York: McGraw-Hill. 4. Herbert, C. Taylor, Burke, N. (2011). *Best and Taylor's Physiological basis of medical practice*, 13th Ed., 1899-1978,	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		of medical practice, united states: edi 12th, 2011, 1899-1978; 5. Colledge NR, Walker BR, Stuart HR, *Davidson's Principles and Practice of Medicine*, London, ELBS/Churchill Livingstone: edi 21st 2010. 6. Guyton AJ, Hall E, *Textbook of Medical Physiology*, WB Saunders Company: edi 12th, 2010. 7. Piro JD, Talbert RL, Yee G, Wells B, Michael L, Posey, *Pharmacotherapy: A Pathophysiological Approach*, McGraw-Hill Medical London: edi 9th, 2014. 8. Kumar V, Cotran RS, Robbins SL, *Basic Pathology*, Philadelphia, WB Saunders Company, edi 6th 1997. 9. Walker R, Edwards C, *Clinical Pharmacy and Therapeutics*, Churchill Livingstone publication London, Edi 3rd, 2003.	Wolters Kluwer India Pvt. Ltd. 5. Colledge, N.R. Walker, B.R. Stuart, H.R. (2010). *Davidson's Principles and Practice of Medicine*, 21st Ed., London: ELBS/Churchill Livingstone. 6. Guyton, A.J. Hall, E. (2010). *Textbook of Medical Physiology,* 12th Ed., WB Saunders Company. 7. Piro, J.D. Talbert, R.L. Yee, G. Wells, B. Michael, L. Posey, (2014). *Pharmacotherapy: A Pathophysiological Approach,* 9th Ed., London: McGraw-Hill Medical. 8. Kumar, V. Cotran, R.S. Robbins, S.L. (1997). *Basic Pathology,* Philadelphia, WB Saunders Company. 9. Walker, R. Edwards, C. (2003). *Clinical Pharmacy and Therapeutics,* 3rd Ed., London: Churchill Livingstone publication. **Suggested e-material:** 1. www.wesnorman.com 2. www.pharmacologyeducation.org 3. www.pharmacology2000.com 4. www.healthline.com 5. www.mayoclinic.org 6. www.webmed.com 7. www.merckvetmanual.com	
Course code PHAR 101 **Course name** Biochemistry	Upon completion of the course, the student shall be able to know • Fundamentals roles of biomolecules • Various metabolic pathways and regulations of biological/biochemical processes • Introduction, properties, nomenclature, classification, therapeutic and diagnostic applications of enzymes	**Section-A** **Biomolecules:** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics:** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP **Carbohydrate metabolism:** Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance. Hormonal regulation of blood glucose level and Diabetes mellitus **Section-B** **Biological oxidation:** Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate phosphorylation. Inhibitors ETC and oxidative phosphorylation/Uncouplers **Lipid metabolism:** β-Oxidation of saturated fatty acid (Palmitic acid). Formation and utilization of ketone bodies; ketoacidosis. De novo synthesis of fatty acids (Palmitic acid). Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D. Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism:** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders. Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia). Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice **Section-C** **Nucleic acid metabolism and genetic information transfer:**	**Section-A** **Biomolecules:** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics:** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP **Carbohydrate metabolism:** Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance. Hormonal regulation of blood glucose level and Diabetes mellitus **Section-B** **Biological oxidation:** Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate phosphorylation. Inhibitors ETC and oxidative phosphorylation/Uncouplers **Lipid metabolism:** β-Oxidation of saturated fatty acid (Palmitic acid). Formation and utilization of ketone bodies; ketoacidosis. De novo synthesis of fatty acids (Palmitic acid). Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D. Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism:** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders. Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia). Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice **Section-C** **Nucleic acid metabolism and genetic information transfer:** Biosynthesis of purine and pyrimidine nucleotides. Catabolism of	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Biosynthesis of purine and pyrimidine nucleotides. Catabolism of purine nucleotides and Hyperuricemia and Gout disease. Organization of mammalian genome. Structure of DNA and RNA and their functions. DNA replication (semi conservative model). Transcription or RNA synthesis. Genetic code, Translation or Protein synthesis and inhibitors. **Enzymes:** Introduction, properties, nomenclature and IUB classification of enzymes. Enzyme kinetics (Michaelis plot, Line Weaver Burke plot). Enzyme inhibitors with examples. Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation. Therapeutic and diagnostic applications of enzymes and isoenzymes. Coenzymes –Structure and biochemical functions. **Recommended Books (Latest Editions)** 1. Nelson DL, Cox MM, *Lehninger-Principles of Biochemistry*, W H Freeman & Co:Edi 6th, 2012 2. Murry RK, Bender DK, Bothom KA, Kennely PJ, Well PA, Rodwell VW, *Harper's Biochemistry,* edi 28th, 2009. 3. Chakrapani U, Satyanarayan U, Biochemistry, Books and Allied PVT, 2012. 4. Rao AVSSR, *Textbook of Biochemistry*, UBS Publishers' Distributors Pvt. Ltd: 2008. 5. Conn E, Stumpf P, Bruening G, DOI RH, *Outlines of Biochemistry*, John Wiley & Sons, Edi 5th, 2009. 6. Gupta RC, Bhargavan S, *Practical Biochemistry*, 5th edi, 2019. 7. Plummer DT, *An Introduction of Practical Biochemistry*, McGraw-Hill (UK) Edi 3rd, 1987.	purine nucleotides and Hyperuricemia and Gout disease. Organization of mammalian genome. Structure of DNA and RNA and their functions. DNA replication (semi conservative model). Transcription or RNA synthesis. Genetic code, Translation or Protein synthesis and inhibitors. **Enzymes:** Introduction, properties, nomenclature and IUB classification of enzymes. Enzyme kinetics (Michaelis plot, Line Weaver Burke plot). Enzyme inhibitors with examples. Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation. Therapeutic and diagnostic applications of enzymes and isoenzymes. Coenzymes –Structure and biochemical functions. **Recommended Books (Latest Edition):** 1. Nelson, D.L. Cox, M.M. (2012). *Lehninger-Principles of Biochemistry,* 6th Ed., W H Freeman & Co. 2. Murry, R.K. Bender, D.K. Bothom, K.A. Kennely, P.J. Well, P.A. Rodwell, V.W. (2009). *Harper's Biochemistry*, 28th Ed., New York: McGra-Hill. 3. Chakrapani, U. Satyanarayan, U. (2012). *Biochemistry*, Books and Allied PVT. 4. Rao, A.V.S.S.R. (2008). *Textbook of Biochemistry*, UBS Publishers' Distributors Pvt. Ltd. 5. Conn, E. Stumpf, P. Bruening, G. Doi R.H. (2009). *Outlines of Biochemistry,* 5th Ed., John Wiley & Sons. 6. Gupta, R.C. Bhargavan, S.(2019). *Practical Biochemistry*, 5th Ed., New Delhi: Jaypee brother's medical publishers 7. Plummer, D.T. (1987). *An Introduction of Practical Biochemistry*, 3rd Ed., UK: McGraw-Hill. **Suggested e-material:** 1. http://lib.myilibrary.com/?id=276871 From Physiology and Chemistry to Biochemistry Burma, D. P.; Chakraworty, Maharani Pearson publisher 2. http://lib.myilibrary.com/?id=527025 Principles of Biochemistry: Pearson New International Edition Moran, Laurence A;Horton, Robert A;Scrimgeour, Gray Pearson publisher 3. http://onlinelibrary.wiley.com/book/10.1002/9783527622023Enzyme Kinetics: Principles and Methods, Second Edition Hans Bisswanger Wiley publisher 4. http://www.sciencedirect.com/science/book/9780123851109 5. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118695425.ch10	
Course code PHAR 103 **Course name** Human Anatomy and Physiology-II	Upon completion of the course, the student shall be able to know • Anatomy and physiology of various body system • Principles of body energetics • Concept of genetic material	**Section-A** **Nervous system:** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. **Central nervous system:** Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity) **Digestive system:** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestineand large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.	**Section-A** **Nervous system:** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. **Central nervous system:** Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity) **Digestive system:** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestineand large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Energetics: Formation and role of ATP, Creatinine Phosphate and BMR. **Section-B** **Respiratory system:** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system:** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney. **Section-C** **Endocrine system:** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. **Reproductive system:** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics:** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance **Recommended Books (Latest Editions)** 1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam K, Sembulingam P, *Essentials of Medical Physiology, Jaypee brothers medical publishers*, New Delhi: 6th edi, 2012. 2. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier 3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA: 1979. 4. Tortora GJ, Grabowski SR, *Principles of Anatomy and Physiology*, Palmetto, GA, U.S.A: 2003 5. Singh I, *Textbook of Human Histology*, Jaypee brother's medical publishers, New Delhi, 6th edi: 2011. 6. Ghai CL, *Textbook of Practical Physiology*, Jaypee brother's medical publishers, New Delhi, 8th edi: 2013 7. Srinageswari K, Sharma R, *Practical workbook of Human Physiology*, Jaypee brother's medical publishers, New Delhi, 2015 8. 9. 10. Guyton AC, Hall JE, *Text book of Medical Physiology*, Miamisburg, U.S.A: 11th Edi 2006. **Reference Books:** 1 Tandon OP, Tripathi Y, *Physiological basis of Medical Practice*, Best and Tailor, Williams & Wilkins Co, USA: 2011. 2. Guyton AC, Hall JE, *Text book of Medical Physiology*, Miamisburg, U.S.A: 11th Edi 2006. 3. Chatterrje CC, *Human Physiology*, vol 1-2, Academic Publishers Kolkata, 2005.	**Energetics:** Formation and role of ATP, Creatinine Phosphate and BMR. **Section-B** **Respiratory system:** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system:** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney. **Section-C** **Endocrine system:** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. **Reproductive system:** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics:** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance **Recommended Books (Latest Edition):** 1. Sembulingam, K. Sembulingam, P. (2012). *Essentials of Medical Physiology,* 6th Ed., New Delhi: Jaypee brothers medical publishers. 2. Rang, H. P. Dale, M. M. Ritter, J. M. Flower, R. J. (2015). *Rang and Dale's Pharmacology*, 8th Ed., Churchil Livingstone Elsevier. 3. Tandon, O.P. Tripathi, Y. (1979). *Physiological basis of Medical Practice-Best and Tailor,* Williams & Wilkins Co, Riverview. 4. Guyton, A.C. Hall, J.E. (2006). *Text book of Medical Physiology,*11th Ed., Miamisburg,. 5. Tortora, G.J. Grabowski, S.R. (2003). *Principles of Anatomy and Physiology*, Palmetto, GA. 6. Singh, I. (2011). *Textbook of Human Histology*, 6th Ed., New Delhi: Jaypee brother's medical publishers. 7. Ghai, C.L. (2013). *Textbook of Practical Physiology*, 8th Ed., New Delhi: Jaypee brother's medical publishers. 8. Srinageswari, K. Sharma, R. (2015). *Practical workbook of Human Physiology,* New Delhi: Jaypee brother's medical publishers. 9. Tandon, O.P. Tripathi, Y. (2011). *Physiological basis of Medical Practice,* Best and Tailor, Williams & Wilkins Co. 10. Guyton, A.C. Hall, J.E. (2006). *Text book of Medical Physiology,* 6th Ed., Miamisburg. 11. Chatterrje, C.C. (2005*). Human Physiology*, vol 1-2, Kolkatta: Academic Publishers. **Suggested e-material:** 1. www.apchute.com 2. www.openstax.cnx.org 3. www.wesnorman.com	
Course code PHAR 106 **Course name** Pharmaceutical Organic Chemistry-I	Upon completion of the course, the student shall be able to know • Types, classification, principles/mechanisms, applications of isomerism in organic compounds	*General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences* **Section-A** **Classification, nomenclature and isomerism:** Classification of Organic	*General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences* **Section-A** **Classification, nomenclature and isomerism:** Classification of Organic	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	• General methods of preparation and reactions types, principles/mechanisms, applications of alkanes, alkenes, conjugated dienes, alkyl halides, alcohols, carbonyl compounds (aldehydes and ketones), carboxylic acids& aliphatic amines	Compounds. Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds). Structural isomerisms in organic compounds **Alkanes*, Alkenes* and Conjugated dienes*:** SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP^2 hybridization in alkenes. E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement **Section-B** **Alkyl halides*:** SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN_1 versus SN_2 reactions, Factors affecting SN1 and SN2 reactions. Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*:** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol **Carbonyl compounds* (Aldehydes and ketones):** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde. **Section-C** **Carboxylic acids*:** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids , amide and ester. Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid. **Aliphatic amines*:** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine **Books recommended:** 1. Bassett. J. Denny R. C., Jeffery G.H., Mendhanm J, Vigel's *Textbook of Quantitative Inorganic Analysis*, John Wiley & Sons: Edi 5th, 1989. 2. Conners K.A., *A Text book of Pharmaceutical Analysis*, Wiley inter-science: edi 3rd, 1982. 3. Harris DC, *Quantitatise Chemical Analysis*, W.H. free mann and Company, New York: Edi 6th, 2003.	Compounds. Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds). Structural isomerisms in organic compounds **Alkanes*, Alkenes* and Conjugated dienes*:** SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP^2 hybridization in alkenes. E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement **Section-B** **Alkyl halides*:** SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN_1 versus SN_2 reactions, Factors affecting SN1 and SN2 reactions. Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*:** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol **Carbonyl compounds* (Aldehydes and ketones):** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde. **Section-C** **Carboxylic acids*:** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester. Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid. **Aliphatic amines*:** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine **Recommended Books (Latest Edition):** **1.** Bassett, J. Denny, R.C. Jeffery, G.H. Mendhanm, J. (1989). Vigel's *Textbook of Quantitative Inorganic Analysis*, 5th Ed., John Wiley & Sons. 2. Conners, K.A. (1982). *A Text book of Pharmaceutical Analysis*, 3rd Ed., Wiley inter-science. 3. Harris, D.C. (2003). *Quantitatise Chemical Analysis*, 6th Ed., New York: W.H. free mann and Company. **Suggested e-material:** 1. Organic Chemistry: Pearson New International Edition Bruice, Paula Y. http://lib.myilibrary.com?id=527161 2. Organic Chemistry: Pearson New International Edition Wade, Leroy G. http://lib.myilibrary.com?id=527192 3. Solutions Manual for Organic Chemistry: Pearson New International Edition Wade, Leroy G;Simek, Jan W. http://lib.myilibrary.com?id=527020	"Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code CS 102L **Course name** Computer Applications in Pharmacy Lab		1. Design a questionnaire using a word processing package to gather information about a particular disease. 2. Create a HTML web page to show personal information. 3 Retrieve the information of a drug and its adverse effects using online tools 4 Creating mailing labels Using Label Wizard , generating label in MS WORD 5 Create a database in MS Access to store the patient information with the required fields Using access 6. Design a form in MS Access to view, add, delete and modify the patient record inthe database 7. Generating report and printing the report from patient database 8. Creating invoice table using – MS Access 9. Drug information storage and retrieval using MS Access 10. Creating and working with queries in MS Access 11. Exporting Tables, Queries, Forms and Reports to web pages 12. Exporting Tables, Queries, Forms and Reports to XML pages	1. Design a questionnaire using a word processing package to gather information about a particular disease. 2. Create a HTML web page to show personal information. 3 Retrieve the information of a drug and its adverse effects using online tools 4 Creating mailing labels Using Label Wizard , generating label in MS WORD 5 Create a database in MS Access to store the patient information with the required fields Using access 6. Design a form in MS Access to view, add, delete and modify the patient record inthe database 7. Generating report and printing the report from patient database 8. Creating invoice table using – MS Access 9. Drug information storage and retrieval using MS Access 10. Creating and working with queries in MS Access 11. Exporting Tables, Queries, Forms and Reports to web pages 12. Exporting Tables, Queries, Forms and Reports to XML pages	
Course code PHAR 101L **Course name** Biochemistry Lab		1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch) 2. Identification tests for Proteins (albumin and Casein) 3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) 4. Qualitative analysis of urine for abnormal constituents 5. Determination of blood creatinine 6. Determination of blood sugar 7. Determination of serum total cholesterol 8. Preparation of buffer solution and measurement of pH 9. Study of enzymatic hydrolysis of starch 10. Determination of Salivary amylase activity 11. Study the effect of Temperature on Salivary amylase activity. 12. Study the effect of substrate concentration on salivary amylase activity.	1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch) 2. Identification tests for Proteins (albumin and Casein) 3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) 4. Qualitative analysis of urine for abnormal constituents 5. Determination of blood creatinine 6. Determination of blood sugar 7. Determination of serum total cholesterol 8. Preparation of buffer solution and measurement of pH 9. Study of enzymatic hydrolysis of starch 10. Determination of Salivary amylase activity 11. Study the effect of Temperature on Salivary amylase activity. 12. Study the effect of substrate concentration on salivary amylase activity.	
Course code PHAR 103L **Course name** Human Anatomy and Physiology- II Lab		Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject. 1. To study the integumentary and special senses using specimen, models, etc., 2. To study the nervous system using specimen, models, etc., 3. To study the endocrine system using specimen, models, etc 4. To demonstrate the general neurological examination 5. To demonstrate the function of olfactory nerve 6. To examine the different types of taste. 7. To demonstrate the visual acuity 8. To demonstrate the reflex activity 9. Recording of body temperature 10. To demonstrate positive and negative feedback mechanism. 11. Determination of tidal volume and vital capacity. 12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 13. Recording of basal mass index. 14. Study of family planning devices and pregnancy diagnosis test. 15. Demonstration of total blood count by cell analyser	Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject. 1. To study the integumentary and special senses using specimen, models, etc., 2. To study the nervous system using specimen, models, etc., 3. To study the endocrine system using specimen, models, etc 4. To demonstrate the general neurological examination 5. To demonstrate the function of olfactory nerve 6. To examine the different types of taste. 7. To demonstrate the visual acuity 8. To demonstrate the reflex activity 9. Recording of body temperature 10. To demonstrate positive and negative feedback mechanism. 11. Determination of tidal volume and vital capacity. 12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 13. Recording of basal mass index. 14. Study of family planning devices and pregnancy diagnosis test. 15. Demonstration of total blood count by cell analyser	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		16. Permanent slides of vital organs and gonads.	16. Permanent slides of vital organs and gonads.	
Course code PHAR 106L **Course name** Pharmaceutical Organic Chemistry-I Lab		**1. Systematic qualitative analysis of unknown organic compounds like** 1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test 3. Solubility test 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. 5. Melting point/Boiling point of organic compounds 6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound bymelting point/ boiling point. 8. Minimum 5 unknown organic compounds to be analysed systematically. **2. Preparation of suitable solid derivatives from organic compounds** **3. Construction of molecular models**	**1. Systematic qualitative analysis of unknown organic compounds like** 1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test 3. Solubility test 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. 5. Melting point/Boiling point of organic compounds 6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound bymelting point/ boiling point. 8. Minimum 5 unknown organic compounds to be analysed systematically. **2. Preparation of suitable solid derivatives from organic compounds** **3. Construction of molecular models**	

Name of Programme: Bachelor of Pharmacy
Course details: Third Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 204 **Course name** Pharmaceutical Microbiology	Upon completion of the course, the student shall be able to know • Methods of identification, cultivation and preservation of various microorganisms • The importance and implementation of sterilization in pharmaceutical processing and industry • Sterility testing of pharmaceutical products • Microbial standardization of pharmaceuticals. • Cell cultute technology and its applications in pharmaceutical industries.	**Section-A** Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes. Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy. **Section-B** Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous,radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators. Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants. Factors influencing disinfection, antiseptics and their evaluation. Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. **Section-C** Designing of aseptic area, laminar flow equipments; study of different	**Section-A** Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes. Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy. **Section-B** Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators. Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants. Factors influencing disinfection, antiseptics and their evaluation. Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. **Section-C** Designing of aseptic area, laminar flow equipments; study of different	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic. Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research. **Recommended Books: (Latest Editions)** 1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. 2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi. 3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. 4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. 5. Rose: Industrial Microbiology. 6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan 7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution. 8. Peppler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions. 10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai 11. Edward: Fundamentals of Microbiology. 12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi 13. Bergeys manual of systematic bacteriology, Williams and Wilkins-A Waverly company	sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic. Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research. **Recommended Books (Latest Edition):** 1. Hugo, W.B., Russel A.D. (2004). *Pharmaceutical Microbiology*, 7th Ed., London: Blackwell Scientific publications. 2. Reed, G (2004). *Prescott and Dunn Industrial Microbiology*. 4th Ed., Delhi: CBS Publishers & Distributors. 3. Pelczar, M.J., Chan, E.C.S, Kreig, N.R. (2002). *Microbiology*. 5th Ed., New Delhi: Tata McGraw Hill, 2002. 4. Harris, M., Tindall, B. (2000). *Pharmaceutical Microbiology*. London. 5. Rose, A.H. (1961). *Industrial Microbiology*. London: Butterworths. 6. Frobisher, M., Hinsdill, R., Crabtree, K.T., Goodheart, C.R. (1968). *Fundamentals of Microbiology*. 9th Ed., Japan: WB Saunders Co. 7. Carter, S.J. (2005). *Cooper and Gunn's: Tutorial Pharmacy*. 12th Ed., New Delhi: CBS Publisher and Distributiors. 8. Peppler, H.J., Perlman, D. (1979). *Microbial Technology*. 2nd Ed., Wisconsin: Elsevier. 9. I.P., B.P., U.S.P.- latest editions. 10. Ananthnarayan, R. (1990). *A Text Book of Microbiology*. 4th Ed., Hyderabad: Orient Longman Limited. 11. Edward, A.I. (1983). *Fundamentals of Microbiology*. 4th Ed., Addison Wesley Publishing Company. 12. Jain, N.K. (2005). *Pharmaceutical Microbiology*. 2nd Ed., Delhi: Vallabh Prakashan. 13. Bergey, D.H., Holt, J.G. (1994.) Bergeys manual of systematic bacteriology. 2nd Ed., Baltimore: Williams and Wilkins- A Waverly company. **Suggested e-material:** 1. https://www.elsevier.com/books/pharmaceutical-microbiology/ 2. moscmm.org/pdf/Ananthanarayan%20microbio.pdf	
Course code PHAR 205 **Course name** Pharmaceutical Organic Chemistry-II	Upon completion of the course, the student shall be able to know • General methods of preparation and reactions of various organic compounds • Classification,principles/mechanisms, properties and applications of various organic compounds	General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences. **Section-A** **Benzene and its derivatives** I. Analytical, synthetic and other evidences in the derivation of structure of benzene, orbital picture, resonance in benzene, aromatic characters, Huckel's rule. II. Reactions of benzene - nitration, sulphonation, halogenation, Friedel crafts alkylation- limitations and Friedel crafts acylation. III. Type of substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction.	General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences. **Section-A** **Benzene and its derivatives** I. Analytical, synthetic and other evidences in the derivation of structure of benzene, orbital picture, resonance in benzene, aromatic characters, Huckel's rule. II. Reactions of benzene - nitration, sulphonation, halogenation, Friedel crafts alkylation- limitations and Friedel crafts acylation. III. Type of substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		IV. Structure and uses of DDT (Dichloro diphenyl trichloroethane), Saccharin, BHC (Benzene hexachloride) and Chloramine. **Section-B** **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, structure and uses of phenol, cresols, resorcinol, naphthols. **Aromatic Amines*** - Basicity of amines, effect of substituents on basicity and synthetic uses of aryl diazonium salts. **Aromatic Acids*** - Acidity, effect of substituents on acidity and important reactions of benzoic acid. **Fats and Oils-** I. Fatty acids reactions- Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. II. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination. **Section-C** **Polynuclear hydrocarbons:** Synthesis, reactions**,** structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane & their derivatives (1-naphthol, 1-hydroxyphenanthrene, 1-hydroxyanthracene, diphenylmethanol, triphenylmethanol) **Cyclo alkanes*:** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only. **Recommended Books (Latest Editions)** 1. Organic Chemistry by Morrison and Boyd 2. Organic Chemistry by I.L. Finar, Volume-I 3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl. 4. Organic Chemistry by P.L. Soni 5. Practical Organic Chemistry by Mann and Saunders. 6. Vogel's text book of Practical Organic Chemistry 7. Advanced Practical organic chemistry by N.K.Vishnoi. 8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.	IV. Structure and uses of DDT (Dichloro diphenyl trichloroethane), Saccharin, BHC (Benzene hexachloride) and Chloramine. **Section-B** **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, structure and uses of phenol, cresols, resorcinol, naphthols. **Aromatic Amines*** - Basicity of amines, effect of substituents on basicity and synthetic uses of aryl diazonium salts. **Aromatic Acids*** - Acidity, effect of substituents on acidity and important reactions of benzoic acid. **Fats and Oils-** I. Fatty acids reactions- Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. II. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination. **Section-C** **Polynuclear hydrocarbons:** Synthesis, reactions**,** structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane & their derivatives (1-naphthol, 1-hydroxyphenanthrene, 1-hydroxyanthracene, diphenylmethanol, triphenylmethanol) **Cyclo alkanes*:** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only. **Recommended Books (Latest Edition):** 1. Morrison, R.T., Boyd, R.T. (1992). *Organic Chemistry*. 6th Ed., New York:Prentice Hall. 2. Finar, I.L. (1963). *Organic Chemistry*. 4th Ed., London: Longsman. 3. Bahl, A., Bahl, B.S. (2014). *Textbook of Organic Chemistry*. 5TH Ed., New Delhi: S Chand and company Ltd. 4. Soni, P.L., Chawla, H.M. (2012). *Textbook of Organic Chemistry*. 29th Ed., New Delhi: Sultan Chand & Sons. 5. Mann, F.G., Saunders, B.C. (2009). *Practical Organic Chemistry*. 4th Ed., London: Pearson. 2009. 6. Vogel, A.I., Tatchell, A.R., Furnis, B. S., Hannaford, A.J., Smith, P.W.G. (1989). *Vogel's text book of Practical Organic Chemistry*. 5th Ed., London :Pearson. 7. Vishnoi, N.K. (2009). *Advanced Practical organic chemistry*. 3rd Ed., New Delhi: Vikas publishing House. 8. Pavia, D.L., Lampman, G.M., Kriz, G.S. (1998). *Introduction to Organic Laboratory techniques*. 3rd Ed., seattle Marry Finch. **Suggested e-material:** 1. General, Organic, and Biological Chemistry: Pearson New International Edition Timberlake, Karen C. http://lib.myilibrary.com?id=527383 2. Organic Chemistry: Pearson New International Edition Wade, Leroy G. http://lib.myilibrary.com?id=527192 3. Essential Organic Chemistry: Pearson New International Edition Bruice, Paula Y. http://lib.myilibrary.com?id=527184	
Course code PHAR **Course name** Pharmaceutical Physical Chemistry	Upon completion of the course, the student shall be able to know • Different states of matter and their properties		**SECTION-A** **Behavior of gases:** Kinetic theory of gases, deviation from behaviors and explanation. **Liquid state:** Physical properties (vapour pressure, surface tension,	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	• Principle of thermodynamics and their pharmaceutical applications • Various aspects of chemical kinetics and quantum mechanics.		viscosity, refractive index, optical rotation, dipole moment) and their role in chemical constitution determination. **Solutions**: Ideal and real solutions, solutions of gases in liquids, colligative properties, partition coefficient, conductance and its measurement, Debye Huckel theory. **SECTION-B** **Thermodynamics**: Definition of thermodynamic terms: system, surroundings etc, types of system, intensive and extensive properties, state and path functions, thermodynamic equilibrium, heat and work. ***First law:*** Postulates, limitations, brief account of heat capacity and enthalpy. ***Second law:*** Postulates, need of law, reversible and irreversible processes, Carnot cycle, Carnot theorem, thermodynamic temperature scale, brief account of entropy. ***Third law:*** Criteria for spontaneity, residual entropy. **Adsorption:** Freudlich and Gibbs adsorption, isotherms, Langmuir theory of adsorption. **Photochemistry:** Consequences of light absorption, Jablonski diagram, Lambert-Beer Law, Quantum efficiency. **SECTION-C** **Chemical kinetics**: General consideration and concepts, Zero, first and second order reactions, complex reactions, theories of reaction kinetics, half life determination, influence of temperature, light, solvent, catalytic species and other factors, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis. **Quantum mechanics:** Postulates of quantum mechanics, operators in quantum mechanics, the Schrodinger wave equation. **Recommended Books (Latest Edition):** 1. Bahl, B.S., Tuli, G.D., Bahl, A. (2009). *Essential of Physical Chemistry*. 1st Ed., New Delhi: S. Chand & Company Pvt Ltd. 2. Negi, A.S., Anand, S.C. (1985). *Textbook of Physical Chemistry*, 5th Ed., New Delhi: Wiley Eastern Ltd. 3. Glasstone, S., Lewis, D. (1993). *Elements of Physical Chemistry*, 2nd Ed., London: Macmillan Education. 4. Shoemaker, M., David, P., Garland, D.P., Carl, W. (1975). Experiments of Physical Chemistry. 3rd Ed., New York: MC graw Hill Book Co.. **Suggested e-material:** 1. https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry 2. https://www.acs.org/content/acs/en	
Course code PHAR 213 **Course name** Pharmaceutical Engineering	Upon completion of the course, the student shall be able to know • Various type of flow and flow meter • Various objectives, applications and functions of various processes used in pharmaceutical industries. • Various preventive methods used for corrosion control in pharmaceutical industries. • Different types of conveyors • Various material used in plant construction	**Section-A** **Flow of fluids:** Types of manometers, reynolds number and its significance, bernoulli's theorem and its applications, energy losses, orifice meter, venturimeter, pitot tube and rotometer. **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, construction, working, uses, merits and demerits of double cone blender, twin shell blender, ribbon blender, sigma blade mixer, planetary mixers, propellers, turbines, paddles & silverson emulsifier. **Heat Transfer:** Objectives, applications & heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Section-B**	**Section-A** **Flow of fluids:** Types of manometers, reynolds number and its significance, bernoulli's theorem and its applications, energy losses, orifice meter, venturimeter, pitot tube and rotometer. **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, construction, working, uses, merits and demerits of double cone blender, twin shell blender, ribbon blender, sigma blade mixer, planetary mixers, propellers, turbines, paddles & silverson emulsifier. **Heat Transfer:** Objectives, applications & heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Section-B**	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation. **Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. **Section-C** **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & supercentrifuge. **Materials of pharmaceutical plant construction, corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems. **Recommended Books (Latest Editions)** 1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition. 2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition. 3. Unit operation of chemical engineering – Mcabe Smith, Latest edition. 4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition. 5. Remington practice of pharmacy- Martin, Latest edition. 6. Theory and practice of industrial pharmacy by Lachmann., Latest edition. 7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition. 8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.	**Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation. **Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. **Section-C** **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & supercentrifuge. **Materials of pharmaceutical plant construction, corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems. **Recommended Books (Latest Edition):** 1. Badger, W.L., Banchero, J.T. (1955). *Introduction to chemical engineering*. New York: McGraw- Hill. 2. Simpson, N.J.K. (2000). *Solid phase extraction, Principles, techniques and applications*. 1st Ed., California: CRC Press. 3. McCabe, W., Smith, J., Harriott, P. (2017). *Unit operation of chemical engineering.* 7th Ed., New York: McGraw- Hill. 4. Subrahmanyam, C.V.S., Setty, J.T., Sarasija, S., Kussum, D.V. (2009). *Pharmaceutical engineering principles and practices*. India: Vallabh Publication. 5. Martin, E.W., Cook, E.F. (2005). *Remington practice of pharmacy*. 21st edition. Philadelphia: Lippincott Williams and Wilkins. 6. Lachman, L., Lieberman, H.A., Kanig, J.L. (1990). *Theory and practice of industrial pharmacy*. 3th Ed., Phildelphia: Varghese Publishing House. 7. Subrahmanyam, C.V.S. (2008). *Text of Physical pharmaceutics*. 2nd Ed., India: Vallabh Publication. **8.** Carter, S.J. (2005). *Cooper and Gunn's Tutorial pharmacy*. 6th Ed., London: CBS Publication. **Suggested e-material:** 1. gmpua.com/Process/ProcessEngineering	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 217 **Course name** Physical Pharmaceutics-I	Upon completion of the course, the student shall be able to know • Various physicochemical properties of drug molecules. • Various aspects in pre formulation studies. • Surface and interfacial phenomenon on formulation. • Various aspects of size reduction and size separation pertaining to dosage preparation.	**Section-A** **Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids (Binary solutions, ideal solutions). Raoult's law, real solutions. Partially miscible liquids, critical solution temperature and applications. Distribution law, its limitations and applications. **States of matter and properties of matter**: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism. **Section-B** **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications. **Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB scale, solubilisation, detergency, adsorption at solid interface. **Complexation and protein binding:** Introduction, classification of complexation, applications, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants. **Section-C** **pH, buffers and isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions. **Size reduction:** Objectives, mechanisms & laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of hammer mill, ball mill, fluid energy mill, edge runner mill & end runner mill. **Size separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation. Principles, construction, working, uses, merits and demerits of sieve shaker, cyclone separator, air separator, bag filter & elutriation tank. **Recommended Books: (Latest Editions)** 1. Physical Pharmacy by Alfred Martin 2. Experimental Pharmaceutics by Eugene, Parott. 3. Tutorial Pharmacy by Cooper and Gunn. 4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia. 5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc. 6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc. 7. Physical Pharmaceutics by Ramasamy C and ManavalanR. 8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee 9. Physical Pharmaceutics by C.V.S. Subramanyam 10. Test book of Physical Pharmacy, by Gaurav Jain & Roop K. Khar	**Section-A** **Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids (Binary solutions, ideal solutions). Raoult's law, real solutions. Partially miscible liquids, critical solution temperature and applications. Distribution law, its limitations and applications. **States of matter and properties of matter**: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism. **Section-B** **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications. **Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB scale, solubilisation, detergency, adsorption at solid interface. **Complexation and protein binding:** Introduction, classification of complexation, applications, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants. **Section-C** **pH, buffers and isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions. **Size reduction:** Objectives, mechanisms & laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of hammer mill, ball mill, fluid energy mill, edge runner mill & end runner mill. **Size separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation. Principles, construction, working, uses, merits and demerits of sieve shaker, cyclone separator, air separator, bag filter & elutriation tank. **Recommended Books (Latest Edition):** 1. Martin, A., Swarbrick, J. (1993). *Physical Pharmacy*. 3rd Ed., Marryland: Lippincott Williams and Wilkins. 2. Parott, L.E., Saski, W. (1977). *Experimental Pharmaceutics*. 4th Ed., Minneapolis: Burgess publishers. 3. Cater, S.J. (2005). *Tutorial Pharmacy*. 6th Ed., India: CBS publishers. 4. Stocklosam, M.J., Ansel, H.C. (1986). *Pharmaceutical Calculations*. 8th Ed., Philadelphia: Lippincott Williams and Wilkins. 5. Liberman, H.A., Lachman, C., Schwartz, J.B. (1990). *Pharmaceutical Dosage forms*, Tablets, 2nd Ed., New York: Marcel Dekkar Inc. 6. Liberman, H.A , Lachman, C. (1990). *Pharmaceutical Dosage forms. Disperse systems,* 2nd Ed., New York: Marcel Dekkar Inc. 7. Ramasamy, C., Manavalan, R. (2015). *Physical Pharmaceutics*. 2nd Ed., Chenniai: Vignesh Publisher.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			8. Subramanyam, C.V.S., Settee, T.J. (2014). *Laboratory Manual of Physical Pharmaceutics*. 2nd Ed., New Delhi: Vallabh publication. 9. Subramanyam, C.V.S. (2000). *Text book of Physical Pharmaceutics*. 2nd Ed., New Delhi: Vallabh publication. 10. Jain, G., Khar, R.K., Ahmad, F.J. (2012). *Theory and practice of Physical Pharmacy*. 1st edition, New Delhi: Elesvier. **Suggested e-material:** 1. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 2. https://www.pdfdrive.com/pharmaceutical-books.html 3. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 4. http://202.74.245.22:8080/xmlui/handle/123456789/39 5. www.elsevier.com/books/ 6. https://accesspharmacy.mhmedical.com/book.aspx?bookid=513	
Course code PHAR 204L **Course name** Pharmaceutical Microbiology Lab		1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology. 2. Sterilization of glassware, preparation and sterilization of media. 3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical). 5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques. 6. Microbiological assay of antibiotics by cup plate method and other methods 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals. 9. Bacteriological analysis of water 10. Biochemical test.	1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology. 2. Sterilization of glassware, preparation and sterilization of media. 3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical). 5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques. 6. Microbiological assay of antibiotics by cup plate method and other methods 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals. 9. Bacteriological analysis of water 10. Biochemical test.	
Course code PHAR 205L **Course name** Pharmaceutical Organic Chemistry-II Lab		I **Experiments involving laboratory techniques** • Recrystallization • Steam distillation II **Determination of following oil values (including standardization of reagents)** • Acid value • Saponification value • Iodine value III **Preparation of compounds** • Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol/Aniline by acylation reaction. • 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction. • 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid /Nitro benzene by nitration reaction. • Benzoic acid from Benzyl chloride by oxidation reaction. • Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. • 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.	I **Experiments involving laboratory techniques** • Recrystallization • Steam distillation II **Determination of following oil values (including standardization of reagents)** • Acid value • Saponification value • Iodine value III **Preparation of compounds** • Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol/Aniline by acylation reaction. • 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction. • 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid /Nitro benzene by nitration reaction. • Benzoic acid from Benzyl chloride by oxidation reaction. • Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. • 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions. • Benzil from Benzoin by oxidation reaction.	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Benzil from Benzoin by oxidation reaction. • Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction • Cinnammic acid from Benzaldehyde by Perkin reaction • *P*-Iodo benzoic acid from *P*-amino benzoic acid	• Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction • Cinnammic acid from Benzaldehyde by Perkin reaction • *P*-Iodo benzoic acid from *P*-amino benzoic acid	
Course code PHAR 213L **Course name** Pharmaceutical Engineering Lab		I. Determination of radiation constant of brass, iron, unpainted and painted glass. II. Steam distillation – To calculate the efficiency of steam distillation. III. To determine the overall heat transfer coefficient by heat exchanger. IV. Construction of drying curves (for calcium carbonate and starch). V. Determination of moisture content and loss on drying. VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method. VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill,de humidifier. VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations–Construction of various size frequency curves including arithmetic and logarithmic probability plots. IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill. X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryerand such other major equipment. XI. Factors affecting Rate of Filtration and Evaporation (Surface area, concentration and Thickness/ viscosity XII. To study the effect of time on the rate of crystallization. XIII. To calculate the uniformity Index for given sample by using double cone blender.	I. Determination of radiation constant of brass, iron, unpainted and painted glass. II. Steam distillation – To calculate the efficiency of steam distillation. III. To determine the overall heat transfer coefficient by heat exchanger. IV. Construction of drying curves (for calcium carbonate and starch). V. Determination of moisture content and loss on drying. VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method. VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill,de humidifier. VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations–Construction of various size frequency curves including arithmetic and logarithmic probability plots. IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill. X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryerand such other major equipment. XI. Factors affecting Rate of Filtration and Evaporation (Surface area, concentration and Thickness/ viscosity XII. To study the effect of time on the rate of crystallization. XIII. To calculate the uniformity Index for given sample by using double cone blender.	
Course code PHAR 217L **Course name** Physical Pharmaceutics-I Lab		1. Determination the solubility of drug at room temperature 2. Determination of pKa value by half neutralization/ Henderson Hasselbalch equation. 3. Determination of Partition co-efficient of benzoic acid in benzene and water 4. Determination of Partition co- efficient of Iodine in CCl_4 and water 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method 6. Determination of surface tension of given liquids by drop count and drop weight method 7. Determination of HLB number of a surfactant by saponification method 8. Determination of Freundlich and Langmuir constants using activated charcoal 9. Determination of critical micellar concentration of surfactants 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 11. Determination of stability constant and donor acceptor ratio of	1. Determination the solubility of drug at room temperature 2. Determination of pKa value by half neutralization/ Henderson Hasselbalch equation. 3. Determination of Partition co-efficient of benzoic acid in benzene and water 4. Determination of Partition co- efficient of Iodine in CCl_4 and water 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method 6. Determination of surface tension of given liquids by drop count and drop weight method 7. Determination of HLB number of a surfactant by saponification method 8. Determination of Freundlich and Langmuir constants using activated charcoal 9. Determination of critical micellar concentration of surfactants 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 11. Determination of stability constant and donor acceptor ratio of	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Cupric-Glycine complex by pH titration method	Cupric-Glycine complex by pH titration method	

Name of Programme: Bachelor of Pharmacy
Course details: Fourth Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 211 **Course name** Medicinal Chemistry-I	Upon completion of the course, the student shall be able to know: • Various aspects of medicinal chemistry • Classification, synthesis, SAR, mechanism of action and uses of various drugs •	Study of the development of the following classes of drugs, classification, mechanism of action, uses of drugs mentioned in the course, structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*) **Section-A** **Introduction to medicinal chemistry:** History and development of medicinal chemistry. Physicochemical properties in relation to biological action (Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation). Effect of bioisosterism, optical and geometrical isomerism on biological activity. **Drugs acting on autonomic nervous system:** **SYMPATHOMIMETIC AGENTS*:*** SAR of Sympathomimetic agents. *Direct acting:* Nor-epinephrine, epinephrine, phenylephrine*, dopamine, methyldopa, clonidine, dobutamine, isoproterenol, terbutaline, salbutamol*, bitolterol, naphazoline, oxymetazoline and xylometazoline. *Indirect acting agents:* Hydroxyamphetamine, pseudoephedrine, propylhexedrine. *Agents with mixed mechanism:* Ephedrine, Metaraminol. **ADRENERGIC ANTAGONISTS:** *Alpha adrenergic blockers:* Tolazoline*, phentolamine, phenoxybenzamine, prazosin, dihydroergotamine, methysergide. *Beta adrenergic blockers:* SAR of beta blockers, propranolol*, metibranolol, atenolol, betazolol, bisoprolol, esmolol, metoprolol, labetolol, carvedilol. ***Parasympathomimetic agents:*** SAR of Parasympathomimetic agents. *Direct acting agents:* Acetylcholine, carbachol*, bethanechol, methacholine, pilocarpine. *Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):* Physostigmine, neostigmine*, pyridostigmine, edrophonium chloride, tacrine hydrochloride, ambenonium chloride, isofluorphate, echothiophate iodide, parathione, malathion. *Cholinesterase reactivator:* Pralidoxime chloride. *Cholinergic blocking agents:* SAR of cholinolytic agents *Solanaceous alkaloids and analogues:* Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*. *Synthetic cholinergic blocking agents:* Tropicamide, cyclopentolate hydrochloride, clidinium bromide, dicyclomine hydrochloride*, glycopyrrolate, methantheline bromide, propantheline bromide, benztropine mesylate, orphenadrine citrate, biperidine hydrochloride, procyclidine hydrochloride*, tridihexethyl chloride, isopropamide iodide, ethopropazine hydrochloride. **Section-B**	Study of the development of the following classes of drugs, classification, mechanism of action, uses of drugs mentioned in the course, structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*) **Section-A** **Introduction to medicinal chemistry:** History and development of medicinal chemistry. Physicochemical properties in relation to biological action (Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation). Effect of bioisosterism, optical and geometrical isomerism on biological activity. **Drugs acting on autonomic nervous system:** **SYMPATHOMIMETIC AGENTS*:*** SAR of Sympathomimetic agents. *Direct acting:* Nor-epinephrine, epinephrine, phenylephrine*, dopamine, methyldopa, clonidine, dobutamine, isoproterenol, terbutaline, salbutamol*, bitolterol, naphazoline, oxymetazoline and xylometazoline. *Indirect acting agents:* Hydroxyamphetamine, pseudoephedrine, propylhexedrine. *Agents with mixed mechanism:* Ephedrine, Metaraminol. **ADRENERGIC ANTAGONISTS:** *Alpha adrenergic blockers:* Tolazoline*, phentolamine, phenoxybenzamine, prazosin, dihydroergotamine, methysergide. *Beta adrenergic blockers:* SAR of beta blockers, propranolol*, metibranolol, atenolol, betazolol, bisoprolol, esmolol, metoprolol, labetolol, carvedilol. ***Parasympathomimetic agents:*** SAR of Parasympathomimetic agents. *Direct acting agents:* Acetylcholine, carbachol*, bethanechol, methacholine, pilocarpine. *Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):* Physostigmine, neostigmine*, pyridostigmine, edrophonium chloride, tacrine hydrochloride, ambenonium chloride, isofluorphate, echothiophate iodide, parathione, malathion. *Cholinesterase reactivator:* Pralidoxime chloride. *Cholinergic blocking agents:* SAR of cholinolytic agents *Solanaceous alkaloids and analogues:* Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*. *Synthetic cholinergic blocking agents:* Tropicamide, cyclopentolate hydrochloride, clidinium bromide, dicyclomine hydrochloride*, glycopyrrolate, methantheline bromide, propantheline bromide, benztropine mesylate, orphenadrine citrate, biperidine hydrochloride, procyclidine hydrochloride*, tridihexethyl chloride, isopropamide iodide, ethopropazine hydrochloride. **Section-B**	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Drugs acting on central nervous system **GENERAL ANESTHETICS:** *Inhalation anesthetics:* Halothane*, Methoxyflurane, enflurane, sevoflurane, isoflurane, desflurane. *Ultra short acting barbitutrates:* Methohexital sodium*, thiamylal sodium, thiopental sodium. *Dissociative anesthetics:* Ketamine hydrochloride.* **NARCOTIC AND NON-NARCOTIC ANALGESICS:** *Morphine and related drugs:* SAR of morphine analogues, morphine sulphate, codeine, meperidine hydrochloride, anilerdine hydrochloride, diphenoxylate hydrochloride, loperamide hydrochloride, fentanyl citrate*, methadone hydrochloride*, propoxyphene hydrochloride, pentazocine, levorphanol tartarate. *Narcotic antagonists:* Nalorphine hydrochloride, levallorphan tartarate, naloxone hydrochloride. *Anti-inflammatory agents:* Sodium salicylate, aspirin, mefenamic acid*, meclofenamate, indomethacin, sulindac, tolmetin, zomepriac, diclofenac, ketorolac, ibuprofen*, naproxen, piroxicam, phenacetin, acetaminophen, antipyrine, phenylbutazone. **Section-C** **Drugs acting on central nervous system:** **SEDATIVES AND HYPNOTICS:** *Benzodiazepines:* SAR of benzodiazepines, chlordiazepoxide, diazepam*, oxazepam, chlorazepate, lorazepam, alprazolam, zolpidem *Barbiturtes:* SAR of barbiturates, barbital*, phenobarbital, mephobarbital, amobarbital, butabarbital, pentobarbital, secobarbital *Miscelleneous:* **Amides & imides:** Glutethmide. **Alcohol & their carbamate derivatives:** Meprobomate, ethchlorvynol. **Aldehyde & their derivatives:** Triclofos sodium, paraldehyde. **ANTIPSYCHOTICS** *Phenothiazeines:* SAR of Phenothiazeines - Promazine hydrochloride, chlorpromazine hydrochloride*, triflupromazine, thioridazine hydrochloride, piperacetazine hydrochloride, prochlorperazine maleate, trifluoperazine hydrochloride. *Ring analogues of phenothiazeines:* Chlorprothixene, thiothixene, loxapine succinate, clozapine. *Flurobuterophenones:* Haloperidol, droperidol, risperidone. *Beta amino ketones:* Molindone hydrochloride. *Benzamides:* Sulpieride. **ANTICONVULSANTS:** SAR of anticonvulsants**,** mechanism of anticonvulsant action. *Barbiturates:* Phenobarbitone, methabarbital. *Hydantoins:* Phenytoin*, Mephenytoin, ethotoin *Oxazolidinediones:* Trimethadione, paramethadione *Succinimides:* Phensuximide, methsuximide, ethosuximide* *Urea and monoacylureas:* Phenacemide, carbamazepine* *Benzodiazepines:* Clonazepam *Miscellaneous:* Primidone, valproic acid , gabapentin, felbamate. **Drug metabolism**: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects. **Recommended Books (Latest Editions)** 1. Wilson and Gisvold's Organic medicinal and Pharmaceutical Chemistry. 2. Foye's Principles of Medicinal Chemistry. 3. Burger's Medicinal Chemistry, Vol I to IV.	**Drugs acting on central nervous system** **GENERAL ANESTHETICS:** *Inhalation anesthetics:* Halothane*, Methoxyflurane, enflurane, sevoflurane, isoflurane, desflurane. *Ultra short acting barbitutrates:* Methohexital sodium*, thiamylal sodium, thiopental sodium. *Dissociative anesthetics:* Ketamine hydrochloride.* **NARCOTIC AND NON-NARCOTIC ANALGESICS:** *Morphine and related drugs:* SAR of morphine analogues, morphine sulphate, codeine, meperidine hydrochloride, anilerdine hydrochloride, diphenoxylate hydrochloride, loperamide hydrochloride, fentanyl citrate*, methadone hydrochloride*, propoxyphene hydrochloride, pentazocine, levorphanol tartarate. *Narcotic antagonists:* Nalorphine hydrochloride, levallorphan tartarate, naloxone hydrochloride. *Anti-inflammatory agents:* Sodium salicylate, aspirin, mefenamic acid*, meclofenamate, indomethacin, sulindac, tolmetin, zomepriac, diclofenac, ketorolac, ibuprofen*, naproxen, piroxicam, phenacetin, acetaminophen, antipyrine, phenylbutazone. **Section-C** **Drugs acting on central nervous system:** **SEDATIVES AND HYPNOTICS:** *Benzodiazepines:* SAR of benzodiazepines, chlordiazepoxide, diazepam*, oxazepam, chlorazepate, lorazepam, alprazolam, zolpidem *Barbiturtes:* SAR of barbiturates, barbital*, phenobarbital, mephobarbital, amobarbital, butabarbital, pentobarbital, secobarbital *Miscelleneous:* **Amides & imides:** Glutethmide. **Alcohol & their carbamate derivatives:** Meprobomate, ethchlorvynol. **Aldehyde & their derivatives:** Triclofos sodium, paraldehyde. **ANTIPSYCHOTICS** *Phenothiazeines:* SAR of Phenothiazeines - Promazine hydrochloride, chlorpromazine hydrochloride*, triflupromazine, thioridazine hydrochloride, piperacetazine hydrochloride, prochlorperazine maleate, trifluoperazine hydrochloride. *Ring analogues of phenothiazeines:* Chlorprothixene, thiothixene, loxapine succinate, clozapine. *Flurobuterophenones:* Haloperidol, droperidol, risperidone. *Beta amino ketones:* Molindone hydrochloride. *Benzamides:* Sulpieride. **ANTICONVULSANTS:** SAR of anticonvulsants**,** mechanism of anticonvulsant action. *Barbiturates:* Phenobarbitone, methabarbital. *Hydantoins:* Phenytoin*, Mephenytoin, ethotoin *Oxazolidinediones:* Trimethadione, paramethadione *Succinimides:* Phensuximide, methsuximide, ethosuximide* *Urea and monoacylureas:* Phenacemide, carbamazepine* *Benzodiazepines:* Clonazepam *Miscellaneous:* Primidone, valproic acid , gabapentin, felbamate. **Drug metabolism**: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects. **Recommended Books (Latest Editions):** 1. Beale, J.M., Block, J., Wilson, G. (2010). *Organic medicinal and Pharmaceutical Chemistry*, 12th Ed., Phildephia: Lippincott Williams and Wilkins. 2. Lemke, T.L., Williams, D.A., Rocho, V.F., Zito, S.W. (2012). *Foye's*	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		4. Introduction to principles of drug design- Smith and Williams. 5. Remington's Pharmaceutical Sciences. 6. Martindale's extra pharmacopoeia. 7. Organic Chemistry by I.L. Finar, Vol. II. 8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5. 9. Indian Pharmacopoeia. 10. Text book of practical organic chemistry- A.I.Vogel.	*Principles of Medicinal Chemistry*, 7th Ed., Phildephia: Lippincott Williams and Wilkins. 3. Abraham, D.J., Rotella, R.J. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development,* 7th Ed., New york: John Wiley and Sons. 4. Smith, J.H., Williams, H. (2010). *Introduction to principles of drug design*, 3rd Ed., Australia: Harwood academic publishers. 5. Remington, P.J., Beringer, P. (2006). *Remington's Pharmaceutical Sciences,* 21st Ed., Phildephia: Lippincott Williams and Wilkins. 6. Buckley, G. (1988). *Martindale's extra pharmacopoeia,* 29th Ed., British journal of general practice. 7. Finar, I.L. (2002). *Organic Chemistry:* Volume 2. Stereochemistry and the Chemistry Natural Products. 5th Ed., London ; Perason. 8. Lednicer, D. (1997). *The Organic Chemistry of Drug Synthesis*, 5TH Edition, John New York: Wiley and Sons Ltd. 9. Indian Pharmacopoeia. 10. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. (2009). *Vogel's Tatchell.Text book of practical organic chemistry*, 5th Ed., London: Pearson. 2009 **Suggested e-material:** 1. https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC 2. https://www.wiley.com/en-us/Burger%27s+Medicinal+Chemistry%2C+Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154	
Course code PHAR 214 **Course name** Pharmaceutical Organic Chemistry-III	Upon completion of the course, the student shall be able to know • Nomenclature and classification. Synthesis, reactions and medicinal uses of heterocyclic compounds • the stereo chemical aspects of organic compounds and stereo chemical reactions	**Stereo isomerism:** ***Optical isomerism*** **-** Optical activity, enantiomerism, diastereoisomerism, meso compounds, elements of symmetry, chiral and achiral molecules. DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers. Racemic modification and resolution of racemic mixture. Asymmetric synthesis (partial and absolute) & reactions of chiral molecules. ***Geometrical isomerism:*** Nomenclature of geometrical isomers (Cis-Trans, E-Z, Syn-Anti systems), methods of determination of configuration of geometrical isomers. Conformational isomerism in ethane, n-butane and cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions. **Section-B** **Heterocyclic compounds:** Nomenclature and classification. Synthesis, reactions and medicinal uses of following compounds - Pyrrole, Furan, Thiophene Pyrazole, Imidazole, Oxazole, Thiazole, Pyridine, Quinoline, Isoquinoline, Acridine, Indole and their derivatives (pyrrolidine, furfural, 2,2'- bithiophene, N-phenyl pyrazole, imidazoline, 2-alkyloxazole, 4-hydroxy-1,3-thiazole, 2-methyl pyridine, 8-hydroxylquinoline, 1,2,3,4- tetrahydroisoquinoline, proflavin, indole-3-acetic acid). **Section-C** Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives (6-amino purine, pyrimidine-2,4 (1H, 3H)- dione, benzazepine). **Reactions of synthetic importance**: Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt	**Stereo isomerism:** ***Optical isomerism*** **-** Optical activity, enantiomerism, diastereoisomerism, meso compounds, elements of symmetry, chiral and achiral molecules. DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers. Racemic modification and resolution of racemic mixture. Asymmetric synthesis (partial and absolute) & reactions of chiral molecules. ***Geometrical isomerism:*** Nomenclature of geometrical isomers (Cis-Trans, E-Z, Syn-Anti systems), methods of determination of configuration of geometrical isomers. Conformational isomerism in ethane, n-butane and cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions. **Section-B** **Heterocyclic compounds:** Nomenclature and classification. Synthesis, reactions and medicinal uses of following compounds - Pyrrole, Furan, Thiophene Pyrazole, Imidazole, Oxazole, Thiazole, Pyridine, Quinoline, Isoquinoline, Acridine, Indole and their derivatives (pyrrolidine, furfural, 2,2'- bithiophene, N-phenyl pyrazole, imidazoline, 2-alkyloxazole, 4-hydroxy-1,3-thiazole, 2-methyl pyridine, 8-hydroxylquinoline, 1,2,3,4- tetrahydroisoquinoline, proflavin, indole-3-acetic acid). **Section-C** Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives (6-amino purine, pyrimidine-2,4 (1H, 3H)- dione, benzazepine). **Reactions of synthetic importance**: Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		condensation. **Recommended Books (Latest Editions)** 1. Organic chemistry by I.L. Finar, Volume-I & II. 2. A text book of organic chemistry – Arun Bahl, B.S. Bahl. 3. Heterocyclic Chemistry by Raj K. Bansal 4. Organic Chemistry by Morrison and Boyd 5. Heterocyclic Chemistry by T.L. Gilchrist	condensation. **Recommended Books (Latest Edition):** 1. Finar, I.L. (2002). *Organic chemistry,* 6th Ed., India: Pearson Education. 2. Bahl, B.S., Bahl, A. (2014). *A text book of organic chemistry*, 5th Ed., India: S.Chand and Company Ltd. 3. Bansal, R.K. (2017). *Heterocyclic Chemistry*, 5th Ed., India: New Age International Private Ltd. 4. Morrison, R.T., Boyd, R.M., Bhattacharjee, S.K. (2011) *Organic Chemistry*, 7th Ed., New York: Pearson Publishers. 5. Gilchrist, T.L. (1997). *Heterocyclic Chemistry*, 3rd Ed., UK: Prentice Hall. **Suggested e-material:** 1. Organic Chemistry: Pearson New International Edition Wade, Leroy G. http://lib.myilibrary.com?id=527192 2. Organic Chemistry: Pearson New International Edition Bruice, Paula Y. http://lib.myilibrary.com?id=527161 3. Organic chemistry concepts: Gregory Roos and Cathryn Roos http://www.sciencedirect.com/science/book/9780128016992	
Course code PHAR 215 **Course name** Pharmacognosy and Phytochemistry-I	Upon completion of this course student will have an understanding of: • history, scope and development of Pharmacognosy • Quality control of natural products • role of the plant tissue culture in enhancing the production of secondary metabolites. • Standardization of crude drug on the basis of different standardization parameters	**Section-A** **Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida. **Section-B** **Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin. Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants. Conservation of medicinal plants **Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines. **Section-C** **Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers - Cotton, Jute, Hemp, Hallucinogens, Teratogens, Natural allergens.	**Section-A** **Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida. **Section-B** **Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin. Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants. Conservation of medicinal plants **Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines. **Section-C** **Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers - Cotton, Jute, Hemp, Hallucinogens, Teratogens, Natural allergens.	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic uses and commercial utility as Pharmaceutical Aids and/or Medicines for the following primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, romelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids (Waxes, fats, fixed oils)**: Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax **Marine Drugs:** Novel medicinal agents from marine sources **Recommended books (Latest editions):** 1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009. 2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988. 3. Text Book of Pharmacognosy by T.E. Wallis 4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi. 5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi. 6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi. 7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007 8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae 9. Anatomy of Crude Drugs by M.A. Iyengar	**Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic uses and commercial utility as Pharmaceutical Aids and/or Medicines for the following primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, romelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids (Waxes, fats, fixed oils)**: Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax **Marine Drugs:** Novel medicinal agents from marine sources **Recommended books (Latest editions):** 1. Evans, W.C. (2009). *Trease and Evans. Pharmacognosy*, 16th Ed., London: W.B. Sounders & Co., 2009. 2. Tyler, V.E., Brady, L.R., Robbers, J.E. (1988). *Pharmacognosy*, 9th Ed., Philadelphia: Lea and Febiger. 3. Wallis, T.E., Churchill, A. (2005). *Text Book of Pharmacognosy*, 5th Ed., India: CBS Publishers. 4. Mohammad, A. (2012). *Pharmacognosy and Phytochemistry*, 2nd Ed., New Delhi: CBS Publishers and Distribution. 5. Purohit, A.P., Kokate, C.K., Gokhale, S.B. (2007). *Text book of Pharmacognosy*, 37th Ed., New Delhi: Nirali Prakashan. 6. Choudhary, R.D. (1996). *Herbal drug industry,* Ist Ed., New Delhi: Eastern Publisher. 7. Ansari, S.H. (2007). *Essentials of Pharmacognosy*, 2nd Ed. New Delhi: Birla publications. 8. Gokhale, S.B., Kokate, C.K. (2017). *Practical Pharmacognosy*, 18th Ed. New Delhi: Nirali Prakashan. 9. Lyengar, M.A., Nayak, S.G.K. (2017). *Anatomy of Crude Drugs*, 12th Ed., India: PharmaMed Press. **Suggested e-material:** 1. http://nsdl.niscair.res.in 2. http://www.herbs4youth.eu/files/workbook_processingtransf.pdf 3. https://biot202.files.wordpress.com 4. http://www.naturaldatabase.com. http://www.nlm.nih.gov/medlineplus/druginfo/herb_All.html 5. http://dietarysupplements.nlm.nih.gov/dietary/ingred.jsp 6. http://ods.od.nih.gov/ 7. http://nccam.nih.gov/ 8. http://apps.who.int/medicinedocs/en/d/Js2200e/ 9. www.fda.gov/medwatch 10. http://apps.who.int/medicinedocs/documents/h1791e/h1791e.pdf 11. http://ayush.gov.in/sites/default/files/File779%20%20%204.pdf 12. www.ayurveda.hu/api/API-Vol-1.	
Course code PHAR 216 **Course name** Pharmacology-I	Upon completion of the course, the student shall be able to know • Various principles of pharmacology • Classification and mode of actions of different categories of drugs • Effect of drug action at organ system/sub cellular/ macromolecular level	**Section-A** **General Pharmacology** a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme	**Section-A** **General Pharmacology** Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	• transduction mechanism of various receptors. • structure, organization and pharmacology of drugs acting on ans, pns and CNS • Applications of basic pharmacological knowledge in the prevention and treatment of various diseases	induction, enzyme inhibition, kinetics of elimination **Section-B** **General Pharmacology** a. **Pharmacodynamics-** Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action. b. Adverse drug reactions. c. Drug interactions (pharmacokinetic and pharmacodynamic) d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance. **Pharmacology of drugs acting on peripheral nervous system** a. Organization and function of ANS. b. Neurohumoral transmission,co-transmission and classification of neurotransmitters. c. Parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). e. Local anesthetic agents. f. Drugs used in myasthenia gravis and glaucoma. **Section-C** **Pharmacology of drugs acting on central nervous system** a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anesthetics and pre-anesthetics. c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics e. Alcohols and disulfiram f. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. g. Drugs used in Parkinson's disease and Alzheimer's disease. h. CNS stimulants and nootropics. i. Opioid analgesics and antagonists j. Drug addiction, drug abuse, tolerance and dependence. **Recommended Books (Latest Editions)** 1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier 2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill 3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics 4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A.K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams &Wilkins 5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- 6. Pharmacology 7. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE	**Section-B** **General Pharmacology:** Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action. Adverse drug reactions. Drug interactions (pharmacokinetic and pharmacodynamic. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance. **Pharmacology of drugs acting on peripheral nervous system:** Organization and function of ANS. Neurohumoral transmission, co-transmission and classification of neurotransmitters. Parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents. Drugs used in myasthenia gravis and glaucoma. **Section-C** **Pharmacology of drugs acting on central nervous system:** Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and pre-anesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics.. Alcohols and disulfiram. **Psychopharmacological agents:** Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinson's disease and Alzheimer's disease. CNS stimulants and nootropics, Opioid analgesics and antagonists, Drug addiction, drug abuse, tolerance and dependence. **Recommended Books (Latest Edition):** 1. Rang, H., MacEwan, D., Ritter, J., Flower, R., Henderson, G., Loke, Y.K. (2019). *Rang and Dale's Pharmacology*, 9th Ed., London: Churchil Livingstone Elsevier. 2. Katzung, B.G., Masters, S.B., Trevor, A.J. (2010). *Basic and clinical pharmacology*, 11th Ed., USA: Tata Mc Graw-Hill. 3. Brunton, L.L., Knollmann, B., Dandan, R.H. (2017). *Goodman and Gilman's, The Pharmacological Basis of Therapeutics,* 13th Ed., California: McGraw-Hill Education. 4. Marry, A.K.K., Lloyd, Y.Y., Brian, K. A., Robbin, L.C., Joseph, G.B., Wayne, A.K., Bradley, R.W. (2008). *Applied Therapeutics, The Clinical use of Drugs*, 9th Ed., Philadelphia: The Point Lippincott Williams &Wilkins. 5. Tripathi, K.D. (2018). *Essentials of Medical Pharmacology,* 8th Ed., New Delhi: JAYPEE Brothers Medical Publishers Ltd. 6. Sharma, H. L., Sharma, K.K. (2012). *Principles of Pharmacology*, 2nd Ed., Ahemdabad: Paras medical publisher. 7. Craig, C.R., Sitzel, R.E. (2003). *Modern Pharmacology with clinical Applications*, 6th Ed., Philadelphia: Lippincott Williams &Wilkins. 8. Ghosh, M.N. (2012). *Fundamentals of Experimental Pharmacology*, 6th Ed., Kolkata: Hilton & Company. 9. Kulkarni, S.K. (2005). *Handbook of experimental pharmacology*. 3rd Ed., New Delhi: Vallabh Prakshan.	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Brothers Medical 8. Publishers (P) Ltd, New Delhi. 9. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher 10. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert, 11. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. 12. 10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan,	**Suggested e-material:** 1. www.cvpharmacology.com 2. www.treatment4addiction.com 3. www.medicalnewtoday.com 4. www.edvivas.com 5. www.pharmafactz.com 6. www.ausmed.com 7. www.medicinenet.com	
Course code PHAR 218 **Course name** Physical Pharmaceutics-II	Upon completion of this course student will have an understanding of: • Principles of chemical kinetics & to use them in assigning expiry date for formulation. • Rheology principles and their applications on formulations. • Various aspects of drug stability.	**Section-A** **Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action. **Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers. **Deformation of solids:** Plastic and elastic deformation, Heckel equation, stress, strain, elastic modulus. **Section-B** **Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method. **Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. **Section-C** **Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention **Recommended Books: (Latest Editions)** 1. Physical Pharmacy by Alfred Martin, Sixth edition 2. Experimental pharmaceutics by Eugene, Parott. 3. Tutorial pharmacy by Cooper and Gunn. 4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia. 5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc. 6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc. 7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.	**Section-A** **Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action. **Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers. **Deformation of solids:** Plastic and elastic deformation, Heckel equation, stress, strain, elastic modulus. **Section-B** **Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method. **Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. **Section-C** **Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention **Recommended Books (Latest Edition):** 1. Martin, A., Swarbrick, J. (1993). *Physical Pharmacy*, 3rd Ed., Marryland: Lippincott Williams and Wilkins. 2. Parott, L.E., Saski, W. (1977). *Experimental Pharmaceutics*, 4th Ed., Minneapolis: Burgess publishers. 3. Cater, S.J. (2005). *Tutorial Pharmacy*, 6th Ed., India: CBS publishers. 4. Stocklosam, M.J., Ansel, H.C. (1986). *Pharmaceutical Calculations*, 8th Ed., Philadelphia: Lippincott Williams and Wilkins. 5. Liberman, H.A., Lachman, C., Schwartz, J.B. (1990). *Pharmaceutical Dosage forms*, Tablets, 2nd Ed., New York: Marcel	No changes in the syllabus. "Reference Books (Latest Editions):" merged in the recommended books. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Dekkar Inc. 6. Liberman, H.A., Lachman, C. (1990). *Pharmaceutical Dosage forms. Disperse systems.* 2nd Ed., New York: Marcel Dekkar Inc. 7. Ramasamy, C., Manavalan, R. (2015). *Physical Pharmaceutics*. 2nd Ed., Chenniai: Vignesh Publisher. **Suggested e-material:** 1. https://accesspharmacy.mhmedical.com/book.aspx?bookid=513 2. http://www.pharmtech.com/ 3. https://www.ncbi.nlm.nih.gov/pmc/ 4. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 5. https://www.pdfdrive.com/pharmaceutical-books.html 6. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 7. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 8. www.elsevier.com/books/	
Course code PHAR 211L **Course name** Medicinal Chemistry-I Lab		**I Preparation of drugs/ intermediates** • 1,3-pyrazole • 1,3-oxazole • Benzimidazole • Benztriazole • 2,3- diphenyl quinoxaline • Benzocaine • Phenytoin • Phenothiazine • Barbiturate **II Assay of drugs** • Chlorpromazine • Phenobarbitone • Atropine • Ibuprofen • Aspirin • Furosemide **III Determination of Partition coefficient for any two drugs**	**I Preparation of drugs/ intermediates** • 1,3-pyrazole • 1,3-oxazole • Benzimidazole • Benztriazole • 2,3- diphenyl quinoxaline • Benzocaine • Phenytoin • Phenothiazine • Barbiturate **II Assay of drugs** • Chlorpromazine • Phenobarbitone • Atropine • Ibuprofen • Aspirin • Furosemide **III Determination of Partition coefficient for any two drugs**	
Course code PHAR 215L **Course name** Pharmacognosy and Phytochemistry-I Lab		1. Analysis of crude drugs by chemical tests: (i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil 2. Determination of stomatal number and index 3. Determination of vein islet number, vein islet termination and paliside ratio. 4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer 5. Determination of Fiber length and width 6. Determination of number of starch grains by Lycopodium spore method 7. Determination of Ash value 8. Determination of Extractive values of crude drugs 9. Determination of moisture content of crude drugs 10. Determination of swelling index and foaming	1. Analysis of crude drugs by chemical tests: (i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil 2. Determination of stomatal number and index 3. Determination of vein islet number, vein islet termination and paliside ratio. 4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer 5. Determination of Fiber length and width 6. Determination of number of starch grains by Lycopodium spore method 7. Determination of Ash value 8. Determination of Extractive values of crude drugs 9. Determination of moisture content of crude drugs 10. Determination of swelling index and foaming	
Course code PHAR 216L **Course name** Pharmacology-I Lab		1. Introduction to experimental pharmacology. 2. Commonly used instruments in experimental pharmacology. 3. Study of common laboratory animals. 4. Maintenance of laboratory animals as per CPCSEA guidelines. 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal	1. Introduction to experimental pharmacology. 2. Commonly used instruments in experimental pharmacology. 3. Study of common laboratory animals. 4. Maintenance of laboratory animals as per CPCSEA guidelines. 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		studies. 6. Study of different routes of drugs administration in mice/rats. 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice. 8. Effect of drugs on ciliary motility of frog oesophagus 9. Effect of drugs on rabbit eye. 10. Effects of skeletal muscle relaxants using rota-rod apparatus. 11. Effect of drugs on locomotor activity using actophotometer. 12. Anticonvulsant effect of drugs byMES and PTZ method. 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. 14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anesthetics by different methods *Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*	studies. 6. Study of different routes of drugs administration in mice/rats. 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice. 8. Effect of drugs on ciliary motility of frog oesophagus 9. Effect of drugs on rabbit eye. 10. Effects of skeletal muscle relaxants using rota-rod apparatus. 11. Effect of drugs on locomotor activity using actophotometer. 12. Anticonvulsant effect of drugs byMES and PTZ method. 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. 14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anesthetics by different methods *Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*	
Course code PHAR 218L **Course name** Physical Pharmaceutics-II Lab		1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination sedimentation volume with effect of different suspending agent 7. Determination sedimentation volume with effect of different concentration of single suspending agent 8. Determination of viscosity of semisolid by using Brookfield viscometer 9. Determination of reaction rate constant first order. 10. Determination of reaction rate constant second order 11. Accelerated stability studies	1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination sedimentation volume with effect of different suspending agent 7. Determination sedimentation volume with effect of different concentration of single suspending agent 8. Determination of viscosity of semisolid by using Brookfield viscometer 9. Determination of reaction rate constant first order. 10. Determination of reaction rate constant second order 11. Accelerated stability studies	

Name of Programme: Bachelor of Pharmacy
Course details: Fifth Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Industrial Pharmacy-I	Upon completion of this course student will have an understanding of: • various pharmaceutical dosage forms and their manufacturing techniques. • various considerations in development of pharmaceutical dosage forms. • evaluation quality of solid, liquid and semisolid dosage forms.		**Section-A** **Tablets:** Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. **Tablet coating:** Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. **Quality control tests:** In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia **Section-B** **Capsules:** *Hard gelatin capsules:* Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			defects. In process and final product quality control tests for capsules. *Soft gelatin capsules:* Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Parenteral Products:** Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives. Production procedure, production facilities and controls, aseptic processing. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.Filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. **Section-C** **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets. **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stabilitystudies. **Packaging materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests. **Recommended Books (Latest Editions):** 1. Troy, D.B. (2006). *Remington: The Science and Practice of Pharmacy*. 21st edition, Vol.I & Vol.-II, Easton Pennysylvannia: Mack Publishing Co. 2. Cooper, J.W. Gunn, G. (1986). *Tutorial Pharmacy*, London: Petman Books Ltd. 3. Lachman, L. (1986). *Theory and Practice of Industrial Pharmacy*. Philadelphia: Lea & Febiger 4. Ansel, HC*. Allen, L.V. (2014). Introduction to Pharmaceutical Dosage Forms*. Philadelphia: Wolters Kluwer. 5. Juliano, R.L. (1981) *Drug Delivery Systems,* Oxford:Oxford University Press . 6. Harrys (2000). *Cosmetology*, *Art and Science of Formulating Cosmetic Products.* 9th edition, Palm Springs: Chemical Publishing Company. 7. Balsam,M.S.,Sagarin,E.,(2008) *Cosmetics: Science and Technology*.2th edition, U.S.A.: Krieger Publishing Company. **Suggested e-material:** 1. https://accesspharmacy.mhmedical.com/book.aspx?bookid=513 2. http://www.pharmtech.com/ 3. https://www.ncbi.nlm.nih.gov/pmc/ 4. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 5. https://www.pdfdrive.com/pharmaceutical-books.html 6. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 7. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject www.elsevier.com/books/	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Medicinal Chemistry-II	Upon completion of this course student will have an understanding of: • chemistry of drugs with respect to their pharmacological activity • the drug metabolic pathways, adverse effect and therapeutic value of drugs. • structural Activity Relationship of different class of drugs. • chemical synthesis of selected drugs		Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*) **Section-A** Antihistaminic agents: Histamine, receptors and their distribution in the human body. **H_1-antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine, Cromolyn sodium. **H_2-antagonists:** Cimetidine*, Famotidine, Ranitidine. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole **Anti-neoplastic agents:** **Alkylating agents:** Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastine sulphate, Vincristine sulphate **Miscellaneous:** Cisplatin, Mitotane. **Section-B** **Antianginal:** **Vasodilators:** Amyl nitrite, Nitroglycerine*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** **Carbonic anhydrase inhibitors:** Acetazolamide*, Methazolamide, Dichlorphenamide. **Thiazides:** Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. **Osmotic Diuretics:** Mannitol **Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride. **Anti-arrhythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemic agents**: Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide,	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Bosentan, Tezosentan. **Section-C** **Drugs acting on Endocrine system:** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones:** Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole. **Antidiabetic agents:** Insulin and its preparations Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose. **Local Anesthetics:** SAR of Local anesthetics **Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **Amino Benzoic acid derivatives**: Benzocaine*, Butamben, Procaine*, Butacaine,Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous**: Phenacaine, Diperodon, Dibucaine.* **Recommended Books (Latest Edition):** 1. Beale, J.M., Block, J., Wilson, G. (2010). *Organic medicinal and Pharmaceutical Chemistry*, 12th Ed., Phildephia: Lippincott Williams and Wilkins. 2. Lemke, T.L., Williams, D.A., Rocho, V.F., Zito, S.W. (2012). *Foye's Principles of Medicinal Chemistry*, 7th Ed., Phildephia: Lippincott Williams and Wilkins. 3. Abraham, D.J., Rotella, R.J. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development,* 7th Ed., New york: John Wiley and Sons. 4. Smith, J.H., Williams, H. (2010). *Introduction to principles of drug design*, 3rd Ed., Australia: Harwood academic publishers. 5. Remington, P.J., Beringer, P. (2006). *Remington's Pharmaceutical Sciences,* 21st Ed., Phildephia: Lippincott Williams and Wilkins. 6. Buckley, G. (1988). *Martindale's extra pharmacopoeia,* 29th Ed., British journal of general practice. 7. Finar, I.L. (2002). *Organic Chemistry:* Volume 2. Stereochemistry and the Chemistry Natural Products. 5th Ed., London ; Perason. 8. Lednicer, D. (1997). *The Organic Chemistry of Drug Synthesis*, 5TH Edition, John New York: Wiley and Sons Ltd. 9. Indian Pharmacopoeia. 10. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. (2009). *Vogel's Tatchell.Text book of practical organic chemistry*, 5th Ed., London: Pearson. 2009 **Suggested e-material:** 1. https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC 2. https://www.wiley.com/en-us/ Burger %27s+ Medicinal+Chemistry%2C+Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Pharmacology II	Upon completion of this course student will have an understanding of: • pharmacological actions of different categories of drugs • details about mechanism of drug action at organ system/sub cellular/ macromolecular levels • applications of basic pharmacological knowledge in the prevention and treatment of various diseases • correlation of pharmacology with other bio medical sciences. • signal transduction mechanism of various receptors. • structure, organization and pharmacology of drugs acting on ans, PNS and CNS		**Section-A** **Pharmacology of drugs acting on cardio vascular system:** Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure, anti-hypertensive drugs, anti-anginal drugs, anti-arrhythmic drugs and anti-hyperlipidemic drugs. **Pharmacology of drugs acting on cardio vascular system:** Drug used in the therapy of shock, hematinics, coagulants, anticoagulants, fibrinolytics, anti-platelet drugs and plasma volume expanders **Pharmacology of drugs acting on urinary system**: Diuretics and anti-diuretics. **Section-B** **Autocoids and related drugs:** Introduction to autacoids and classification, histamine, 5-HT and their antagonists. Prostaglandins, thromboxanes and leukotrienes, angiotensin, bradykinin and substance P. Non-steroidal anti-inflammatory agents, anti-gout drugs and anti-rheumatic drugs **Pharmacology of drugs acting on endocrine system:** Basic concepts in endocrine pharmacology. Anterior pituitary hormones- analogues and their inhibitors. Thyroid hormones- analogues and their inhibitors. Hormones regulating plasma calcium level- parathormone, calcitonin and vitamin-D. Insulin, oral hypoglycemic agents and glucagon. ACTH and corticosteroids. **Section-C** **Pharmacology of drugs acting on endocrine system**: Androgens and anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus. **Bioassay**: Principles and applications of bioassay, types of bioassay, bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT. **Recommended Books (Latest Edition):** 1. Ghosh MN, *Fundamentals of Experimental Pharmacology,* Scientific Book Agency, Calcutta, 2007. 2. Grover JK., *Experiments in Pharmacy & Pharmacology* CBS Publishers, New Delhi, 1990. 3. Kulkarni S.K., *Hand Book of Experimental Pharmacology* Vallabh Prakashan, Delhi,2005. 4. Barar FSK,*Text Book of Pharmacology* Interpoint, New Delhi,2013. 5. Goodman & Gilman, *The Pharmacological basis of Therapeutics* Editors: J.G. Hardman, L.E. Limbird, P.B. Molinos, R.W. Ruddon and A.G. Gil, Pergamon press,1996. 6. Katzung BG, *Basic & Clinic Pharmacology* Prentice Hall, International,2010. 7. LaurenceDR ,Bennet PN,*Clinical Pharmacology* Churchill Livingstone,1998. 8. Rang MP, Dale MM, Riter JM, *Pharmacology* Churchill Livingstone,2015. 9. Tripathi KD,*Essentials of Medical Pharmacology* Jay Pee Publishers, New Delhi,2013. 10. Satoskar & Bhandarkar,*Pharmacology & Pharmacotheropeutics.* Popular Prakashan Pvt. Ltd. Bombay, 2013. **Suggested e-material:** 1. www.cvpharmacology.com 2. www.treatment4addiction.com 3. www.medicalnewtoday.com 4. www.edvivas.com 5. www.pharmafactz.com	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			6. www.ausmed.com	
Course code PHAR **Course name** Pharmacognosy and Phytochemistry-II	Upon completion of this course student will have an understanding of: • glycosides as secondary metabolite, their classification, chemical structure and properties • use of different categories of glycosides in different diseases • how ayurvedic formulations are prepared and stored. • use of the traditional medicine in curing different ailments		**Section-A** **Metabolic pathways in higher plants and their determination**: Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies. **Basics of Phytochemistry:** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs. **Section-B** **General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:** **Alkaloids:** Vinca, rauwolfia, belladonna, opium, phenylpropanoids **Flavonoids:** Lignans, tea, ruta steroids, cardiac glycosides **Triterpenoids:** Liquorice, dioscorea, digitalis **Volatile oils:** Mentha, clove, cinnamon, fennel, coriander **Tannins:** Catechu, pterocarpus **Resins:** Benzoin, guggul, ginger, asafoetida, myrrh, colophony **Glycosides:** Senna, aloes, bitter almond iridoids, other terpenoids **Naphthaquinones:** Gentian, artemisia, taxus, carotenoids. **Section-C** **Isolation, Identification and Analysis of Phytoconstituents** **a) Terpenoids:** Menthol, Citral, Artemisin **b) Glycosides:** Glycyrhetinic acid & Rutin **c) Alkaloids:** Atropine, Quinine, Reserpine, Caffeine **d) Resins:** Podophyllotoxin, Curcumin **Industrial production, estimation and utilization of the following phytoconstituents:** Forskolin, sennoside, artemisinin, diosgenin, digoxin, atropine, podophyllotoxin, caffeine, taxol, vincristine and vinblastine. **Recommended books (Latest edition):** 1. Evans, W.C. (2009). *Trease and Evans. Pharmacognosy*, 16th Ed., London: W.B. Sounders & Co. 2. Tyler, V.E., Brady, L.R., Robbers, J.E. (1988). *Pharmacognosy*, 9th Ed., Philadelphia: Lea and Febiger. 3. Wallis, T.E., Churchill, A. (2005). *Text Book of Pharmacognosy*, 5th Ed., New Delhi: CBS Publishers. 4. Mohammad, A. (2012). *Pharmacognosy and Phytochemistry*, 2nd Ed., New Delhi: CBS Publishers and Distribution. 5. Purohit, A.P., Kokate, C.K., Gokhale, S.B. (2007). *Text book of Pharmacognosy*, 37th Ed., Pune: Nirali Prakashan. 6. Choudhary, R.D. (1996). *Herbal drug industry*, 1st Ed., New Delhi: Eastern Publisher. 7. Ansari, S.H. (2007). *Essentials of Pharmacognosy*, 2nd Ed. New Delhi: Birla publications. 8. Gokhale, S.B., Kokate, C.K. (2017). *Practical Pharmacognosy*, 18th Ed. Pune: Nirali Prakashan. **Suggested e-material:** http://nsdl.niscair.res.in http://www.herbs4youth.eu/files/workbook_processingtransf.pdf https://biot202.files.wordpress.com http://www.naturaldatabase.com http://www.nlm.nih.gov/medlineplus/druginfo/herb_All.html	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			http://dietarysupplements.nlm.nih.gov/dietary/ingred.jsp http://ods.od.nih.gov/ http://nccam.nih.gov/ http://apps.who.int/medicinedocs/en/d/Js2200e/ www.fda.gov/medwatch http://apps.who.int/medicinedocs/documents/h1791e/h1791e.pdf http://ayush.gov.in/sites/default/files/File779%20%20%204.pdf www.ayurveda.hu/api/API-Vol-1	
Course code PHAR **Course name** Pharmaceutical Jurisprudence	Upon completion of this course student will have an understanding of: • pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals. • various Indian pharmaceutical Acts and Laws • regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals • code of ethics during the pharmaceutical practice		**Section-A** **Drugs and Cosmetics Act, 1940 and its rules 1945:** Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license. **Drugs and Cosmetics Act, 1940 and its rules 1945:** Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Sch F & DMR (OA). Sale of Drugs – Wholesale, Retail sale and restricted license. Offences and penalties Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors. **Section-B** **Pharmacy Act 1948:** Objectives, definitions, pharmacy council of India, its constitution and functions, education regulations, state and joint state pharmacy councils, constitution and functions, registration of pharmacists, offence and penalties. **Medicinal and toilet preparation act 1955:** Objectives, definitions, licensing, manufacture in bond and outside bond, export of alcoholic preparations, manufacture of ayurvedic, homeopathic, patent & proprietary preparations. Office and penalties. **Narcotic drugs and psychotropic substances act 1985 and rules:** Objectives, definitions, authorities and officers, constitution and functions of narcotic and psychotropic consultative committee, national fund for controlling the drug abuse, prohibition, control and regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, offences and penalties. **Section-C** **Study of salient features of drugs and magic remedies act and its rules:** Objectives, definitions, prohibition of certain advertisements, classes of exempted advertisements, offences and penalties. **Prevention of cruelty to animals act 1960:** Objectives, definitions, Institutional animal ethics committee, CPCSEA guidelines for breeding and stocking of animals, performance of experiments, transfer and acquisition of animals for experiment, records, power to suspend or revoke registration, offences and penalties. **National pharmaceutical pricing authority:** Drugs price control order (DPCO) 2013. Definitions, sale prices of bulk drugs, retail price of formulations, retail price and ceiling price of scheduled formulations, national list of essential medicines. **Pharmaceutical legislations:** A brief review, introduction, study of	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			drugs enquiry committee, health survey and development committee, Hathi committee and Mudaliar committee. **Code of pharmaceutical ethics:** Definition, pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath. **Medical termination of pregnancy act.** **Right to information act.** **Introduction to Intellectual Property Rights (IPR).** **Recommended books (Latest edition):** 1. Mittal, B.M., (1899). *Textbook of Forensic Pharmacy*, Calcutta: National Book Centre. 2. *(Relevant Acts & Rules,* (2006)Delhi: Publishing by the Govt. of India. *3.* Jain, N.K., (2018) *A Textbook of Forensic Pharmacy*, Delhi. : Vallabh Prakashan. **Suggested e-material:** *1.* www.imedpub.com/.../pharmaceutical-jurisprudence-journals-articles-ppts-list.php 2. https://cdsco.gov.in	
Course code PHAR **Course name** Industrial Pharmacy-I Lab			1. Preparation and evaluation of Paracetamol tablets 2. Preparation and evaluation of Aspirin tablets 3. Coating of tablets- film coating of tables/granules 4. Preparation and evaluation of Tetracycline capsules 5. Preparation of Calcium Gluconate injection 6. Preparation of Ascorbic Acid injection 7. Qulaity control test of (as per IP) marketed tablets and capsules 8. Preparation of Eye drops/ and Eye ointments 9. Preparation of Creams (cold / vanishing cream) 10. Evaluation of Glass containers (as per IP)	
Course code PHAR **Course name** Medicinal Chemistry-II Lab			1. Synthesis of selected drugs from the course content involving two or more steps. 2. Establishing the pharmacopoeial standards of the drugs synthesized.	
Course code PHAR **Course name** Pharmacology-II Lab			1. Introduction to in-vitro pharmacology and physiological salt solutions. 2. Effect of drugs on isolated frog heart. 3. Effect of drugs on blood pressure and heart rate of dog. 4. Studyof diuretic activity of drugs using rats/mice. 5. DRC of acetylcholine using frog rectus abdominis muscle. 6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively. 7. Bioassay of histamine using guinea pig ileum by matching method. 8. Bioassay of oxytocin using rat uterine horn by interpolation method. 9. Bioassay of serotonin using rat fundus strip by three point bioassay. 10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay. 11. Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method). 12. Determination of PD_2 value using guinea pig ileum. 13. Effect of spasmogens and spasmolytics using rabbit jejunum. 14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model. 15. Analgesic activity of drug using central and peripheral methods Note: All laboratory techniques and animal experiments are	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			demonstrated by simulated experiments by softwares and videos	
Course code PHAR **Course name** Pharmacognosy and Phytochemistry-II Lab			1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander 2. Exercise involving isolation & detection of active principles a. Caffeine - from tea dust. b. Diosgenin from Dioscorea c. Atropine from Belladonna d. Sennosides from Senna 3. Separation of sugars by Paper chromatography 4. TLC of herbal extract 5. Distillation of volatile oils and detection of phytoconstitutents by TLC 6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh	

Name of Programme: Bachelor of Pharmacy
Course details: Sixth Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Biopharmaceutics and Pharmacokinetics	Upon completion of this course student will have an understanding of: • biopharmaceutics and pharmacokinetics, their role in formulation, development and clinical testing. • related to compartment modelling and plasma concentration measurement. • dosage adjustment in clinical & pathological conditions and pharmacokinetic drug interaction. • bioavailability – bioequivalence (BA-BE) study.		**Section-A** **Introduction to Biopharmaceutics:** Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution**: Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution. **Plasma and tissue protein binding of drugs**: factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs. **Section-B** **Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs **Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs. **Section-C** **Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. Intravenous Injection (Bolus), Intravenous infusion and Extravascular administrations. Pharmacokinetics parameters - K, $t_{1/2}$, Vd, AUC, Ka, Cl_T and CL_{RE} - definitions methods of eliminations, understanding of their significance and application. **Multi-compartment models:** Two compartment open model, IV bolus. **Multiple dosage regimen:** Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settings. **Nonlinear Pharmacokinetics:** Introduction, Factors causing Non-linearity, Michaelis-menton method of estimating parameters, Explanation with example of drugs. **Recommended books (Latest editions):** 1. Notari,R.E.,(1971).*BiopharmaceuticsandPharmacokinetics,* New York*: An introduction* Marcel Dekker Inc.	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			2. Rowland, M., Tozer,T.N.,(1989)*Clinical Pharmacokinetics*, New.York: Lea and Febriger. 3. Wagner, J.G. (1976), *Fundamentals of Clinical Pharmacokinetics*, Hamilton: Drugs Intelligence Publishers. 4. Wagner, J.G., (1993). *Pharmacokinetics for the Pharmaceutical Scientist*, Basel, Switzerland: Technomic Publishing A.G.. **Suggested e-material:** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code PHAR **Course name** Herbal Drug Technology	Upon completion of this course student will have an understanding of: • alkaloidal drugs ,their classification, chemical tests and uses • various enzymes and functions • worldwide trade affecting the national economy • role of the plant tissue culture in enhancing the accumulation of secondary metabolites • chromatography helps in identification and quantification of mixture of chemical constituents present in the drugs		**Section-A** **Herbs as raw materials:** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation, source of herbs selection, identification and authentication of herbal materials, processing of herbal raw material. Biodynamic agriculture good agricultural practices in cultivation of medicinal plants including organic farming**.** **Pest and Pest management in medicinal plants:** Biopesticides/Bioinsecticides. **Indian Systems of Medicine:** Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma **Section-B** **Nutraceuticals:** General aspects, market, growth, scope and types of products available in the market. Health benefits and role of nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. **Study of following herbs as health food:** Alfa-alfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions- Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra. **Herbal Cosmetics:** Herbal Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. **Herbal excipients:** Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations:** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes **Section-C** **Evaluation of Drugs:** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products:** Definition of the terms- Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy. Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs. **General Introduction to Herbal Industry:** Herbal drugs industry, Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			plants in India. **Schedule T:** Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives. Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records. **Recommended books (Latest editions):** 1. Evans, W.C. (2009). *Trease and Evans. Pharmacognosy*, 16th Ed., London: W.B. Sounders & Co., 2009. 2. Tyler, V.E., Brady, L.R., Robbers, J.E. (1988). *Pharmacognosy*, 9th Ed., Philadelphia: Lea and Febiger. 3. Wallis, T.E., Churchill, A. (2005). *Text Book of Pharmacognosy*, 5th Ed., India: CBS Publishers. 4. Mohammad, A. (2012). *Pharmacognosy and Phytochemistry*, 2nd Ed., New Delhi: CBS Publishers and Distribution. 5. Purohit, A.P., Kokate, C.K., Gokhale, S.B. (2007). *Text book of Pharmacognosy*, 37th Ed., New Delhi: Nirali Prakashan. 6. Choudhary, R.D. (1996). *Herbal drug industry,* Ist Ed., New Delhi: Eastern Publisher. 7. Ansari, S.H. (2007). *Essentials of Pharmacognosy*, 2nd Ed. New Delhi: Birla publications. 8. Gokhale, S.B., Kokate, C.K. (2017). *Practical Pharmacognosy*, 18th Ed. New Delhi: Nirali Prakashan. 9. Lyengar, M.A., Nayak, S.G.K. (2017). *Anatomy of Crude Drugs*, 12th Ed., India: PharmaMed Press. **Suggested e-material:** 1. http://nsdl.niscair.res.in 2. http://www.herbs4youth.eu/files/workbook_processingtransf.pdf 3. https://biot202.files.wordpress.com 4. http://www.naturaldatabase.com 5. http://www.nlm.nih.gov/medlineplus/druginfo/herb_All.html 6. http://dietarysupplements.nlm.nih.gov/dietary/ingred.jsp 7. http://ods.od.nih.gov/ 8. http://nccam.nih.gov/ 9. http://apps.who.int/medicinedocs/en/d/Js2200e/ 10. www.fda.gov/medwatch 11. http://apps.who.int/medicinedocs/documents/h1791e/h1791e.pdf 12. http://ayush.gov.in/sites/default/files/File779%20%20%204.pdf 13. www.ayurveda.hu/api/API-Vol-1	
Course code PHAR **Course name** Medicinal Chemistry-III	Upon completion of this course student will have an understanding of: • correlation between pharmacology of a disease and its mitigation or cure. • drug metabolic pathways, adverse effect and therapeutic value of drugs • structural activity relationship of different class of drugs. • synthesis of some important class of drugs. • mechanism pathways of different class of medicinal		**Section-A** **Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)** **Antibiotics:** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β-Lactam antibiotics:** Penicillin, Cepholosporins, **β**-Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin **Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline. **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin.	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	compounds. • chemistry of drugs with respect to their pharmacological activity		**Prodrugs:** Basic concepts and application of prodrugs design. **Antimalarials:** Etiology of malaria. **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil. **Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquon **Section-B** **Anti-tubercular Agents** **Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate. **Urinary tract anti-infective agents Quinolones:** SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine. **Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir. **Antifungal agents:** **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*. **Section-C** **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. **Sulphonamides and Sulfones:** Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones:** Dapsone*. **Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. **Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis. **Recommended Books (Latest Editions):** 1. Beale, J.M., Block, J., Wilson, G. (2010). *Organic medicinal and Pharmaceutical Chemistry*, 12th Ed., Phildephia: Lippincott Williams and Wilkins. 2. Lemke, T.L., Williams, D.A., Rocho, V.F., Zito, S.W. (2012). *Foye's Principles of Medicinal Chemistry*, 7th Ed., Phildephia: Lippincott Williams and Wilkins. 3. Abraham, D.J., Rotella, R.J. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development,* 7th Ed., New york: John Wiley	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			and Sons. 4. Smith, J.H., Williams, H. (2010). *Introduction to principles of drug design*, 3rd Ed., Australia: Harwood academic publishers. 5. Remington, P.J., Beringer, P. (2006). *Remington's Pharmaceutical Sciences,* 21st Ed., Phildephia: Lippincott Williams and Wilkins. 6. Buckley, G. (1988). *Martindale's extra pharmacopoeia,* 29th Ed., British journal of general practice. 7. Finar, I.L. (2002). *Organic Chemistry:* Volume 2. Stereochemistry and the Chemistry Natural Products. 5th Ed., London ; Perason. 8. Lednicer, D. (1997). *The Organic Chemistry of Drug Synthesis*, 5TH Edition, John New York: Wiley and Sons Ltd. 9. Indian Pharmacopoeia. 10. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. (2009). *Vogel's Tatchell.Text book of practical organic chemistry*, 5th Ed., London: Pearson. 2009 **Suggested e-material:** 1. https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC 2. https://www.wiley.com/en-us/ Burger %27s+ Medicinal+Chemistry%2C+Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154	
Course code PHAR **Course name** Pharmacology-III	Upon completion of this course student will have an understanding of: • mechanism of drug action and its relevance in the treatment of different diseases • various receptor actions using isolated tissue preparation. • cell communication mechanism • newer targets of several disease conditions for treatment • structure, organization and pharmacology of drugs acting on cvs, git, hemopoeitic system, respiratory system, endocrine system, diuretics and autacoids		**Section-A** **Pharmacology of drugs acting on Respiratory system:** Anti -asthmatic drugs, Drugs used in the management of COPD, Expectorants and antitussives, Nasal decongestants, Respiratory stimulants. **Pharmacology of drugs acting on the Gastrointestinal Tract:** Antiulcer agents, Drugs for constipation and diarrhea, Appetite stimulants and suppressants. Digestants and carminatives. Emetics and anti-emetics. **Chemotherapy:** General principles of chemotherapy. Sulfonamides and cotrimoxazole. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides. **Section-B** **Chemotherapy:** Antitubercular agents, Antileprotic agents, Antifungal agents, Antiviral drugs, Anthelmintics, Antimalarial drugs, Antiamoebic agents. **Chemotherapy:** Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy. **Immunopharmacology:** Immunostimulants, Immunosuppressant, Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars. **Section-C** **Principles of toxicology:** Definition and basic knowledge of acute, subacute and chronic toxicity. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity. General principles of treatment of poisoning, Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning. **Chronopharmacology:** Definition of rhythm and cycles. Biological clock and their significance leading to chronotherapy. **Recommended books (Latest editions):** 1. Kulkarni, S.K. (2013). *Handbook of Experimental Pharmacology*, Vallabh Prakashan. 2. Ghosh, M.N. (2008). *Fundamentals of Experimental Pharmacology*, 5th Ed., Kolkata: Hilton & Company Publishers. 3. *Handbook on GLP, Quality Practices for Regulated Non-Clinical*	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Research and Development, World Health Organization, 2nd Ed., 2008. 4. *Schedule Y, Guideline: Drugs and cosmetics (second amendment) Rules*, CDSCO, 1945. 5. *Annual Report to the People on Health*, Ministry of Health and Family Welfare, New Delhi, 2005 6. Rick, N.G. (2015). *Drugs from Discovery to Approval*, 3rd Ed., United States: Wiley-Blackwell Publishers. 7. Gad, C.S. (2015). *Animal Models in Toxicology*, 3rd Ed., New York: CRC Press. 8. *OECD (452) guidelines for the Testing of Chemicals*, 2018 9. Stine, E.R., Brown, M.T. (2015). *Principles of toxicology*, 3rd Ed., New York: CRC Press. **Suggested e-material:** 1. www.cvpharmacology.com 2. www.treatment4addiction.com 3. www.medicalnewtoday.com 4. www.edvivas.com 5. www.pharmafactz.com 6. www.ausmed.com	
Course code PHAR **Course name** Pharmaceutical Biotechnology	Upon completion of this course student will have an understanding of: • importance of genetic engineering & enzyme immobilization in pharmaceutical industries • production and application of monoclonal antibodies in health care. • use of fermentation technology in pharmaceutical field.		**Section-A** **Brief introduction to Biotechnology with reference to Pharmaceutical Sciences**. **Enzyme Biotechnology**: Methods of enzyme immobilization and applications. **Biosensors**: Working and applications of biosensors in Pharmaceutical Industries. **Brief introduction to Protein Engineering**. Use of microbes in industry. Production of Enzymes- General consideration -Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. **Basic principles of genetic engineering.** Study of cloning vectors, restriction endonucleases and DNA ligase. **Recombinant DNA technology**: Application of genetic engineering in medicine. Application of r DNA technology and genetic engineering in the production of: Interferon; Vaccines- hepatitis- B; Hormones- Insulin. Brief introduction to PCR **Section-B** **Immunity:** Types of immunity- humoral immunity, cellular immunity. Structure of Immunoglobulins. Structure and Function of MHC. Hypersensitivity reactions, Immune stimulation and Immune suppressions. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. Storage conditions and stability of official vaccines. **Hybridoma technology:** Production, Purification and Applications. **Immuno blotting techniques:** ELISA, Western blotting, Southern blotting. **Section-C** Genetic organization of Eukaryotes and Prokaryotes. Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. **Microbial biotransformation**: Introduction and its applications. **Mutation**: Types of mutation/mutants. **Fermentation**: methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. Large	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin. **Recommended books (Latest editions):** 1. Vyas, S.P., Dixit, V.K.(2010). *Pharmaceutical Biotechnology*, New Delhi: CBS Publication. 2. Prescott, Dunn's, (2004)..*Industrial Microbiology*, Delhi :CBS Publishers and Distributors. 3. Stanbury, P.F., Ahhitar, A.,(2008). *Principles of Fermentation Technology*., 4. Kieslich, K.(1984).,*Biotechnology* . Vol. 69 Switzerland :Verleg Chernie . 5. Standury, P.F.,, Whitaker, A., Hall, S.J.,(1990). *Principles of Fermentation*, New Delhi.:Aditya Book Private Limited. 1990. 6. Crueger, W., Crueger, A.,(2000). *Biotechnology-A Textbook of Industrial Microbiology*, Delhi: Panima Publishing Corporation. **Suggested e-material:** 1. http://site.iugaza.edu.ps/tbashiti/files/2013/02/2.Pharmaceutical_Biotechnology_ConceptsApplications-Gary_Walsh.pdf 2. http://web.xidian.edu.cn/yqxia/files/20140227_103205.pdf 3. https://drive.google.com/file/d/0BxB7ZrIzz8L7STd4WEhneHlKcXc/view?usp=drivesdk	
Course code PHAR **Course name** Quality Assurance	Upon completion of this course student will have an understanding of: • the importance of quality in pharmaceutical products. • importance of Good practices such as GMP, GLP etc. • factors affecting the quality of pharmaceutical are explored. • regulatory aspects of pharmaceutical taught to the student. • process involved in manufacturing of pharmaceuticals different section/department and activity is learnt.		**Section-A** **Organization and personnel:** Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. **Section-B** **Quality Control:** Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities **Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Section-C** **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports anddocuments, distribution records. **Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management **Recommended books (Latest editions):** 1. Quality Assurance Guide (1996) by Organization of Pharmaceutical Procedures of India, 3rd revised Ed., Volume I	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			& II. 2. Weinberg, S. (1995). Good Laboratory Practice Regulations. 2nd Ed., Vol. 69, New York: Marcel Dekker, Inc. 3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999. 4. Sharma, P. P. (1991). How to Practice GMP's. Agra:Vandana Publications. 5. The International Pharmacopoeia (2005)– Vol I, II, III, IV & V - General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms, 3rd Ed., WHO, Geneva. 6. Hirsch, A. F. (1989). Good Laboratory Practice Regulations. Vol 38, New York: Marcel Dekker Inc. 7. Deshpande, S. W., Gandhi, N. The Drugs and Cosmetics Act 1940 and Rules 1945. 8th Ed., Mumbai:Susmit Publishers. 8. Shah, D. H. (2000). QA Manual. 1st Ed., Business Horizons, Elsevier. 9. Willig, S. H., Stoker J. (1991). Good Manufacturing Practices for Pharmaceuticals A Plan For Total Quality Control. Vol. 52, 3rd Ed., New York: Marcel Dekker Inc. **Suggested e-material:** 1. www.ich.org 2. https://www.who.int	
Course code PHAR **Course name** Herbal Drug Technology Lab			1. To perform preliminary phytochemical screening of crude drugs. 2. Determination of the alcohol content of Asava and Arista. 3. Evaluation of excipients of natural origin. 4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation. 5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements . 6. Monograph analysis of herbal drugs from recent Pharmacopoeias. 7. Determination of Aldehyde content 8. Determination of Phenol content 9. Determination of total alkaloids	
Course code PHAR **Course name** Medicinal Chemistry-III Lab			**I Preparation of drugs and intermediates** 1 Sulphanilamide 2 7-Hydroxy, 4-methyl coumarin 3 Chlorobutanol 4 Triphenyl imidazole 5 Tolbutamide 6 Hexamine **II Assay of drugs** 1 Isonicotinic acid hydrazide 2 Chloroquine 3 Metronidazole 4 Dapsone 5 Chlorpheniramine maleate 6 Benzyl penicillin **III** Preparation of medicinally important compounds or intermediates	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			by Microwave irradiation technique **IV** Drawing structures and reactions using chem draw® **V** Determination of physicochemical properties such as logP, clogP, MR, Molecularweight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)	
Course code PHAR **Course name** Pharmacology-III Lab			1. Dose calculation in pharmacological experiments 2. Antiallergic activity by mast cell stabilization assay 3. Studyof anti-ulcer activityof a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model. 4. Study of effect of drugs on gastrointestinal motility 5. Effect of agonist and antagonists on guinea pig ileum 6. Estimation of serum biochemical parameters by using semi-autoanalyser 7. Effect of saline purgative on frog intestine 8. Insulin hypoglycemic effect in rabbit 9. Test for pyrogens (rabbit method) 10. Determination of acute oral toxicity (LD50) of a drug from a given data 11. Determination of acute skin irritation / corrosion of a test substance 12. Determination of acute eye irritation / corrosion of a test substance 13. Calculation of pharmacokinetic parameters from a given data 14. Biostatistics methods in experimental pharmacology (student's t test, ANOVA) 15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test) **Experiments are demonstrated by simulated experiments/videos*	

Name of Programme: Bachelor of Pharmacy
Course details: Seventh Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Instrumental Methods of Analysis	Upon completion of this course student will have an understanding of: • Instrumentation techniques available. • Aspects of separation for multi components of drugs and excipients using various instrumentation techniques. • Accurate analysis and report the results in defined formats of documentation and express the observations with clarity. • professional and safety responsibilities for working in the analysis laboratory	**Spin decoupling. Shift reagents.**	**Section-A** **Ultraviolet-visible (UV-vis) spectroscopy:** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. *Instrumentation* - Sources of radiation, wavelength selectors, sample cells, detectors (Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode) & calibration as per ICH and USFDA guidelines. *Applications* - Spectrophotometric titrations, single component and multi component analysis. **Infra-red (IR) spectroscopy:** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. *Instrumentation* - Sources of radiation, wavelength selectors, detectors (Golay cell, bolometer, thermocouple, thermister, pyroelectric detector) & calibration as per ICH and USFDA guidelines. Applications (Interpretation of data/ IR spectra of some simple compounds).	

			Section-B **Fluorimetry:** Theory, concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation, applications & calibration as per ICH and USFDA guidelines. **Flame photometry (AAS & AES)**: Principle, interferences, instrumentation, applications & calibration as per ICH and USFDA guidelines. **Nephelo-turbidometry**: Principle, instrumentation and applications **Section-C** **Nuclear magnetic resonance spectroscopy:** Principle of proton-NMR, shielding & de-shielding of magnetic nuclei, chemical shift and its measurements, factors affecting chemical shift, spin-spin interaction (relaxation & coupling), coupling constant 'J', factors influencing coupling constant. Instrumentation and applications (Interpretation of data/ NMR spectra of some simple compounds). **Mass spectrometry:** Introduction to mass spectra, principle, fragmentation, different types of peak (molecular ion, isotopic ion peak, fragmentation peak) and their importance. Instrumentation. ionization techniques (Electron impact, chemical, ionization, MALDI, FAB), analyzers (Time of flight and Quadrupole). Applications (Interpretation of data/mass spectra of some simple compounds). **Recommended books (Latest editions):** 1. Chatten, L.G. (1966). *A text book of Pharmaceutical Chemistry.* Vol. I & II, New York: Marcel. Dekkar. 2. Backeet, A.H., Stenlake, J.B. (1962). *Practical Pharmaceutical Chemistry* Vol. I & II, London: The Atholone Press of the University of London. 3. Willard, H.H., Merrit, L., Dean, J.A. (1966) *Instrumental methods of analysis*. New York: Van Nostrand Renhold. 4. Obonson, J.W.R. (1970). *Undergraduate Instrumental Analysis.* New York: Marcel Dekkar Inc. 5. Parikh, V.H. (1974). *Absorption Spectroscopy of Organic Molecules.* London: Addison-Wesley Publishing Co. 6. Indian Pharmacopoeia (2018), Ministry of Health, Govt. of India. 7. Backeet, A.H. Stenlake, J.B. (1988). *Practical Pharmaceutical Chemistry* Vol. I and II. London: The Atholone Press. **Suggested e-material:** 1. https://nptel.ac.in/downloads/103108100/ 2. https://catalog.williams.edu	
Course code PHAR **Course name** Industrial Pharmacy-II	Upon completion of this course student will have an understanding of: • process of pilot plant and scale up of pharmaceutical dosage forms. • process of technology transfer from lab scale to commercial batch. • different Laws and Acts that regulate pharmaceutical industry Understand the approval process and		**Section-**A **Pilot plant scale up techniques:** General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology. **Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and	

	regulatory requirements for drug products		agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE /SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues **Section-B** **Regulatory affairs :**Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals **Regulatory requirements for drug approval**: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies. **Section-**C **Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs. **Registration of Indian drug product in overseas market** Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research. **Recommended books (Latest editions):** 1. Troy, D.B. (2006). *Remington: The Science and Practice of Pharmacy*. 21st edition, Vol.I & Vol.-II, Easton Pennysylvannia: Mack Publishing Co. 2. Cooper, J.W. Gunn, G. (1986). *Tutorial Pharmacy*, London: Petman Books Ltd. 3. Lachman L. (1986). *Theory and Practice of Industrial Pharmacy*. Philadelphia: Lea & Febiger. 4. Ansel, HC. *Allen, L.V. (2014). Introduction to Pharmaceutical Dosage Forms*. Philadelphia: Wolters Kluwer. 5. Willing, Tuckerman and Hitching. *GMP for Pharmaceuticals*. 6. ISO reports. 7. Indian Patent act. 8. Castensen, J. T. (1990). *Drug Stability: Principles and Practices*. New York: Marcel Dekker. **Suggested e-material:** 1. www.ich.org 2. www.cdsco.in 3. www.who.int	
Course code PHAR **Course name** Novel Drug Delivery System	Upon completion of this course student will have an understanding of: • various approaches for development of novel drug delivery systems. • criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation		**Section-**A **Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems. **Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications	

			Mucosal Drug Delivery system: Introduction, Principles of bioadhesion /mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability andformulation considerations of buccal delivery systems **Section-**B **Implantable Drug Delivery Systems**: Introduction, advantages and disadvantages, concept of implants and osmotic pump. **Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches **Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications **Section-**C **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers **Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications **Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome -preliminary study, ocular formulations and ocuserts **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications. **Recommended Books: (Latest Editions)** 1. Chien, Y.W. (1992). *Novel Drug Delivery Systems*. New York: Marcel Dekker, Inc. 2. Robinson, J.R., Lee, V.H.L. (1992). *Controlled Drug Delivery Systems.* New York: Marcel Dekker, Inc. 3. Mathiowitz, E. (2002). *Encyclopedia of Controlled Delivery*. New York: Wiley Interscience Publication. 4. Jain, N.K. (1997). *Controlled and Novel Drug Delivery*, New Delhi: CBS Publishers & Distributors. 5. Vyas, S.P., Khar, R.K. (2002). *Controlled Drug Delivery-concepts and advances*, New Delhi: Vallabh Prakashan. **Suggested e-material:** 1. Indian Journal of Pharmaceutical Sciences (IPA) 2. Indian Drugs (IDMA) 3. Journal of Controlled Release (Elsevier Sciences) 4. Drug Development and Industrial Pharmacy(Marcel & Decker) 5. International Journal of Pharmaceutics (Elsevier Sciences)	
Course code PHAR **Course name** Dosage Form Design	Upon completion of this course student will have an understanding of: • Concept of pre-formulation; prodrug and their influence on formulation and stability of products. • BCS Classification and solubilization in context to dosage form development. • *in vitro* dissolution study of solids and interpretation of dissolution data. • bioavailability studies and *in vivo* methods of evaluation and		**SECTION-A** **Pre-formulation Studies**: Introduction to pre-formulation, goals and objectives, study of physicochemical characteristics of drug substances. *Physical properties:* Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. *Chemical Properties:* Hydrolysis, oxidation, reduction, racemisation, polymerization. Application of pre-formulation parameters in the development and stability of dosage forms. **BCS classification**: Introduction, classification and its applications. **SECTION-B** **Prodrugs**: Introduction, types, application of prodrug in solving problems related to stability, bioavailability and elegancy of formulation.	

	their statistical treatment.		**Solubility and solubilization**: Techniques of solubilization of drugs including surfactant systems, co-solvents, solid state manipulations, complexation and chemical modifications. **SECTION-C** **Performance evaluation, in vitro: Dissolution**: Introduction, dissolution studies for solid dosage forms, methods of interpretation of dissolution data: model dependent and model independent methods, dissolution profile comparison. **Performance evaluation, in vivo: bioavailability studies**: Introduction, bioavailability testing protocol and procedures, methods of evaluation and statistical treatment. 1. Wells, J.I. (1990). *Pharmaceutical Prefomulation: The Physicochemical Properties of Drug Substances*. London: Ellis Horwood, Chiechester. 2. Yalkowsky, S.H. (1981). *Techniques of Solubilization of Drugs*. New York: Marcel Dekker. 3. Lewis, G.A. (2007). *Optimization Methods. In Encyclopedia of Pharmaceutical Technology*. New York: Informa Healthcare. 4. Banker, G.S. Rhode, C.T. (1979). *Modern Pharmaceutics*. New York: Marcel DekkarInc. 5. Bean, H.S. Beckett, A.H., Careless, A.H. (1982). *Advances in pharmaceutical sciences*, Vol. I, II, III & IV, London: Academic Press. 6. Gibaldi, M. Perrier, D. (1982). *Pharmacokinetics.* New York: Marcel Dekkar Inc. 7. *Troy, D.B. (2006). Remington: The Science and Practice of Pharmacy. 21st edition, Vol.I & Vol.-II,* Easton Pennysylvannia: Mack Publishing Co. 8. Khar, R.K., Vyas, S.P., Ahmad, F.J., Jain, G.K. (2013). *Lachman/Liebermans: The Theory and Practice of Industrial Pharmacy.* New Delhi: CBS Publisher. *9.* Gibaldi, M. (1991). *Biopharmaceutics and clinical* **Suggested e-material:** 1. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 2. https://www.pdfdrive.com/pharmaceutical-books.html 3. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 4. http://swepub.kb.se/ 5. https://ethos.bl.uk/Home.do	
Course code PHAR **Course name** Pharmacy Practice	Upon completion of this course student will have an understanding of: • The role of pharmacist in different areas of hospital and hospital pharmacy • Production and handling of radiopharmaceuticals. • drug information services and data retrieval in healthcare		**Section-**A **Hospital and it's organization:** Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions. **Hospital pharmacy and its organization:** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **Adverse drug reaction:** Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. **Community Pharmacy:** Organization and structure of retail and	

			wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store. **Drug distribution system in a hospital:** Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. **Section-**B **Hospital formulary:** Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. **Therapeutic drug monitoring:** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **Medication adherence:** Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. **Patient medication history interview:** Need for the patient medication historyinterview, medication interview forms. **Community pharmacy management:** Financial, materials, staff, and infrastructure requirements. **Pharmacy and therapeutic committee:** Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. **Drug information services:** Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. **Patient counseling:** Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist **Section-**C **Education and training program in the hospital:** Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. **Prescribed medication order and communication skills:** Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients. **Budget preparation and implementation:** Budget preparation and implementation **Clinical Pharmacy:** Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. **Over the counter (OTC) sales:** Introduction and sale of over the counter, and Rational use of common over the counter medications. **Drug store management and inventory control:** Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure **Investigational use of drugs:** Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.	

			Interpretation of Clinical Laboratory Tests: Blood chemistry, hematology, and urinalysis **Recommended Books (Latest Edition):** 1. Merchant, S.H., Quadry, J.S. (2001). *A textbook of hospital pharmacy*. Ahmadabad: B.S. Shah Prakakshan. 2. Parthasarathi, G., Nyfort-Hansen, K., Nahata, M.C. (2004). *A textbook of Clinical Pharmacy Practice- essential concepts and skills.* Chennai: Orient Longman Private Limited. 3. Hassan, W.E. (1986). *Hospital pharmacy*. Philadelphia: Lea & Febiger. 4. Bajaj, A. Tipins, H.P. (2008). *Hospital Pharmacy*. Nashik: Career Publications. 5. Lee, M. (2013). *Basic skills in interpreting laboratory data*, Bethesda: American Society of Health System Pharmacists Inc. 6. Parmar, N.S. (2008). *Health Education and Community Pharmacy, New Delhi*: CBS Publishers & Distributers. **Suggested e-material:** 1. Therapeutic drug monitoring. ISSN: 0163-4356 2. Journal of pharmacy practice. ISSN : 0974-8326 3. American journal of health system pharmacy. ISSN: 1535-2900 (online) 4. Pharmacy times (Monthly magazine) 5. http://202.74.245.22:8080/xmlui/bitstream/handle/123456789/418/Martin%20Stephens%20Hospital%20Pharmacy%20%202011.pdf?sequence=1	
Course code PHAR **Course name** Instrumental Methods of Analysis Lab	Upon completion of this course student will have an understanding of: Various instrumentation technique of analysis.		1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds 2. Estimation of dextrose by colorimetry 3. Estimation of sulfanilamide bycolorimetry 4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy 5. Assay of paracetamol by UV- Spectrophotometry 6. Estimation of quinine sulfate by fluorimetry 7. Study of quenching of fluorescence 8. Determination of sodium by flame photometry 9. Determination of potassium by flame photometry 10. Determination of chlorides and sulphates by nephelo turbidometry 11. Separation of amino acids by paper chromatography 12. Separation of sugars by thin layer chromatography 13. Separation of plant pigments by column chromatography 14. Demonstration experiment on HPLC 15. Demonstration experiment on Gas Chromatography	
Course code PHAR **Course name** Dosage Form Design Lab	**Learning outcomes** Upon completion of this course student will know: • Preformulation study of API for dosage form development • Evaluation as performance indicator		1. Preformulation studies including determination of solubility, partition coefficient, flow property, melting point, particle size and size distribution of paracetamol/aspirin/or any other drug. 2. Preformulation studies including drug excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design 3. Experiments demonstrating improvement in bioavailability through prodrug concept. 4. Stability evaluation of various dosage forms and their expiration dating 5. Dissolution testing and data evaluation for oral solid dosage forms 6. Evaluation of Pharmaceutical equivalence of some marketed products	

Course code PHAR **Course name** Practice School	Upon completion of this course student will have an understanding of: • Patient based assessment skills. • therapeutic decision making skills. • Interpretation of the laboratory results to aid in clinical diagnosis. • rationale pharmacotherapeutic alternatives. • Individualisation of therapeutic regimen.			

Name of Programme: Bachelor of Pharmacy
Course details: Eighth Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR **Course name** Biostatistics and Research Methodology	Upon completion of this course student will have an understanding of: • operation of M.S. Excel, SPSS, R and MINITAB, DoE (Design of Experiment) • various statistical techniques to solve statistical problems		**Section-**A **Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency**: Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion**: Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation Pharmaceuticals examples **Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples **Parametric test**: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference **Section-**B **Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases. Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels **Section-**C **Introduction to practical components of industrial and clinical trials problems**: Statistical Analysis Using Excel, SPSS, MINITAB, design of	

			experiments, R Online Statistical Software's to Industrial and Clinical trial approach **Design and Analysis of experiments:** **Factorial Design:** Definition, 2^2, 2^3 design. Advantage of factorial design **Response Surface methodology**: Central composite design, Historical design, Optimization Techniques **Recommended Books (Latest edition):** 1. Bolton, S. Bon, C. (2010). *Pharmaceutical statistics- Practical and clinical applications.* New York: Informa Health Care. 2. Gupta, S.C. (2018). *Fundamental of Statistics*. Mumbai: Himalaya Publishing House. 3. Pannerselvam, R. (2012). *Design and Analysis of Experiments*. Delhi:PHI Learning Private Limited, 4. Montgomery, D.C. (1997). *Design and Analysis of Experiments*. New York: Wiley. **Suggested e-material:** 1. https://www.elsevier.com/.../research-methodology-and-biostatistics 2. https://www.eolss.net/sample-chapters/C02/E4-31-04-00.pdf	
Course code PHAR **Course name** Social and Preventive Pharmacy	Upon completion of this course student will have an understanding of: • high consciousness of current issues related to health and pharmaceutical problems within the country and world wide. • critical way of thinking based on current healthcare development. • Evaluate alternative ways of solving problems related to health and pharmaceutical issues.		**Section-**A **Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social cases of diseases and social problems of the sick. **Social and health education:** Food in relation to nutrition and health, balanced diet, nutritional deficiencies, vitamin deficiencies, malnutrition and its prevention. **Sociology and health:** socio cultural factors related to health and disease. Imapct of urbanization on health and disease. Poverty and health. **Section-**B **Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug-addiction-drug substance abuse. **National health programs**, its objectives, functioning and outcome of the following: HIV and AIDS control programme, TB, integrated disease surveillance program (IDSP), National leprosy control programme, national mental health program, national programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme. **Section-**B National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school. **Recommended Books (Latest edition)*:*** 1. Prabhakara, G.N. (2010). *Short Textbook of Preventive and Social Medicine*, New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 2. Roy, R.N., Saha, I. (2013). *Mahajan and Gupta- Textbook of Preventive and Social Medicine*. New Delhi: Jaypee Brothers Medical	

			Publishers (P) Ltd. 3. Jain, V. (2014). Review of Preventive and Social Medicine (Including Biostatistics. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 4. Hiremath, L.D., Hiremath, D.A. (2012). *Essentials of Community Medicine—A Practical Approach*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 5. Park, K. (2011). *Textbook of Preventive and Social Medicine*, Jabalpur: Banarsidas Bhanot Publishers. 6. Adepu, R. (2015). *Community Pharmacy Practice*, Hyderabad: BSP publishers. **Suggested e-material:** 1. Research in Social and Administrative Pharmacy, Elsevier, Ireland	
Course code PHAR **Course name** Advanced Instrumentation Techniques (Discipline Elective)	Upon completion of this course student will have an understanding of: • advanced instruments used and its applications in drug analysis. • chromatographic separation and analysis of drugs • calibration of various analytical instruments • analysis of drugs using various analytical instruments.		**Section-A** **Extraction techniques**: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction **Chromatography:** Introduction to chromatography *Adsorption and partition column chromatography*-Methodology, advantages, disadvantages and applications. *Thin layer chromatography*- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. *Paper chromatography*-Introduction, methodology, development techniques, advantages, disadvantages and applications *Gel chromatography*- Introduction, theory, instrumentation and applications *Affinity chromatography*- Introduction, theory, instrumentation and applications **Section-B** **Chromatography:** *Gas chromatography* - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, & disadvantages, applications and calibration of GC as per ICH &US FDA guidelines. *High performance liquid chromatography (HPLC)*-Introduction, theory, instrumentation, advantages, applications and calibration of HPLC as per ICH &US FDA guidelines. *Ion exchange chromatography*- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications **Hyphenated techniques:** LC-MS/MS, GC-MS/MS, HPTLC-MS. **Electrophoresis**: Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications. **Section-C** **Thermal methods of analysis:** Principle, instrumentation and applications of thermo-gravimeteric analysis (TGA), Differential thermal analysis (DTA), and differential scanning calorimetry (DSC). **X-ray diffraction methods:** Origin of x-rays, basic aspects of crystals, x-ray crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications. **Radioimmunoassay:** Importance, various components, principle, different methods, limitation and applications of radioimmunoassay **Recommended books (Latest editions):** 1. Chatten, L.G. (1966). *A text book of Pharmaceutical Chemistry.*	

			Vol. I & II, New York: Marcel. Dekkar. 2. Backeet, A.H., Stenlake, J.B. (1962). *Practical Pharmaceutical Chemistry* Vol. I & II, London: The Atholone Press of the University of London. 3. Willard, H.H., Merrit, L., Dean, J.A. (1966) *Instrumental methods of analysis*. New York: Van Nostrand Renhold. 4. Obonson, J.W.R. (1970). *Undergraduate Instrumental Analysis.* New York: Marcel Dekkar Inc. 5. Parikh, V.H. (1974). *Absorption Spectroscopy of Organic Molecules.* London: Addison-Wesley Publishing Co. 6. Indian Pharmacopoeia (2018), Ministry of Health, Govt. of India. 7. Backeet, A.H. Stenlake, J.B. (1988). *Practical Pharmaceutical Chemistry* Vol. I and II. London: The Atholone Press. **Suggested e-material:** 1. fist.ump.edu.my/index.php/en/ 2. https://www.acs.org/content/dam/acsorg	
Course code **Course name** Pharmaceutical Regulatory Science	Upon completion of this course student will have an understanding of: • process of drug discovery and development • regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals • regulatory approval process and their registration in Indian and international markets		Section-A New Drug Discovery and development Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development. Regulatory Approval Process Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA) in US. Changes to an approved NDA / ANDA. Section-B Regulatory authorities and agencies Overview of regulatory authorities of United States, European Union, Australia, Japan, Canada (Organization structure and types of applications) Registration of Indian drug product in overseas market Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical 164 Document (eCTD), ASEAN Common Technical Document (ACTD) research. Section-C Clinical trials Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials Regulatory Concepts Basic terminologies, guidance, guidelines, regulations, laws and acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book. Recommended books (Latest edition): 1. Itkar, S. Vyawahare, N.S. *Drug Regulatory Affairs*, Pune: Nirali Prakashan. 2. Berry, I.R., Martin, R.P. (2008). *The Pharmaceutical Regulatory Process*, Ed. Drugs and the Pharmaceutical Sciences, CRC press. 3. Richard, A. Guarino, M.D. (2004). *New Drug Approval Process: Accelerating Global Registrations.* CRC Press. 4. Weinberg, S. (2008). Guidebook for drug regulatory submissions. New York: John Wiley & Sons. Inc. 5. Pisano, D.J. Mantus, D. (2008). FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics. CRC Press.	

Course code PHAR **Course name** Quality Control and Standardization of Herbals	Upon completion of this course student will have an understanding of: • Detection of different type of adulteration present in the crude drug • Evaluation of the quality and purity of the drugs by morphological, microscopical, chemical, physical and biological evaluation • stereochemistry of natural products • biogenetic pathways ongoing in the plants for the production of secondary metabolites		**Section-A** Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms. WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use Quality assurance in herbal drug industry. cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines. WHO Guidelines on GACP for Medicinal Plants. **Section-B** EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines. Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions. **Section-C** Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products. **Recommended Books (Latest edition):** 1. Evans, W. (2009). *Trease and Evans' Pharmacognosy*. Saunders Ltd. 2. Kokate, C.K., Purohit, A.P., Gokhale, G.B. (2008). *Pharmacognosy*. New Delhi: Nirali Prakashan. 3. Rangari, V.D. (2006). *Text book of Pharmacognosy and Phytochemistry.* Nashik: Carrier Pub. 4. Aggrawal, S.S. (2002). *Herbal Drug Technology*. Universities Press. 5. EMEA. Guidelines on Qualityof Herbal Medicinal Products/Traditional Medicinal Products. 6. Mukherjee, P.W. (2002). *Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals.* New Delhi: Business Horizons Publishers. 7. Shinde, M.V., Dhalwal, K., Potdar, K., Mahadik, K. (2009). *Application of quality control principles to herbal drugs*. International Journal of Phytomedicine. 1p, 4-8. 8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998. 9. WHO. The International Pharmacopeia, Vol. 2: QualitySpecifications, 3rd edn. World Health Organization, Geneva, 1981. 10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999. 11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005. 12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004. **Suggested e-material:** 1.https://www.elsevier.com/books/quality-control-and...of-herbal.../ 2. https://onlinelibrary.wiley.com	

Course code **Course name** Pharmacovigilance	Upon completion of this course student will have an understanding of: • history and development of pharmacovigilance • national and international scenario of pharmacovigilance • dictionaries, coding and terminologies used in pharmacovigilance • detection of new adverse drug reactions and their assessment • international standards for classification of diseases and drugs • adverse drug reaction reporting systems and communication in pharmacovigilance • ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning • CIOMS requirements for ADR reporting		**Section-A** **Introduction to Pharmacovigilance** • History and development of Pharmacovigilance • Importance of safety monitoring of Medicine • WHO international drug monitoring programme • Pharmacovigilance Program of India(PvPI) **Introduction to adverse drug reactions** • Definitions and classification of ADRs • Detection and reporting • Methods in Causality assessment • Severity and seriousness assessment • Predictability and preventability assessment • Management of adverse drug reactions **Basic terminologies used in pharmacovigilance** Terminologies of adverse medication related events • Regulatory terminologies **Drug and disease classification** • Anatomical, therapeutic and chemical classification of drugs • International classification of diseases • Daily defined doses • International Non proprietary Names for drugs **Section-B** **Drug dictionaries and coding in pharmacovigilance** • WHO adverse reaction terminologies • MedDRA and Standardised MedDRA queries • WHO drug dictionary • Eudravigilance medicinal product dictionary **Information resources in pharmacovigilance** • Basic drug information resources • Specialised resources for ADRs **Establishing pharmacovigilance programme** • Establishing in a hospital • Establishment & operation of drug safety department in industry • Contract Research Organisations (CROs) • Establishing a national programme **Vaccine safety surveillance** • Vaccine Pharmacovigilance • Vaccination failure • Adverse events following immunization **Pharmacovigilance methods** • Passive surveillance – Spontaneous reports and case series • Stimulated reporting • Active surveillance – Sentinel sites, drug event monitoring and registries • Comparative observational studies – Cross sectional study, case control study and cohort study • Targeted clinical investigations **Communication in pharmacovigilance** • Effective communication in Pharmacovigilance • Communication in Drug Safety Crisis management • Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media **Section-C** **Statistical methods for evaluating medication safety data** Safety data generation • Pre clinical phase • Clinical phase • Post approval phase **ICH Guidelines for Pharmacovigilance** • Organization and objectives of ICH • Expedited reporting • Individual case safety reports • Periodic safety update reports • Post approval expedited reporting • Pharmacovigilance planning • Good clinical practice in pharmacovigilance studies **Pharmacogenomics of adverse drug reactions** **Drug safety evaluation in special population** • Paediatrics • Pregnancy and lactation • Geriatrics CIOMS • CIOMS Working Groups • CIOMS Form **CDSCO (India) and Pharmacovigilance** • D&C Act and Schedule Y • Differences in Indian and global pharmacovigilance requirements **Recommended Books (Latest edition):** 1. Gupta, SK. (2011). *Textbook of Pharmacovigilance*. New Delhi:	

			Jaypee Brothers, Medical Publishers. 2. Cobert, B. Biron, P. (2009). *Practical Drug Safety from A to Z*. Jones and Bartlett Publishers. 3. Andrews, E.B. Moore, N. (2014). *Mann's Pharmacovigilance*: New York: Wiley Publishers. 4. Talbot, J. Walle, P. (2003). *Stephens' Detection of New Adverse Drug Reactions*. New York: Wiley Publishers. 5. Waller P. Harrison-Woolrych, M. (2017). *An Introduction to Pharmacovigilance. New York:* Wiley Publishers. **Suggested E learning** 1http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297 2 http://www.ich.org/ 3 http://www.cioms.ch/ 4 http://cdsco.nic.in/ 5 http://www.who.int/vaccine_safety/en/ 6 http://www.ipc.gov.in/PvPI/pv_home.html	
Course code PHAR **Course name** Cosmetic Science	Upon completion of this course student will have an understanding of: • various key ingredients and basic science to develop cosmetics and cosmeceuticals • scientific knowledge to develop cosmetics and cosmeceuticals with desired safety, stability and efficacy with compliance to Indian Regulatory Authority.		**Section-**A **Classification of cosmetic and cosmeceutical products**: Definition of cosmetics as per Indian and EU regulations, Evolution of Cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. **Classification and application Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums. **Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmecuticals. Antiperspants & deodorants- Actives & mechanism of action. **Section-**B **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash. Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** **Skin Care:** Aloe and turmeric Hair care: Henna and amla. **Oral care:** Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste. **Section-**C **Principles of Cosmetic Evaluation:** Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties. Soaps, and syndet bars. Evolution and skin benfits. Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. **Cosmetic problems associated with Hair and scalp:** Dandruff, Hair fall causes **Cosmetic problems associated with skin:** blemishes, wrinkles, acne, prickly heat and body odor. **Recommended Books (Latest edition):**	

			1. Wilkinson, J.B. Moore, R.J. (1982). *Harry's Cosmeticology*. Chemical Publication. 2. Sharma, P.P. (2014). *Cosmetics – Formulations, Manufacturing and Quality Control,* Delhi: Vandana Publications Pvt. Ltd. 3. Nanda, S. Khar, R.K. (2010). *Text book of cosmelicology*. Delhi: Birla Publications (Regd) Pvt Ltd.	
Course code **Course name** Pharmaceutical Marketing	Upon completion of this course student will have an understanding of: • marketing concepts • techniques used in marketing • application of the marketing in the pharmaceutical industry.		**Section-A** **Marketing:** Definition, general concepts, and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research. **Section-B** **Product decision:** Meaning, Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packagingand labeling decisions, Product management in pharmaceutical industry. **Promotion**: Meaning and methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products. **Pharmaceutical marketing channels**: Designing channel, channel members, selecting the appropriatechannel, conflict in channels, physical distribution management: Strategic importance, tasks in physicaldistribution management. **Section-C** **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR. **Pricing:** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issuesin price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing**: Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing. **Recommended Books: (Latest Editions)** **1** Kotler, P. Keller, K.L. (2011). *Marketing Management*, New Delhi: Prentice Hall of India. 2. Walker, O.C., Boyd, H.W. and Larreche, J.C. (2006). *Marketing Strategy- Planning and Implementation*, New Delhi: Tata MC GrawHill. 3. Grewal, D. Levy, M. *Marketing*. (2012). 6th edition, New Delhi: Tata MC GrawHill. 4. Kumar, A. Menakshi, N. (2011). *Marketing Management*, New Delhi: Vikas Publishing. 5. Saxena, R. (2009). *Marketing Management*. New Delhi: Tata MC GrawHill.	

Course code PHAR **Course name** Project Work	Upon completion of this course student will have an understanding of: • Experiments, the research tools lie literature review, presentation of data etc.		This course will govern the process of literature review and presentation, which is prescribed for any type of research work.	
Project Work A Advanced Instrumentation Techniques Lab	Upon completion of this course student will have an understanding of: • Advanced instruments used and its applications in drug analysis. • chromatographic separation and analysis of drugs • calibration of various analytical instruments • analysis of drugs using various analytical instruments		1. To perform experiment based on solid phase extraction and liquid-liquid extraction 2. To perform experiment based on various chromatography: a. a*dsorption and partition column chromatography* *b. Thin layer chromatograph* *c. Paper chromatography* *d. Gel chromatography* *e. Affinity chromatography* *f. Gas chromatography /High performance liquid chromatography* *3.* To perform experiment based on electrophoresis. 4. To perform experiment based on thermal techniques. 5. To perform experiment based on XRD 6. To perform experiment based on radioimmunoassay technique.	
Project Work B Cosmetic Science Lab	Upon completion of this course student will have an understanding of: • evaluation of various key ingredients and basic science to develop cosmetics and cosmeceuticals • Scientific knowledge to develop cosmetics and cosmeceuticals with desired safety, stability and efficacy with compliance to Indian Regulatory Authority.		1 To prepare and evaluate cold cream 2 To prepare and evaluate Vanishing cream 3 Formulation & evaluation Suppositories 4 To prepare and evaluate Shaving creams 5 Development and evaluation of Shampoo 6 Development and evaluation of Toothpaste 7 Development and evaluation of Antidandruff Shampoo 8 Formulation & evaluation of Clear gel 9 To prepare and evaluate herbal creams	
Project Work C Quality Control and Standardization of Herbals Lab	Upon completion of this course student will have an understanding of: • detection the type of adulteration present in the crude drug • Evalauation of the quality and purity of the drugs by morphological, microscopical, chemical, physical and biological evaluation		1. Determination of lycopodium spores in per mg lycopodium powder 2. Determination of starch grains in per mg ginger powder by lycopodium spore method 3. Determination of acid insoluble and water soluble ash value of given crude drug 4. Determination of sugar content in Ayurvedic formulation 5. Determination of total phenolic content of given extract 6. Determination of total flavonoid content of given extract 7. Determination of antioxidant activity of given alcoholic extract by DPPH method 8. Quantification of flavonoids /steroids By HPTLC 9. Quantification of flavonoids /steroids By HPLC 10. Extraction of volatile oil and their chromatographic profile 11. Standardization of marketed herbal formulation	
Project Work D Social and Preventive Pharmacy Lab	Upon completion of this course student will have an understanding of: • Prescription reading and writing. • Functioning of social pharmacy.			

Programme and Course Format for BOS minutes

Name of Programme: Master of Pharmacy (Pharmaceutical Chemistry/Pharmaceutics/Pharmacology)

Programme Educational Objectives: Pharmacy programme deals with various aspects of modern drug design, drug development, production and quality assurance that are the basis for expertise in all domains of medicine. Pharmacy professionals being a member of healthcare team are unique in their detailed and comprehensive understanding of physical, chemical and biological interactions on the outcomes of drug therapy. They require an understanding of drug entities chemistry, delivery characteristics of dosage formulations, physiological and pharmacological outcomes of drug interactions. Pharmacy curriculum incorporate components of problem solving, case study and project work in the areas of specialization. The main objectives of the Pharmacy programme are:

- To provide exemplary education in a stimulating environment where delivery of pharmaceutical knowledge is integrated with nationally and internationally recognized research to conduct and publish cutting-edge multidisciplinary research in the discovery, utilization and evaluation of therapeutic agents.
- To prepare competent pharmacists at various levels for India.
- To raise sensitivity to professional ethical codes of conduct and social values.
- To prepare globally recognized pharmacy professionals.
- To demonstrate standards of digital literacy that would support professional needs in manufacture, patient care, hospital administration etc.
- To create awareness in society for rationale usage of medicines.
- To create awareness about environmental hazards in relation to GMP & GLP.
- To develop gender-neutral attitudes and practices; respect for all races, nations, religions, cultures, languages and traditions.
- To nurture a temperament that would enable individuals to set and work towards self-driven performance-goals, entrepreneurial ventures and overall leadership.

Programme Outcomes:

PO1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical science and technology; behavioral, social, and administrative pharmaceutical sciences; and manufacturing practices.

PO2: Planning abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decision during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizen or leadership roles when appropriate to facilitate improvement in health and well-being.

PO6: Professional Identity: Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO7: Pharmaceutical Ethics: Honor personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective, make effective presentations and documentation, and give and receive clear instructions.

PO9: The Pharmacist and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO10: Environment and sustainability: Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO11: Life- long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self access and use feedback effectively from others to identify learning needs and to satisfy theses needs on an ongoing basis.

Programme and Course Format for BOS minutes

Programme Name: Pharmaceutical Chemistry
Programme Scheme: First Year
Semester: First

Changes in Scheme

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 503	Advanced Medicinal Chemistry	4	0	0	4
PHAR 504	Advanced Organic Chemistry – I	4	0	0	4
PHAR 509	Chemistry of Natural Products	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
PHAR 524	Pharmacological And Toxicological Screening Methods	4	0	0	4
PHAR 519L	Pharmaceutical Chemistry Lab– I	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 503	Advanced Medicinal Chemistry	4	0	0	4
PHAR 504	Advanced Organic Chemistry – I	4	0	0	4
PHAR 509	Chemistry of Natural Products	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
PHAR 519L	Pharmaceutical Chemistry Lab– I	0	0	12	6
	Discipline Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme Scheme: First Year
Semester: Second

Changes in Scheme

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 501	Advance Organic Chemistry-II	4	0	0	4
PHAR 507	Advanced Spectral Analysis	4	0	0	4
PHAR 511	Computer Aided Drug Design	4	0	0	4
PHAR 515	Intellectual Property Rights	4	0	0	4
PHAR 521	Pharmaceutical Process Chemistry	4	0	0	4
PHAR 520L	Pharmaceutical Chemistry Lab – II	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 501	Advance Organic Chemistry-II	4	0	0	4
PHAR 507	Advanced Spectral Analysis	4	0	0	4
PHAR 511	Computer Aided Drug Design	4	0	0	4
PHAR 521	Pharmaceutical Process Chemistry	4	0	0	4
PHAR 520L	Pharmaceutical Chemistry Lab – II	0	0	12	6
	Open Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme and Course Format for BOS minutes

Programme Name: Pharmaceutics
Programme Scheme: First Year
Semester: First

Changes in Scheme and Minor changes in syllabi of *Modern Pharmaceutics*

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 514	Drug Delivery Systems	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
PHAR 517	Modern Pharmaceutics	4	0	0	4
PHAR 524	Pharmacological And Toxicological Screening Methods	4	0	0	4
PHAR 529	Regulatory Affairs	4	0	0	4
PHAR 522L	Pharmaceutics Lab- I	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 514	Drug Delivery Systems	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
PHAR 517	Modern Pharmaceutics	4	0	0	4
PHAR 529	Regulatory Affairs	4	0	0	4
PHAR 522L	Pharmaceutics Lab- I	0	0	12	6
	Discipline Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme Scheme: First Year
Semester: Second

Minor changes in syllabi of *Advanced Biopharmaceutics & Pharmacokinetics*

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 502	Advanced Biopharmaceutics & Pharmacokinetics	4	0	0	4
PHAR 512	Computer Aided Drug Development	4	0	0	4
PHAR 513	Cosmetics And Cosmeceuticals	4	0	0	4
PHAR 515	Intellectual Property Rights	4	0	0	4
PHAR 518	Molecular Pharmaceutics	4	0	0	4
PHAR 523L	Pharmaceutics Lab – II	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20					
Course code	**Course Name**	**L**	**T**	**P**	**C**
PHAR 502	Advanced Biopharmaceutics & Pharmacokinetics	4	0	0	4
PHAR 512	Computer Aided Drug Development	4	0	0	4
PHAR 513	Cosmetics And Cosmeceuticals	4	0	0	4
PHAR 518	Molecular Pharmaceutics	4	0	0	4
PHAR 523L	Pharmaceutics Lab – II	0	0	12	6
	Open Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme and Course Format for BOS minutes

Programme Name: Pharmacology
Programme Scheme: First Year
Semester: First

Changes made in the scheme to align with PCI regulations 2016.

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
PHAR 505	Advanced Pharmacology – I	4	0	0	4
PHAR 508	Cellular And Molecular Pharmacology	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
PHAR 524	Pharmacological And Toxicological Screening Methods	4	0	0	4
PHAR 528	Principles of Drug Discovery	4	0	0	4
PHAR 526L	Pharmacology Lab – I	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
PHAR 505	Advanced Pharmacology – I	4	0	0	4
PHAR 508	Cellular And Molecular Pharmacology	4	0	0	4
PHAR 516	Modern Pharmaceutical Analytical Techniques	4	0	0	4
	Pharmacological And Toxicological Screening Methods-I	4	0	0	4
PHAR 526L	Pharmacology Lab – I	0	0	12	6
	Discipline Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme Scheme: First Year
Semester: Second

Changes made in the scheme to align with PCI regulations 2016.

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
PHAR 506	Advanced Pharmacology - II	4	0	0	4
PHAR 510	Clinical Research And Pharmacovigilance	4	0	0	4
PHAR 511	Computer Aided Drug Design	4	0	0	4
PHAR 515	Intellectual Property Rights	4	0	0	4
PHAR 525	Pharmacological And Toxicological Screening Methods-II	4	0	0	4
PHAR 527L	Pharmacology Practical – II	0	0	12	6
	Semester wise total:	**20**	**0**	**12**	**26**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
PHAR 506	Advanced Pharmacology - II	4	0	0	4
PHAR 510	Clinical Research And Pharmacovigilance	4	0	0	4
	Principles of Drug Discovery	4	0	0	4
PHAR 525	Pharmacological And Toxicological Screening Methods-II	4	0	0	4
PHAR 527L	Pharmacology Lab – II	0	0	12	6
	Open Elective	4	0	0	4
	Semester wise total:	**20**	**0**	**12**	**26**

Programme and Course Format for BOS minutes

Programme Scheme: Second Year
Semester: Third & fourth

No Changes

Existing scheme as per 2017-18 (Implementation in contingent to PCI norms)

Course code	Course Name	L	T	P	C
PHAR 601P	Project (Part-I)	0	0	52	26
PHAR 602P	Project (Part-II)	0	0	52	26
	Semester wise total:	**0**	**0**	**104**	**52**

Proposed scheme from Academic Session 2019-20

Course code	Course Name	L	T	P	C
PHAR 601P	Project (Part-I)	0	0	52	26
	Reading Elective -1	0	0	0	2
PHAR 602P	Project (Part-II)	0	0	52	26
	Reading Elective -2	0	0	0	2
	Semester wise total:	**0**	**0**	**104**	**56**

Discipline Elective

Course code	Course Name	L	T	P	C
	Pharmacological and Toxicological Screening Methods *****	4	0	0	4
	Herbal Cosmetics	4	0	0	4
	Advanced Pharmaceutical Biotechnology	4	0	0	4
PHAR 515	Intellectual Property Rights	4	0	0	4
	Regulatory Aspects Food and Nutraceuticals	4	0	0	4
	Regulatory Aspects of Medical Devices	4	0	0	4
	Principle of Medicinal Chemistry **#**	4	0	0	4

Reading Elective

Course code	Course Name	L	T	P	C
	Pharmacovigilance	0	0	0	2
	Nutraceuticals	0	0	0	2
	Toxicology	0	0	0	2
	Pharmaceutical Industrial Management	0	0	0	2
	Product development	0	0	0	2
	Molecular basis of drug discovery	0	0	0	2
	Pharmaceutical Quality Assurance	0	0	0	2

***Disciple elective only for Pharmaceutics and Pharmaceutical chemistry**
 # Discipline elective only for Pharmacology

Name of Programme: Master of Pharmacy (Pharmaceutical Chemistry)

Course details: First Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 503 **Course name** Advanced Medicinal Chemistry	Upon completion of this course student will have an understanding of: • varrious aspects of drug designing and methods for their analysis. • factor to design new drug against particular biochemical. • Characterization and interpretation of data	**SECTION-A** **Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists. **Stereochemistry and drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination. **Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **SECTION-B** **Drug biotransformation:** Drug biotransformation and its role in development of new drug molecules. **Prodrug design:** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **Enzyme Inhibitors:** Rational design of enzyme inhibitors, enzyme kinetics & principles of enzyme inhibitors, enzyme inhibitors in medicine, enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors. **SECTION-C** **An overview of target discovery and validation.** **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Peptidomimetics:** Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. **Computational prediction of protein structure:** Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction **Recommended books (Latest edition):** 1. Abraham D, Rotella D, Burger,s *Medicinal Chemistry, drug discovery and development*,willey, edi 7th , vol i-vi, 2010. 2. Beale JM, *Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry*, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi, Edi 12th, 2010. 3. Corwin, Hansch, Samuel C, Rotella D, Ward S, *Comprehensive Medicinal Chemistry*, Elsevier, Edi 3rd, 2017. 4. Martin YC, *Quantitative Drug Design*: A critical Introduction, CRC Press, edi 3rd, 2010. 5. Lemke TS, Williams DA, Roche VF, Zito SW, *Foye,s Principles of Medicinal Chemistry,* lippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi: 7th Edition,2013.	**SECTION-A** **Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. **Biological drug targets**: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists. **Stereochemistry and drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination. **Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **SECTION-B** **Drug biotransformation:** Drug biotransformation and its role in development of new drug molecules. **Prodrug design:** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **Enzyme Inhibitors:** Rational design of enzyme inhibitors, enzyme kinetics & principles of enzyme inhibitors, enzyme inhibitors in medicine, enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors. **SECTION-C** **An overview of target discovery and validation.** **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Peptidomimetics:** Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. **Computational prediction of protein structure:** Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction **Recommended books (Latest edition):** 1. Beale, J.M. (2010). *Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry*, 12th Ed., New Delhi: Lppincott Williams & Wilkins, Woltess Kluwer Pvt.Ltd. 2. Corwin, Hansch, Samuel, C. Rotella, D. Ward, S. (2017).*Comprehensive Medicinal Chemistry*, 3rd Ed., Elsevier. 3. Martin, Y.C. (2010).*Quantitative Drug Design*: A critical Introduction, 3rd Ed., CRC Press. 4. Lemke, T.S. Williams, D.A. Roche, V.F. Zito, S.W. (2013). *Foye,s Principles of Medicinal Chemistry,* 7th Ed., New Delhi: Lippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd. 5. Arienes, E.J. (1975).*Drug Design,* 1st Ed., Academic Press Elsevier. 6. Smith, Williams. (2005). *Introduction to the Principles of Drug*	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		6. Arienes EJ, *Drug Design,* Academic Press, Elsevier: vol 6, Edi 1st, 1975. 7. Smith, Williams, *Introduction to the Principles of Drug Design and Action*, CRC Press: Edi 4, 2005. 8. Silverman RB, *The Organic Chemistry of the Drug Design and Drug action*, Elsevier Publishers: Edi 2nd, 2012. 9. Patrick GL, *An Introduction to Medicinal Chemistry*, Oxford University Press, USA: Edi 1st, 1995. 10. Brahmankar DM, Jaiswal SB, *Biopharmaceutics and pharmacokinetics*, Vallabh Prakashan, New Delhi: Edi 2nd, 2014. 11. Guarna A, Trabocchi A, *Peptidomimetics in Organic and Medicinal Chemistry*, edi 1st, Wiley publishers: 2014.	*Design and Action*, 4th Ed., CRC Press. 7. Silverman, R.B. (2012).*The Organic Chemistry of the Drug Design and Drug action*, 2nd edition, Elsevier Publishers. 8. Patrick, G.L. (1995).*An Introduction to Medicinal Chemistry*, 1st Ed., Oxford University Press. 9. Brahmankar, D.M. Jaiswal, S.B. (2014).*Biopharmaceutics and pharmacokinetics*, 2nd Ed., New Delhi: Vallabh Prakashan. 10. Guarna, A. Trabocchi, A. (2014).*Peptidomimetics in Organic and Medicinal Chemistry*,1st Ed., New York: Wiley publishers.	
Course code PHAR 504 **Course name** Advanced Organic Chemistry-I	Upon completion of this course student will have an understanding of: • basic reaction mechanisms involved in an organic synthesis. • Design organic synthesis by using different techniques in the field of drug discovery and process chemistry.	**SECTION-A** **Basic aspects of organic chemistry:** Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications. Types of reaction mechanisms and methods of determining them, Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. **Addition reactions:** Nucleophilic uni- and bimolecular reactions (SN1 and SN2), Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule), Rearrangement reaction **Study of mechanism and synthetic applications of following named reactions:** Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction **SECTION-B** **Synthetic reagents & applications:** Aluminium isopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, (Benzotriazol-1-yloxy)tris(dimethylamino)phosphonium hexafluorophosphate (BOP). **Protecting groups:** Role of protection in organic synthesis, protection for the hydroxyl group, including 1,2-and 1,3-diols, ethers, esters, carbonates, cyclic acetals & ketals. Protection for the carbonyl group, acetals and ketals. Protection for the carboxyl group, esters and hydrazides. Protection for the amino group and amino acids, carbamates and amides. **Synthon approach and retrosynthesis applications:** Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA). C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-, 1,4-, 1,5-, 1,6-difunctionalized compounds. Strategies for synthesis of three,	**SECTION-A** **Basic aspects of organic chemistry:** Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications. Types of reaction mechanisms and methods of determining them, Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. **Addition reactions:** Nucleophilic uni- and bimolecular reactions (SN1 and SN2), Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule), Rearrangement reaction **Study of mechanism and synthetic applications of following named reactions:** Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction **SECTION-B** **Synthetic reagents & applications:** Aluminium isopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, (Benzotriazol-1-yloxy)tris(dimethylamino)phosphonium hexafluorophosphate (BOP). **Protecting groups:** Role of protection in organic synthesis, protection for the hydroxyl group, including 1,2-and 1,3-diols, ethers, esters, carbonates, cyclic acetals & ketals. Protection for the carbonyl group, acetals and ketals. Protection for the carboxyl group, esters and hydrazides. Protection for the amino group and amino acids, carbamates and amides. **Synthon approach and retrosynthesis applications:** Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA). C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-, 1,4-, 1,5-, 1,6-difunctionalized compounds. Strategies for synthesis of three,	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		four, five and six-membered ring. **SECTION-C** **Heterocyclic Chemistry:** Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis. **Synthesis of few representative drugs containing these heterocyclic nucleus** such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine, Theophylline , Mercaptopurine and Thioguanine. **Books recommended:** 1. "Smith MB, J*erry March,s Advanced Organic chemistry: Reaction, Mechanisms and Structure*, John Wiley and Sons, New York: edi 7th, 2013. 2. Gould ES, Rinchart H, Winston, *Mechanism and Structure in Organic Chemistry,* New York: 1959. 3. Clayden, Greeves, Warren, Woihers, *Organic Chemistry*, Oxford University Press: 2001. 4. Finar IL, *Organic Chemistry,* ELBS, Pearson Education Lts, Dorling Kindersley (India) Pvt. Ltd: vol I-II, 2011. 5. Peter Skyes, *A guide to mechanisms in Organic Chemistry*, Orient Longman, New Delhi: Edi 6th, 2011. 6. Wilson SR, Czarnik AW, *Combinational Chemistry:Synthesis and applications*, Wiley – Blackwell:1997. 8. Carey FA, Sundberg RA, *Advanced Organic Chemistry*, springer: edi 5th, 2007. 9. Warren S, Waytt P, *Organic Synthesis: The Disconnection Approach*, Willy India: Edi 2, 2008. 10. Norman ROC, Coxan JM, Thorns N, *Principles of Organic Synthesis*, Edi 3rd, 1993. 11. Ahluwalia VK, Agarwal R, *Organic Synthesis: Special Techniques*, Narosa Publishers: Edi 3rd, 2001. 12. Ahluwalia VK, Parashar RK, *Organic Reaction Mechanisms*, Narosa Publishers: Edi 4th, 2007.	four, five and six-membered ring. **SECTION-C** **Heterocyclic Chemistry:** Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis. **Synthesis of few representative drugs containing these heterocyclic nucleus** such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine, Theophylline , Mercaptopurine and Thioguanine. **Recommended books (Latest edition):** 1. Smith, M.B. (2013). J*erry March,s Advanced Organic chemistry: Reaction, Mechanisms and Structure*, 7th Ed., New York: John Wiley and Sons. 2. Gould, E.S., Rinchart, H. W. (1959).*Mechanism and Structure in Organic Chemistry,* New York: Holt, Rinehart and Winston. 3. Clayden, Greeves, Warren, Woihers. (2001).*Organic Chemistry*, 2nd Ed., Oxford University Press. 4. Finar, I.L. (2011).*Organic Chemistry,* India: ELBS, Pearson Education Lts, Dorling Kindersley (India) Pvt. Ltd. 5. Peter, Skyes. (2011). *A guide to mechanisms in Organic Chemistry*, 6th Ed., New Delhi: Orient Longman. 6. Wilson, S.R. Czarnik, A.W. (1997).*Combinational Chemistry: Synthesis and applications*: Wiley– Blackwell. 7. Carey, F.A. Sundberg, R.A. (2007). *Advanced Organic Chemistry*, 5th Ed., Springer. 8. Warren, S. Waytt, P. (2008). *Organic Synthesis: The Disconnection Approach*, 2nd Ed., Willy. 9. Norman, R.O.C. Coxan, J.M. Thorns, N. (1993). *Principles of Organic Synthesis*, 3rd, Ed., Nelson Thornes Ltd. 10. Ahluwalia, V.K. Agarwal, R. (2001). *Organic Synthesis: Special Techniques*, 3rd Ed., New Delhi: Narosa Publishers. 11. Ahluwalia, V.K. Parashar, R.K. (2007). *Organic Reaction Mechanisms*, 4th Ed., New Delhi: Narosa Publishers. **Suggested e-material:** 1. Singh, Maya Shankar: Advanced Organic Chemistry : Reactions and Mechanisms: http://lib.myilibrary.com?id=475867 2. Bruice, Paula Y:Organic Chemistry: Pearson New International Edition: http://lib.myilibrary.com?id=527161 3. https://www.organic-chemistry.org 4. https://www.masterorganicchemistry.com/resource-guide/ 5. https://www.organicdivision.org/links/	
Course code PHAR 509 **Course name** Chemistry of Natural Products	Upon completion of this course student will have an understanding of: • The role and applicability of lead molecules of natural	**SECTION-A** **Study of natural products as leads for new pharmaceuticals for the following class of drugs:** a) Drugs Affecting the Central Nervous System: Morphine Alkaloids	**SECTION-A** **Study of natural products as leads for new pharmaceuticals for the following class of drugs:** a) Drugs Affecting the Central Nervous System: Morphine Alkaloids	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	origin in the field of drug research • isolation, purification and characterization of medicinal compounds from natural origin. • application of rDNA technology in the field of drug discovery. • types and uses of various reagents and reactions involved in the structural elucidation of natural compounds.	b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol d) Neuromuscular Blocking Drugs: Curare alkaloids e) Anti-malarial drugs and Analogues f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem) **Active constituent of certain crude drugs used in Indigenous system:** Diabetic therapy – Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum; Liver dysfunction – Phyllanthus niruri; Antitumor – Curcuma longa Linn. **SECTION-B** **Alkaloids:** General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine. **Flavonoids:** Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin. **Steroids:** General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D). **SECTION-C** **Terpenoids:** Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (β carotene). **Vitamins:** Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin. **Recombinant DNA technology and drug discovery rDNA technology**, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation. **Structural characterization of natural compounds**: using IR, ^{1}H-NMR, ^{13}C-NMR and MS spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides. **Books recommended:** 1. Peech, Tracey MV, *Modern Methods of Plant Analysis*, Springer-Verlag- Berlin- Heidelberg: Edi 1st, 1955. 2. Runeckles VC, *Recent advances in Phytochemistry*, Springer Science & Business Media: vol. I-IV, 1975.	b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol d) Neuromuscular Blocking Drugs: Curare alkaloids e) Anti-malarial drugs and Analogues f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem) **Active constituent of certain crude drugs used in Indigenous system:** Diabetic therapy – Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum; Liver dysfunction – Phyllanthus niruri; Antitumor – Curcuma longa Linn. **SECTION-B** **Alkaloids:** General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine. **Flavonoids:** Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin. **Steroids:** General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D). **SECTION-C** **Terpenoids:** Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (β carotene). **Vitamins:** Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin. **Recombinant DNA technology and drug discovery rDNA technology**, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation. **Structural characterization of natural compounds**: using IR, ^{1}H-NMR, ^{13}C-NMR and MS spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides. **Recommended books (Latest edition):** **1.** Peech, Tracey, M.V. (1955). *Modern Methods of Plant Analysis*, 1st Ed., Springer-Verlag- Berlin- Heidelberg. 2. Runeckles, V.C. (1975). *Recent advances in Phytochemistry*, voll-IV, Springer Science & Business Media	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		3. Chemistry of natural products Vol I onwards IWPAC. 4. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California. 5. IKan R, *Natural Product:A laboratory guide*, Academic Press: Edi 2nd, 1091. 6. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California. 7. Natural Product Chemistry "A laboratory guide" – Rapheal Khan. 8. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press. 9. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall. 10. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwal, Himalaya Publishing House. 11. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan. 12. Organic Chemistry Vol I and II by I.L. Finar, Pearson education. 13. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers. 14. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers. 15. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition. 16. Phytochemical methods of Harborne, Springer, Netherlands.	3. Nakanishi, G. Goto, T. Natori, S. (1984). *Natural Product Chemistry, Californiya:* University Science Books. 4. IKan, R. (2014). *Natural Product: A laboratory guide*, 2nd Ed., Academic Press. 5. Manske, R.H.F. (1965). *The Alkaloids :Chemistry and Physiology*, vol 5, 1st Ed., Academic Press. 6. Wells, C.H.J. (9172). *Introduction to molecular Phytochemistry*, Chapmann and Hall. 7. Chatwal, G.R. (2015). *Organic Chemistry of Natural Products*, voll-II, 4th Ed., Himalaya Publishing House. 8. Agarwal, O.P. (2019). *Organic Chemistry of Natural Products*, vol I-II, 4th Ed., Krishan Prakashan media. 9. Finar, I.L. (2011). *Organic Chemistry,* ELBS, Pearson Education Lts, vol I-II, Dorling Kindersley. 10. Gupta, P.K. (2005). *Elements of Biotechnology*, Rastogi Publishers. 11. Vyas, S.P. Dixit, V.K. (2012). *Pharmaceutical Biotechnology*, CBS Publishers. 12. Purohit, Mathur, (2009).*Biotechnology*, 13th Ed., Agro-Bios. **Suggested e-material:** 1. Wiart, Christophe: Lead compounds from medicinal plants for the treatment of neurodegenerative diseases: http://www.sciencedirect.com/science/book/9780123983732 2. medicinal chemistry of bioactive natural products - Kois.SK: https://www.pdfdrive.com/medicinal-chemistry-of-bioactive-natural-products-koissk-e8027117.html 3. https://www.pdfdrive.com/pharmaceutical-biotechnology-concepts-and-applications-d38535075.html	
Course code PHAR 516 **Course name** Modern Pharmaceutical Analytical Techniques	Upon completion of this course student will have an understanding of: • significance of Pharmaceutical Analysis in the profession. • various tools and techniques available for the analysis of drugs. • principles of various conventional analytical techniques. • application of Pharmacopoeial purity and identity tests for samples. • proper handling of laboratory equipments and glassware. • interpretation of spectra and correlate with sample. • converting the observations to meaningful results and drawing the inferences. • comparing various methods of analysis and their outcomes.	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact,	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact,	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography **Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X-ray crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application of potentiometry. **Thermal techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Books recommended:** 1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004. 2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998. 3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers. 4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997. 5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991. 6. Quantitative Analysis of Drugs in Pharmaceutical formulation	chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography **Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X-ray crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application of potentiometry. **Thermal techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Recommended books (Latest edition):** 1. Silverstein, R.M. (2004). *Spectrometric Identification of Organic compounds*, 6th Ed., John Wiley & Sons. 2. Skoog, D.A, Holler, F.J., Nieman, T.A. (1998). *Principles of Instrumental Analysis*, 5th Ed., Bangalore: Eastern press, Bangalore. 3. Beckett, A.H., Stenlake, J.B. (1987). *Practical Pharmaceutical Chemistry,* 4th Ed., New Delhi: CBS publishers. 4. Kemp, W. (1991). *Organic Spectroscopy*, 3rd Ed., ELBS. 5. Sethi, P.D. (1987). *Quantitative Analysis of Drugs in Pharmaceutical formulation*, 3rd Ed., New Delhi: CBS Publishers. 6. Munson, J.W. (2012). *Pharmaceutical Analysis- Modern*	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		- P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997. 7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series	*methods* – Part B, Informa Health care Publishers. **Suggested e-material:** 1. http://www.sciencedirect.com/science/book/9780123869845 Infrared and Raman spectroscopy Larkin, Peter 2. http://www.sciencedirect.com/science/book/9780124115897 Solving problems with NMR spectroscopy Atta-ur-Rahman, Muhammad Iqbal 3. http://lib.myilibrary.com/?id=543351 Quantum Chemistry and Spectroscopy: Pearson New International Edition Engel, Thomas	
Course code PHAR 519L **Course name** Pharmaceutical Chemistry Lab-I	Upon completion of this course student will have an understanding of: • handing various equipments • performing the synthesis of drugs • perform calibration of the instruments • extraction techniques used in various natural resources	1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on Column chromatography 4. Experiments based on HPLC 5. Experiments based on Gas Chromatography 6. Estimation of riboflavin/quinine sulphate by fluorimetry 7. Estimation of sodium/potassium by flame photometry **To perform the following reactions of synthetic importance** 1. Purification of organic solvents, column chromatography 2. Claisen-schimidt reaction. 3. Benzyllic acid rearrangement. 4. Beckmann rearrangement. 5. Hoffmann rearrangement 6. Mannich reaction 7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments) 8. Estimation of elements and functional groups in organic natural compounds 9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data. 10. Some typical degradation reactions to be carried on selected plant constituents	1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on Column chromatography 4. Experiments based on HPLC 5. Experiments based on Gas Chromatography 6. Estimation of riboflavin/quinine sulphate by fluorimetry 7. Estimation of sodium/potassium by flame photometry **To perform the following reactions of synthetic importance** 1. Purification of organic solvents, column chromatography 2. Claisen-schimidt reaction. 3. Benzyllic acid rearrangement. 4. Beckmann rearrangement. 5. Hoffmann rearrangement 6. Mannich reaction 7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments) 8. Estimation of elements and functional groups in organic natural compounds 9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data. 10. Some typical degradation reactions to be carried on selected plant constituents	No changes
Course code **Course name** Pharmacological and Toxicological Screening Methods (Disciplene elective)	Upon completion of this course student will have an understanding of: • Preclinical evaluation of drugs and recent experimental techniques in the drug discovery and	**SECTION-A** **Laboratory Animals, Common laboratory animals:** Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals. Good laboratory practice. Bioassay-Principle,	**SECTION-A** **Laboratory Animals:** Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals	Introduced as Discipline Elective using PCI prescribed syllabus. “Suggested e-material:” has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	development. • Maintenance of laboratory animals as per the guidelines, basic knowledge of various *in-vitro* and *in-vivo* preclinical evaluation processes • regulations and ethical requirement for the usage of experimental animals. • various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals • the various screening methods involved in the drug discovery process • correlate the preclinical data to humans	scope and limitations and methods **SECTION-B** Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive). Regulatory guidelines for conducting toxicity studies OECD, ICH,EPA and Schedule Y. OECD principles of Good laboratory practice (GLP).History, concept and its importance in drug development **Acute, sub-acute and chronic-** oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization-importance and methods in regulatory toxicology studies **SECTION-C** **IND enabling studies (IND studies)-** Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. Safety pharmacology studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies. **Toxicokinetics-** Toxicokinetic evaluation in preclinical studies, saturation kinetics, Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing. **Books recommended:** 1. Handbook of Experimental Pharmacology, SK.Kulkarni 2. Fundamentals of experimental Pharmacology by M.N.Ghosh 3. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/ publications/documents/glphandbook. pdf). 4. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 5. 2005, ministry of health and family welfare (department of health) New Delhi 6. Drugs from discovery to approval by Rick NG. 7. Animal Models in Toxicology, 3rd Edition, Lower and Bryan 8. OECD test guidelines. 9. Principles of toxicology by Karen E. Stine, Thomas M. Brown. 10. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals 11. (http://www.fda.gov/downloads/drugs/guidancecompliance regulatoryinformation /guidances/ucm073246.pdf)	Good laboratory practice. Bioassay: Principle, scope and limitations and methods. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. **SECTION-B** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, anti-inflammatory and antipyretic agents. Gastrointestinal drugs: anti-ulcer, anti-emetic, antidiarrheal and laxatives. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. **SECTION-C** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Immunomodulators, Immunosuppressants and immunostimulants **General principles of immunoassay**: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin. Anti-cancer agents. Hepatoprotective screening methods. Limitations of animal experimentation and alternate animalexperiments. Extrapolation of in vitro data to preclinical and preclinical to humans **Recommended books (Latest edition):** 1. Kulkarni, S.K. (2013). *Handbook of experimental pharmacology*. New Delhi: Vallabh publications. 2. Ghosh, M.N. (2008). Fundamentals of experimental pharmacology. 5th Ed., Munster: Hilton & Co. 3. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi. 4. Rick, N.G. (2015). *Drugs: from discovery to approval*. 3rd Ed.,New York: Wiley Blackwell. 5. Gad, S.C. (2015). *Animal Models in Toxicology*. 3rd Ed.,New	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			York: CRC press. 6. Stine, K.E., Brown, T.M. (2015). *Principles of toxicology*. 3rd Ed.,New York: CRC press. 7. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals. **Suggested e-material:** 1. (http://www.fda.gov/downloads/drugs/guidancecompliance regulatoryinformation /guidances/ucm073246.pdf) 2. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/ publications/documents/glphandbook. pdf).	
Course code **Course name** Herbal Cosmetics (Discipline Elective)	After completion of the course, student shall be able to • Understand the basic principles of various herbal/natural cosmetic preparations • Current Good Manufacturing Practices of herbal/natural cosmetics as per the regulatory authorities		**SECTION-A** **Introduction:** Herbal/natural cosmetics, Classification & Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics, commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs. Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation. **SECTION-B** **Herbal Cosmetics:** Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail. Preparation and standardisation of Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails. **SECTION-C** **Cosmeceuticals of herbal and natural origin:** Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams, deodorants. **Analysis of Cosmetics, Toxicity screening and test methods:** Quality control and toxicity studies as per Drug and Cosmetics Act. **Recommended books:** 1. Panda, H. (2000). Herbal Cosmetics: Hand book, New Delhi: Asia Pacific Business Press Inc. 2. Thomson, E.G. (2015). Modern Cosmetics, vol 1, Mumbai: Universal Publishing Corporation. 3. Sharma, P.P. (2014). Cosmetics - Formulation, Manufacturing & Quality Control, Ed.5th, New Delhi: Vandana Publications. 4. Supriya, B. (2000). Handbook of Aromatic Plants, Jaipur: Pointer Publishers. 5. Skaria, B.P. (2007). Aromatic Plants: Horticulture Science Series,	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			New Delhi: New India Publishing Agency. 6. Keville, K., Green, M., (2008). Aromatheraphy: A Complete Guide to the Healing Art, New Delhi: Sri Satguru Publications. 7. Balsam, M.S., Edward S. (1974). Cosmetics Science and Technology, vol 3, New York: Wiley Interscience. **Suggested e-material:** https://www.pdfdrive.com/cosmetics-books.html	
Course code **Course name** Advanced Pharmaceutical Biotechnology (Discipline Elective)	Upon completion of this course student will have an understanding of: • Enzyme technology, genetic Engineering, Peptides and its applications. • Transgenic animal, human genome and signal transduction. • 3 Microbial transformation, biodegradation and biosensors.		**SECTION-A** **Enzyme Technology:** Classification, general properties of enzymes, dynamics of enzymatic activity, sources of enzymes, extraction and purification, pharmaceutical, therapeutic and clinical application. Production of amyloglucosidase, glucose isomerase,amylase and trypsin. **Genetic Engineering:** Techniques of gene manipulation, cloning strategies,procedures, cloning vectors expression vectors, recombinant selection and screening, expression in E.coli and yeast. Site directed mutagenesis, polymerase chain reaction, and analysis of DNAsequences. Gene library and cDNA Applications of the above technique in the production of, • Regulatory proteins - Interferon, Interleukins • Blood products - Erythropoietin • Vaccines - Hepatitis-B • Hormones – Insulin **Therapeutic peptides:** Study on controlled and site specified delivery of therapeutic peptides and proteins through various routes of administration. **SECTION-B** **Transgenic animals:** Production of useful proteins in transgenic animals and gene therapy. **Human Genome:** The human genome project-a brief study, Human chromosome – Structure and classification, chromosomal abnormalities –Syndromes **Signal transduction:** Introduction, cell signaling pathways, Ion channels, Sensors and effectors, ON and OFF mechanisms, Spatial and temporal aspects of signaling, cellular process, development, cell cycle and proliferation, neuronal signaling, cell stress, inflammatory responses and cell death, signaling defects and diseases. **SECTION-C** **Oncogenes:** Introduction, definition, various oncogenes and their proteins. **Microbial Biotransformation:** Biotransformation for the synthesis of chiral drugs and steroids. **Microbial Biodegradation:** Biodegradation of xenobiotics, chemical and industrial wastes, Production of single-cell protein, Applications	Introduced as Discipline Elective using PCI prescribed syllabus. “Suggested e-material:” has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			of microbes in environmental monitoring. **Biosensors:** Definition, characteristics of ideal biosensors, types of biosensors, biological recognition elements, transducers, application of biosensors. **Recommended books:** 1. Trevan, M.D., Boffey, S., Goulding, K.H., Stanbury, P.F. (1987). Biotechnology-The biological principles. Ed. 1, Stony Stratford: Open University Press. 2. Bickerstaff, G.F. (1997). Immobilization of cells and enzymes. Totowa: Humana Press Inc. 3. Old, R.W., Primrose, S.B. (1981). Principles of Gene Manipulating. University of California Press 4. Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D. Darnell, J. (1999). Molecular Cell Biology. 4th ed. W. H. Freeman Publishers. 5. Primrose, S.B. (1991). Modern Biotechnology. 2nd Ed. London: Blackwell Scientific Publications Ltd. 6. Murray E.T. (1991). Gene transfer and expression protocols-methods in Molecular Biology, vol. VII, Totowa: Humana Press Inc. 7. Asubel, F.M. (2003). Current protocols in Molecular Biology, Vo1.I & II, John Wiley Publishers. **Suggested e-material** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code **Course name** Intellectual Property Rights (Discipline Elective)	Upon completion of this course student will have an understanding of: • patent and copyright for their innovative works. They also get the knowledge of plagiarism in their innovations which can be questioned legally. • selected IP issues that might arise in practice. • federal and state IP protection: • tools and activities of IP practitioners such as the Copyright, Patent, and Trademark websites, searching, reading patents, and more.		**SECTION-A** **Intellectual property rights (IPR):** Definition, scope, objectives, Concepts and fundamentals: intellectual property (IP), intellectual property protection (IPP) and intellectual property rights (IPR); economic importance, mechanism for protection of intellectual property. **Patents:** (Criteria for patentability, Indian patent act. 1970, filing of a patent application, precautions before patenting-disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application- provisional, non-provisional, PCT and convention patent applications, international patenting requirement procedures and costs. **Patent infringement:** Meaning, scope, litigation, drug related patents infringements, case studies and examples, patenting by research students.),	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			SECTION-B **Copyright**, **Trademarks:** (Introduction, meaning of trademark, criteria for eligibility, filling application for trademark registration). **Trade secrets:** Scope modalities and protection case studies. Role of IP in pharmaceutical industry. **Trade related aspects of intellectual property rights:** Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). **WTO**-objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization **SECTION-C** **Technology development/transfer commercialization related aspects:** Meaning, drug related technology development, bioequivalence (BE), scale-up, semi-commercialization and commercialization– practical aspects and problems, significance of transfer of technology (TOT), bottlenecks, managing technology transfer, guidelines for research students, scientists and related personnel, TOT agencies in India APCTD, NRDC, TIFAC, IBCIL, TBSE/SIDBI. **TOT related documentation:** Confidentiality agreements, licensing, MOUs, legal issues, compulsory licensing and issuing of access to medicines, DOHA declaration. **Related quality systems:** Objectives and brief review of US-FDA, UK-MCA, and TGA guidelines. **Standard institutes and certification agencies like**: ISI, BSS, ASTM. **Recommended books (Latest edition):** 1. Treece, D.J. (2003). *Managing Intellectual Capital: Organizational, Strategic and Policy Dimension*. England: Oxford University Press. 2. Wadedhra, B.L. (2004). *Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications*. New Delhi: Universal Law Publishing. 3. Bansal, P. (2008) *IPR Handbook for Pharma Students and Researchers*. Hyderabad: Pharma Book Syndicate. 4. Trivedi, P.R. (2008). *Encylcopedia of Intellectual Property Rights*. New Delhi: Jnanada Prakashan. 5. Willig, S.H. (1982). *Good Manufacturing Practices for Pharmaceuticals*. vol 78, New York: Marcel Dekker,. 6. Das, P., Das, G. (2008). *Protection of Industrial Property Rights Kolkata*: Kamal Law House. 7. Katju, S.N. (2002). *Law and Drugs*, Delhi Law House. **Suggested e-material:** 1. www.fda.gov 2. https://www.ich.org/products/guidelines.html	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			3. Copyright Protection in India [website: http:copyright.gov.in]. 4. Information on orange book [website: www.fda.gov/cder/ob/default.htm]. 5. World Trade Organization [website: www.wto.org].	
Course code **Course name** Regulatory aspects of food and nutraceuticals (Discipline Elective)	Upon completion of the course, the student shall be able to • Know the regulatory Requirements for nutraceuticals • Understand the regulation for registration and labeling of nutraceuticals • food supplements in India, USA and Europe.		**SECTION-A** **Nutraceuticals:** Introduction, History of Food and Nutraceutical, Regulations, Meaning of Nutraceuticals, Dietary Supplements, Functional Foods, Medical Foods, Scope and Opportunities in Nutraceutical Market. **Global Aspects:** WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food And Dietary Supplements. Good Manufacturing Practices for Nutraceuticals **SECTION-B** **India:** Food Safety and Standards Act, Food Safety and Standards Authority of India: Organization and Functions, Regulations for import, manufacture and sale of nutraceutical products in India, Recommended Dietary Allowances (RDA) in India. **USA**: US FDA Food Safety Modernization Act, Dietary Supplement Health and Education Act. U.S. regulations for manufacture and sale of nutraceuticals and dietary supplements, Labelling Requirements and Label Claims for Dietary Supplements, Recommended Dietary Allowances (RDA) in the U.S. **SECTION-C** **European Union:** European Food Safety Authority (EFSA): Organization and Functions. EU Directives and regulations for manufacture and sale of nutraceuticals and dietary supplements. Nutrition labelling. European Regulation on Novel Foods and Novel Food Ingredients. Recommended Dietary Allowances (RDA) in Europe. **Books recommended:** 1. Hasler, Clare M. (2005). Regulation of Functional Foods and Nutraceuticals: A Global Perspective. Vol.1, Delhi: Blackwell Publishing. 2. Bagchi, D. (2014). Nutraceutical and Functional Food Regulations in the United States and Around the World. Elsevier. 3. Pathak, Y. (2009). *Handbook of Nutraceuticals*. Vol 1. CRC Press. 4. Fortin, N.D. (2007). *Food Regulation: Law, Science, Policy and Practice.* Vol 1. Wiley Publishers. **Suggested e-material** 1. http://www.who.int/publications/guidelines/nutrition/en/ 2. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/536324/IPOL_STU(2015)536324_EN.pdf	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added
Course code	Upon completion of the course, the		**SECTION A**	Introduced as Discipline

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course name Regulatory Aspects of Medical Devices (Discipline Elective)	student shall be able to know • basics of medical devices and IVDs, process of development, ethical and quality considerations • harmonization initiatives for approval and marketing of medical devices and IVDs • regulatory approval process for medical devices and IVDs in India, US, Canada, EU, Japan and ASEAN • clinical evaluation and investigation of medical devices and IVDs		**Medical Devices:** Introduction, Definition, Risk based classification and Essential Principles of Medical Devices and IVDs. Differentiating medical devices IVDs and Combination Products from that of pharmaceuticals. History of Medical Device Regulation, Product Lifecycle of Medical Devices and Classification of Medical Devices. **IMDRF/GHTF:** Introduction, Organizational Structure, Purpose and Functions, Regulatory Guidelines, Working Groups, Summary Technical Document (STED), Global Medical Device Nomenclature (GMDN). **SECTION B** **Ethics:** Clinical Investigation of Medical Devices, Clinical Investigation Plan for Medical Devices, Good Clinical Practice for Clinical Investigation of medical devices (ISO 14155:2011) **Quality:** Quality System Regulations of Medical Devices: ISO 13485, Quality Risk Management of Medical Devices: ISO 14971, Validation and Verification of Medical device, Adverse Event Reporting of Medical device **USA:** Introduction, Classification, Regulatory approval process for Medical Devices (510k) Premarket Notification, Pre-Market Approval (PMA), Investigational Device Exemption (IDE) and In vitro Diagnostics, Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI). Basics of In vitro diagnostics, classification and approval process. **SECTION C** **European Union**: Introduction, Classification, Regulatory approval process for Medical Devices (Medical Device Directive, Active Implantable Medical Device Directive) and In vitro Diagnostics (In Vitro Diagnostics Directive), CE certification process. Basics of In vitro diagnostics, classification and approval process. **ASEAN, China & Japan**: Medical Devices and IVDs, Regulatory registration procedures, Quality System requirements and clinical evaluation and investigation. IMDRF study groups and guidance documents. **Books recommended:** 1. Pisano, D. J., Mantus, D. (2008). *FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices and Biologics*. 2nd Ed., CRC Press. 2. Kahan, J. S. (2000). *Medical Device Development: A Regulatory Overview*. PAREXEL International Corporation. 3. Tobin, J. J., Walsh, G. (2008). *Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics Medical, Devices.* Wiley-Blackwell 4. Medina, C. (2003). *Compliance Handbook for Pharmaceuticals, Medical Devices and Biologics*. CRC Press. **Suggested e-material** 1. Country Specific Guidelines from official websites. 2. Code of Federal regulations (Annual Edition) from official websites, US government. 3. www.fda.gov	Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Name of Programme: Master of Pharmacy (Pharmaceutical Chemistry)

Course details: Second Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 501 **Course name** Advanced Organic Chemistry-II	Upon completion of this course student will have an understanding of: • nomenclature, reaction mechanism, kinetics, order of reaction, factors affecting reaction, name reactions of alkanes, alkenes, conjugated dienes, alkyl halides, alchohols, carbonyl compounds, carboxylic acids and aliphatic amines	**SECTION-A** **Green Chemistry:** Introduction, principles of green chemistry **Microwave assisted reactions:** Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis **Ultrasound assisted reactions:** Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications. **Continuous flow reactors:** Working principle, advantages and synthetic applications. **SECTION-B** **Chemistry of peptides:** Coupling reactions in peptide synthesis, Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers, Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides. Segment and sequential strategies for solution phase peptide synthesis with any two case studies. **Side reactions in peptide synthesis:** Deletion peptides, side reactions initiated by proton abstraction, protonation, over activation and side reactions of individual amino acids. **Photochemical reactions:** Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. **Pericyclic reactions:** Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples **SECTION-C** **Catalysis:** Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs. **Transition-metal and Organo-catalysis in organic synthesis:** Metal-catalyzed reactions. **Biocatalysis:** Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction. **Phase transfer catalysis:** Theory and applications **Stereochemistry & asymmetric synthesis:** Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z noation.	**SECTION-A** **Green chemistry:** Introduction, principles of green chemistry **Microwave assisted reactions:** Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis **Ultrasound assisted reactions:** Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications. **Continuous flow reactors:** Working principle, advantages and synthetic applications. **SECTION-B** **Chemistry of peptides:** Coupling reactions in peptide synthesis, Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers, Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides. Segment and sequential strategies for solution phase peptide synthesis with any two case studies. **Side reactions in peptide synthesis:** Deletion peptides, side reactions initiated by proton abstraction, protonation, over activation and side reactions of individual amino acids. **Photochemical reactions:** Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. **Pericyclic reactions:** Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples **SECTION-C** **Catalysis:** Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs. **Transition-metal and Organo-catalysis in organic synthesis:** Metal-catalyzed reactions. **Biocatalysis:** Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction. **Phase transfer catalysis:** Theory and applications **Stereochemistry & asymmetric synthesis:** Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry,	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples. **Books recommended:** 1. March J, *Advanced Organic chemistry, Reaction, mechanisms and structure* John Wiley and sons, New York,2013. 2. Gould ES, *Mechanism and structure in organic chemistry,* Rinchart and Winston, NewYork,1962. 3. Clayden J, Warren S, *Organic Chemistry,* Oxford University Press 2001. 4. Finar IL, *Organic Chemistry Vol I and II.* ELBS, Sixth ed., 1995. 5. Francis A,Richaard A, *Organic chemistry,*Springer,2007. 6. Warren S, *Organic synthesis-the disconnection approach,* Wiley, 2008	Fischers D and L notation, cis-trans isomerism, E and Z noation. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples. **Recommended books (Latest edition):** 1. March, J. (2013). *Advanced Organic chemistry, Reaction, mechanisms and structure,* 7th Ed., New York: John Wiley and sons. 2. Gould, E.S. (1962). *Mechanism and structure in organic chemistry,* 1st Ed., New York: Rinchart and Winston. 3. Clayden, J. Warren, S. (2001). *Organic Chemistry,* 2nd Ed., Oxford University Press. 4. Finar, I.L. (1995). *Organic Chemistry,*6th Ed., London: Pearson Education 5. Francis, A. Richaard, A. (2007). *Organic chemistry,* 5th Ed., Springer. 6. Warren, S. (2008). *Organic synthesis-the disconnection approach* 2nd Ed., New York: Wiley. **Suggested e-material:** 1. Smith, michael : organic synthesis: http://www.sciencedirect.com/science/book/9781890661403 2. Savin, kenneth: writing reaction mechanisms in organic chemistry: http://www.sciencedirect.com/science/book/9780124114753	
Course code PHAR 507 **Course name** Advanced Spectral Analysis	Upon completion of this course student will have an understanding of: • various hyphenated analytical instrumental techniques • different analytical data from diffent principle instrument. • interpretation skills of different analytical data like LC-MS, GC-MS, ATR-IR, DSC etc. theoretically and practically. • Handling of different analytical data to predict the unknown structures.	**SECTION-A** **UV spectroscopy:** Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones. **IR spectroscopy:** ATR-IR, IR Interpretation of organic compounds. **NMR spectroscopy:** 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds. **SECTION-B** **Mass spectroscopy:** Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Mc Lafferty rearrangement, ring rule, interpretation of organic compounds. **Chromatography:** Principle, instrumentation and applications of the following: a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMS (continuous emissions monitoring systems) g) High performance thin layer chromatography h) Super critical fluid chromatography i) Ion chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography **SECTION-C** **Microscopy:** Introduction, principle, instrumentation and applications	**SECTION-A** **UV spectroscopy:** Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones. **IR spectroscopy:** ATR-IR, IR Interpretation of organic compounds. **NMR spectroscopy:** 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds. **SECTION-B** **Mass spectroscopy:** Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Mc Lafferty rearrangement, ring rule, interpretation of organic compounds. **Chromatography:** Principle, instrumentation and applications of the following: a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMS (continuous emissions monitoring systems) g) High performance thin layer chromatography h) Super critical fluid chromatography i) Ion chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography **SECTION-C** **Microscopy:** Introduction, principle, instrumentation and applications	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		of light, phase contrast, fluorescence, confocal and electron (SEM & TEM) microscopy. **Small angle X-ray scattering (SAXS):** Introduction, principle, instrumentation, applications. **Raman spectroscopy:** Introduction, principle, instrumentation and applications. **Books recommended:** 1. Robert M Silverstein, *Spectrometric Identification of Organic compounds*, John Wiley & Sons, 2004. 2. Doglas A, Skoog F James , *Principles of Instrumental Analysis,* Eastern press, Bangalore, 1998. 3. Willards, *Instrumental methods of analysis* ,CBS publishers,2004. 4. William Kemp, *Organic Spectroscopy* ,ELBS, 1991 5. Sethi PD, *Quantitative Analysis of Drugs in Pharmaceutical formulation,* CBS Publishers, New Delhi, 1997. 6. Munson JW, *Pharmaceutical Analysis- Modern methods* – Part B ,Marcel Dekker Series,1981.	of light, phase contrast, fluorescence, confocal and electron (SEM & TEM) microscopy. **Small angle X-ray scattering (SAXS):** Introduction, principle, instrumentation, applications. **Raman spectroscopy:** Introduction, principle, instrumentation and applications. **Recommended books (Latest edition):** 1. Silverstein, R.M. (2004). *Spectrometric Identification of Organic compounds*, John Wiley & Sons. 2. Doglas, A. Skoog, F.J. (1998). *Principles of Instrumental Analysis,* Banglore: Eastern press. 3. Willards, (2004). *Instrumental methods of analysis*, CBS publishers. 4. William, K. (1991). *Organic Spectroscopy*, ELBS. 5. Sethi, P.D. (1997). *Quantitative Analysis of Drugs in Pharmaceutical formulation,* New Delhi: CBS Publishers. 6. Munson, J.W. (1981). *Pharmaceutical Analysis- Modern methods* – Part B , Marcel Dekker Series. **Suggested e-material:** 1. http://www.sciencedirect.com/science/book/9780123869845 Infrared and Raman spectroscopy Larkin, Peter 2. http://www.sciencedirect.com/science/book/9780124115897 Solving problems with NMR spectroscopy Atta-ur-Rahman, Muhammad Iqbal 3. http://lib.myilibrary.com/?id=543351 Quantum Chemistry and Spectroscopy: Pearson New International Edition Engel, Thomas	
Course code PHAR 511 **Course name** Computer Aided Drug Design	Upon completion of this course student will have an understanding of: • Different CADD techniques and their applications in drug discovery. • use of software in identifying drug receptor interactions and pharmacophore mapping. • applicability of *in silico* virtual screening protocols in drug research.	**SECTION-A** Introduction to Computer Aided Drug Design (CADD) History, different techniques and applications. Quantitative Structure Activity Relationships, Basics History and development of QSAR, Physicochemical parameters and methods to calculate physicochemical parameters, Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters. **SECTION-B** **Quantitative Structure Activity Relationships:** Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters. **Molecular modeling and docking:** Molecular and Quantum Mechanics in drug design. Energy Minimization Methods, comparison between global minimum conformation and bioactive conformation. Molecular docking and drug receptor interactions, Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)	**SECTION-A** **Introduction to Computer Aided Drug Design (CADD)**: History, different techniques and applications. **Quantitative Structure Activity Relationships:** Basics History and development of QSAR, Physicochemical parameters and methods to calculate physicochemical parameters, Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters. **SECTION-B** **Quantitative Structure Activity Relationships:** Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters. **Molecular modeling and docking:** Molecular and Quantum Mechanics in drug design. Energy Minimization Methods, comparison between global minimum conformation and bioactive conformation. Molecular docking and drug receptor interactions, Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		SECTION-C **Molecular properties and drug design:** Prediction and analysis of ADMET properties of new molecules and its importance in drug design. De novo drug design, Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. Homology modeling and generation of 3D-structure of protein. **Pharmacophore mapping and virtual screening:** Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In silico drug design and virtual screening techniques, similarity based methods and pharmacophore based screening, structure based In-silico virtual screening protocols. **Books recommended:** 1. Robert M, *Computational and structural approaches to drug discovery*, RCS Publishers, 2007. 2. Martin YC, *Introduction to Quantitative Drug Design*, CRC Press, Taylor & Francis group,2010. 3. Ariens, *Drug Design*, Academic Press, Elsevier Publishers,1975. 4. Williams, Smith *Principles of Drug Design* ,CRC Press, Taylor & Francis,2005. 5. Richard B. Silverman, The Organic Chemistry of the Drug Design and Drug action, Elsevier Publishers,2014. 6. Burger, *Medicinal Chemistry* ,Wiley Publishing Co,2010. 7. Graham L. Patrick, *An Introduction to Medicinal Chemistry,* Oxford University Press.1995. 8. Wilson Gisvold's, *Text book of Organic Medicinal and Pharmaceutical Chemistry,* Ippincott Williams & Wilkins.2004. 9. Corwin Hansch, *Comprehensive Medicinal Chemistry,* Pergamon Publishers,1990.	protease, choline esterase (AchE & BchE) **SECTION-C** **Molecular properties and drug design:** Prediction and analysis of ADMET properties of new molecules and its importance in drug design. De novo drug design, Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. Homology modeling and generation of 3D-structure of protein. **Pharmacophore mapping and virtual screening:** Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In silico drug design and virtual screening techniques, similarity based methods and pharmacophore based screening, structure based In-silico virtual screening protocols. **Recommended books (Latest edition):** 1. Robert, M. (2007). *Computational and structural approaches to drug discovery*, 1st Ed., Italy: RCS Publishers. 2. Martin, Y.C. (2010). *Introduction to Quantitative Drug Design*, 2nd Ed., New York: CRC Press, Taylor & Francis group. 3. Ariens (1975). *Drug Design*, Academic Press, Elsevier Publishers, 1975. 4. Smith, H.J., Williams, H. (2005). Smith *Principles of Drug Design*. CRC Press, Taylor & Francis. 5. Silverman, R.B. (2010). *The Organic Chemistry of the Drug Design and Drug action*, United States: Elsevier Publishers. 6. Abraham, D.J., Rotella, D.P (2010). Burger's *Medicinal Chemistry*, 7th Ed., England: Wiley Publishing Co. 7. Patrick, G.L. (1995). *An Introduction to Medicinal Chemistry,* Oxford University Press. 8. Gisvold's, W. (2004). *Text book of Organic Medicinal and Pharmaceutical Chemistry,* 11th Ed., Lippincott Williams & Wilkins. **Suggested e-material:** 1. https://www.pdfdrive.com/computational-methods-in-drug-discovery-e24068030.html 2. https://www.pdfdrive.com/textbook-of-drug-design-and-discovery-d33454550.html 3. https://www.pdfdrive.com/drug-design-and-discovery-methods-and-protocols-methods-in-e36557495.html	
Course code PHAR 521 **Course name** Pharmaceutical Process Chemistry	Upon completion of this course student will have an understanding of: • synthetic strategy used in process chemistry for scaling up of API from a small scale to a larger scale. • The role of a process chemist in developing synthetic routes that is safe, cost-effective, environmentally friendly and efficient.	**SECTION-A** **Process chemistry:** Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large scale process. In-process control and validation of large scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic Impurities **Unit operations:** Extraction, Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction. Filtration, theory of filtration, pressure and vacuum filtration, centrifugal filtration. Distillation, azeotropic and steam distillation. Evaporation, Types of evaporators, factors affecting evaporation. Crystallization, crystallization from aqueous, nonaqueous solutions factors affecting	**SECTION-A** **Process chemistry:** Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large scale process. In-process control and validation of large scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic Impurities **Unit operations:** Extraction, Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction. Filtration, theory of filtration, pressure and vacuum filtration, centrifugal filtration. Distillation, azeotropic and steam distillation. Evaporation, Types of evaporators, factors affecting evaporation. Crystallization, crystallization from aqueous, nonaqueous solutions factors affecting	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs. **SECTION-B** **Nitration:** Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration. **Halogenation:** Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process. **Oxidation:** Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H2O2, sodium hypochlorite, Oxygen gas, ozonolysis. **Reduction:** Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process. **SECTION-C** **Fermentation:** Aerobic and anaerobic fermentation. Production of Antibiotics; Penicillin and Streptomycin. **Vitamins:** B2 and B12 **Statins:** Lovastatin, Simvastatin **Reaction progress kinetic analysis:** Streamlining reaction steps, route selection, Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up. **Industrial Safety:** MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE), Fire hazards, types of fire & fire extinguishers, Occupational Health & Safety Assessment Series 1800, (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management. **Books recommended:** 1. Gadamasetti K, *Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview,* CRC Press.2007. 2. *Pharmaceutical Manufacturing Encyclopedia,* Science direct ,2004. 3. Burger , *Medicinal Chemistry, John wiley & sons.,2003.* 4. McCabe WL,Smith JC,Harriott Peter, *Unit operations of chemical engineering,* McGraw Hill,2004. 5. Brittain HG, *Polymorphism in Pharmaceutical Solids* .Dekker Series,1999. 6. Regina M. Murphy: *Introduction to Chemical Processes: Principles, Analysis, Synthesis,* Mc Grawhill.,2005. 7. Harrington Peter J, *Pharmaceutical Process Chemistry for Synthesis:Rethinking the Routes to Scale-Up*,Wiley Publisher,2011. 8. Groggins PH, *Unit processes in organic synthesis,* Mc	crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs. **SECTION-B** **Nitration:** Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration. **Halogenation:** Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process. **Oxidation:** Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H2O2, sodium hypochlorite, Oxygen gas, ozonolysis. **Reduction:** Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process. **SECTION-C** **Fermentation:** Aerobic and anaerobic fermentation. Production of Antibiotics; Penicillin and Streptomycin. **Vitamins:** B2 and B12 **Statins:** Lovastatin, Simvastatin **Reaction progress kinetic analysis:** Streamlining reaction steps, route selection, Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up. **Industrial Safety:** MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE), Fire hazards, types of fire & fire extinguishers, Occupational Health & Safety Assessment Series 1800, (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management. **Recommended books (Latest edition):** 1. Gadamasetti, K. (2004). *Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview,* CRC Press.2007 *Pharmaceutical Manufacturing Encyclopedia,* Science direct. 2. Burger (2003). *Medicinal Chemistry,* John wiley & sons. 3. McCabe, W.L. Smith, J.C. Harriott, P. (2004). *Unit operations of chemical engineering,* McGraw Hill. 4. Brittain, H.G. (1999). *Polymorphism in Pharmaceutical Solids,* Dekker Series. 5. Regina, M. Murphy, (2005). *Introduction to Chemical Processes: Principles, Analysis, Synthesis,* Mc Grawhil. 6. Harrington, P.J. (2011). *Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up*, Wiley Publisher. 7. Groggins, P.H.(1938). *Unit processes in organic synthesis,* Mc Grawhil. 8. Hanglein, F.A. (2013). *Chemical Technology,* pergamon	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Grawhill.,1938. 9. Hanglein FA, *Chemical Technology, pergamon publishe* .2013. 10. Gopal M, *Dryden's Outlines of Chemical Technology,* WEP East-WestPress,2006. 11. Mattson Clausen, *Principle of Industrial Chemistry,* Wiley Publishing Co.,1978.	publisher. 9. Gopal, M. (2006). *Dryden's Outlines of Chemical Technology,* WEP East-WestPress. 10. Mattson, C. (1978). *Principle of Industrial Chemistry,* Wiley Publishing Co. **Suggested e-material** 1. Geankoplis, Christie John : Transport Processes and Separation Process Principles (Includes Unit Operations): Pearson New International Edition : http://lib.myilibrary.com?id=527416 2. Wankat : Separation Process Engineering : http://lib.myilibrary.com?id=267515 3. Crowl; Louvar : Chemical Process Safety: Fundamentals with Applications: http://lib.myilibrary.com?id=267500 4. Smith, Michael : Organic synthesis: http://www.sciencedirect.com/science/book/9781890661403 5. Savin, Kenneth: Writing reaction mechanisms in organic chemistry: http://www.sciencedirect.com/science/book/9780124114753	
Course code PHAR 520L **Course name** Pharmaceutical Chemistry Lab-II	Upon completion of this course student will have an understanding of: • various organic reactions • spectral analysis • handling of various analytical instruments • calibration of instruments • computational softwares	1. Synthesis of organic compounds by adapting different approaches involving (3 experiments) a) Oxidation b) Reduction/hydrogenation c) Nitration 2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments) 3. Assignments on regulatory requirements in API (2 experiments) 4. Comparison of absorption spectra by UV and Wood ward – Fieser rule 5. Interpretation of organic compounds by FT-IR 6. Interpretation of organic compounds by NMR 7. Interpretation of organic compounds by MS 8. Determination of purity by DSC in pharmaceuticals 9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra 10. To carry out the preparation of following organic compounds 11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl). 12. Preparation of 4-iodotolene from p-toluidine. 13. NaBH4 reduction of vanillin to vanillyl alcohol 14. Preparation of umbelliferone by Pechhman reaction 15. Preparation of triphenyl imidazole 16. To perform the Microwave irradiated reactions of synthetic importance (Any two) 17. Determination of log P, MR, hydrogen bond donors and acceptors	1. Synthesis of organic compounds by adapting different approaches involving (3 experiments) a) Oxidation b) Reduction/hydrogenation c) Nitration 2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments) 3. Assignments on regulatory requirements in API (2 experiments) 4. Comparison of absorption spectra by UV and Wood ward – Fieser rule 5. Interpretation of organic compounds by FT-IR 6. Interpretation of organic compounds by NMR 7. Interpretation of organic compounds by MS 8. Determination of purity by DSC in pharmaceuticals 9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra 10. To carry out the preparation of following organic compounds 11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl). 12. Preparation of 4-iodotolene from p-toluidine. 13. NaBH4 reduction of vanillin to vanillyl alcohol 14. Preparation of umbelliferone by Pechhman reaction 15. Preparation of triphenyl imidazole 16. To perform the Microwave irradiated reactions of synthetic importance (Any two) 17. Determination of log P, MR, hydrogen bond donors and acceptors	No changes

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		of selected drugs using softwares 18. Calculation of ADMET properties of drug molecules and its analysis using Softwares Pharmacophore modeling 19. 2D-QSAR based experiments 20. 3D-QSAR based experiments 21. Docking study based experiment 22. Virtual screening based experiment	of selected drugs using softwares 18. Calculation of ADMET properties of drug molecules and its analysis using Softwares Pharmacophore modeling 19. 2D-QSAR based experiments 20. 3D-QSAR based experiments 21. Docking study based experiment 22. Virtual screening based experiment	

Name of Programme: Master of Pharmacy (Pharmaceutics)

Course details: First Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 514 **Course name** Drug Delivery Systems	Upon completion of this course student will have an understanding of: • The criteria for selection of drugs and polymers for the development of novel dosage forms • Need of different approaches for preparation of novel drug delivery systems. • Formulation and evaluation of novel drug delivery systems.	**SECTION-A** **Sustained Release (SR) and Controlled Release (CR) formulations:** Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, mechanism of drug delivery from SR/CR formulation. **Polymers:** Introduction, definition, classification, properties and application **Dosage Forms for Personalized Medicine:** Introduction, Definition, Pharmacogenetics, categories of patients for personalized medicines, customized drug delivery systems, bioelectronic medicines, 3D printing of pharmaceuticals, telepharmacy. **SECTION-B** **Rate Controlled Drug Delivery Systems:** Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals. **Gastro-Retentive Drug Delivery Systems:** Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations. **SECTION-C** **Occular Drug Delivery Systems:** Barriers of drug permeation, Methods to overcome barriers. **Transdermal Drug Delivery Systems:** Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation. **Protein and Peptide Delivery:** Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules. **Vaccine delivery systems:** Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines. **Books recommended:** 1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and	**SECTION-A** **Sustained Release (SR) and Controlled Release (CR) formulations:** Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, mechanism of drug delivery from SR/CR formulation. **Polymers:** Introduction, definition, classification, properties and application **Dosage Forms for Personalized Medicine:** Introduction, Definition, Pharmacogenetics, categories of patients for personalized medicines, customized drug delivery systems, bioelectronic medicines, 3D printing of pharmaceuticals, telepharmacy. **SECTION-B** **Rate Controlled Drug Delivery Systems:** Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals. **Gastro-Retentive Drug Delivery Systems:** Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations. **SECTION-C** **Occular Drug Delivery Systems:** Barriers of drug permeation, Methods to overcome barriers. **Transdermal Drug Delivery Systems:** Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation. **Protein and Peptide Delivery:** Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules. **Vaccine delivery systems:** Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines. **Recommended books (Latest edition):**	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		expanded, Marcel Dekker, Inc., New York, 1992. 2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992. 3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim 4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001). 5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002 **JOURNALS** 1. Indian Journal of Pharmaceutical Sciences (IPA) 2. Indian drugs (IDMA) 3. Journal of controlled release (Elsevier Sciences) desirable 4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable	1. Chien, Y.W. (1992). *Novel drug delivery systems*. 2nd Ed., New York: Marcel Dekker, Inc. 2. Robinson, J.R. , Lee, V.H.L. (1992). *Controlled drug delivery systems.* New York: Marcel Dekker, Inc. 3. Mathiowitz, E. (1999). *Encyclopedia of controlled delivery*. New York: Wiley Interscience Publication, John Wiley and Sons, Inc. 4. Jain, N.K. (1997). *Controlled and novel drug delivery.* 1st Ed., New Delhi: CBS Publishers & Distributers. 5. Vyas, S.P., Khar, R.K. (2002). *Controlled drug delivery-concepts and advances.* 1st Ed., New Delhi: Vallabh Prakashan. **Suggested e-material:** 1. Indian Journal of Pharmaceutical Sciences (IPA) 2. Indian drugs (IDMA) 3. Journal of controlled release (Elsevier Sciences) 4. Drug Development and Industrial Pharmacy (Marcel & Decker)	
Course code PHAR 516 **Course name** Modern Pharmaceutical Analytical Techniques	Upon completion of this course student will have an understanding of: • Significance of Pharmaceutical Analysis in the profession. • Various tools and techniques available for the analysis of drugs. • Principles of various conventional analytical techniques. • Application of Pharmacopoeial purity and identity tests for samples. • Interpretation of spectra and correlation with sample.	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X ray Crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application of potentiometry. **Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Books recommended:** 1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004. 2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998. 3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers. 4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997. 5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991. 6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997. 7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series	**Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X ray Crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application of potentiometry. **Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Recommended books (Latest edition):** 1. Silverstein, R.M. (2004). *Spectrometric Identification of Organic compounds*. 6th Ed., New York: Wiley Interscience Publication, John Wiley and Sons, Inc. 2. Skoog, D.A., Holler, F.J., Nieman, T.A. (1998). *Principles of Instrumental Analysis*. 5th Ed., Bangalore: Eastern press. 3. Beckett, A.H., Stenlake, J.B. (1987). *Practical Pharmaceutical Chemistry*. 4th Ed., vol 2. New Delhi: CBS Publishers & Distributers. 5. Kemp, W. (1991). *Organic Spectroscopy*, 3rd Ed., London: Red Globe Press. 6. Sethi, P.D. (1987). *Quantitative Analysis of Drugs in Pharmaceutical formulation.* 3rd Ed., New Delhi: CBS Publishers & Distributers. 7. Munson, J.W. (2008). *Pharmaceutical Analysis- Modern methods – Part B*. vol 11. New York: Marcel Dekker, Inc. **Suggested e-material:** 1. http://www.sciencedirect.com/science/book/9780123869845 Infrared and Raman spectroscopy Larkin, Peter 2. http://www.sciencedirect.com/science/book/9780124115897 Solving problems with NMR spectroscopy Atta-ur-Rahman, Muhammad Iqbal **3.** http://lib.myilibrary.com/?id=543351 Quantum Chemistry and Spectroscopy: Pearson New International Edition Engel, Thomas	
Course code PHAR 517 **Course name** Modern	Upon completion of this course student will have an understanding of: • The concept of pre-	**SECTION-A** **Preformation Concepts –** Drug Excipient interactions - different methods, kinetics of stability, Stability testing. Theories of dispersion and	**SECTION-A** **Preformation Concepts –** Drug Excipient interactions - different methods, kinetics of stability, Stability testing. Dissolution parameter: Similarity	'Similarity factor and kinetic model' shifted to Section A Topic optimization

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Pharmaceutics	formulation and its effect on formulation, efficacy and stability of pharmaceutical products at industry. • Formulation, evaluation and stability aspect of emulsion, suspension, SMEDDS, and parenteral at large scale production. • Aspects related to compression and compaction of tablets. • Better way of application of pharmaceutical and statistical tools.	pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation. **Optimization techniques in Pharmaceutical Formulation:** Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation **SECTION-B** **Validation:** Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities. **cGMP & Industrial Management:** Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, , materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management. **SECTION-C** **Compression and compaction:** Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. ~~Solubility.~~ ~~**Study of consolidation parameters:** Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters,~~ Heckel plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity, Concept of significance, Standard deviation , Chi square test, students T-test , ANOVA test. **Books recommended:** 1. Theory and Practice of Industrial Pharmacy By Lachmann and Libermann 2. Pharmaceutical dosage forms: Tablets Vol. 1-3 by Leon Lachmann. 3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann. 4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann. 5. Modern Pharmaceutics; By Gillbert and S. Banker. 6. Remington's Pharmaceutical Sciences. 7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett. 8. Physical Pharmacy; By Alfred martin 9. Bentley's Textbook of Pharmaceutics – by Rawlins. 10. Good manufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willig. 11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India. 12. Drug formulation manual; By D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi. 13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra. 14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A.	factors – f2 and f1, Higuchi and Peppas plot. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation. **SECTION-B** **Compression and compaction:** Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles, Heckel plots. **Validation:** Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities. **cGMP & Industrial Management:** Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance **SECTION-C** Production management: Production organization, materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management. **Optimization techniques in Pharmaceutical Formulation:** Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation Linearity, Concept of significance, Standard deviation, Chi square test, students T-test , ANOVA test. **Books recommended:** 1. Lachmann, L., Libermann, H.A., Kanig, J.L. (2013). *Theory and practice of industrial pharmacy*. 4th Ed., Bombay: Varghese Publishing House. 2. Lachmann, L., Libermann, H.A., Joseph, B. (1989). *Pharmaceutical dosage forms: Tablets*. 2nd Ed., vol. I-III. New York: Marcel Dekker. 3. Lachmann, L., Libermann, H.A., Martin, M.R., Banker, G.S. (1996). *Pharmaceutical dosage forms: disperse systems.* vol. I-II, CRC press. 4. Avis, K.E., Lachmann, L., Libermann, H.A. (1984). *Pharmaceutical dosage forms: parentral medications.* vol. 1. New York: Marcel Dekker. 5. Gillbert, S.B., Christopher, T.R. (1996). *Modern Pharmaceutics*. 4th Ed., CRC press. 6. Remington, J.P. (2005). *Remington: the science and practice of pharmacy.* 21st Ed., Lippincott williams and wilkins. 7. Bean, H.S., Beckett, A.H., Carless, J.E. (1964). *Advances in pharmaceutical sciences*. vol. I-V, London, Berkeley: Academic press.	techniques shifted to Section C just to match the nature of content. "Suggested e-material:" has been added. Topic **Heckel plots** shifted to topic Compression and consolidation as its part of this chapter. Topic 'solubility' is removed due to irrelevancy with the chapter. Topic 'Production Management' shifted to Section C to adjust work load in sections. Topic '**Diffusion parameters and Pharmacokinetic parameters'** removed as it is not related to consolidation and this chapter (while **Study of consolidation parameters**) already covered in chapter '**Compression and compaction'.**

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Nash. 15. Pharmaceutical Preformulations; By J.J. Wells. 16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams. 17. Encyclopaedia of Pharmaceutical technology, Vol I – III.	8. Sinko, P.J. (2011). *Martin's physical pharmacy and pharmaceutical sciences.* 6th Ed., Lippincott williams and wilkins. 9. Rawlins, E.A. (2012). *Bentley's textbook of pharmaceutics.* 8th Ed., Elsevier. 10. Willing, S.H. (2001). *Good manufacturing practices for pharmaceuticals: a plan for total quality control*. 5th Ed., New York: Marcel Dekker, Inc. 11. *Quality Assurance Guide*, By Organization of Pharmaceutical producers of India. 12. Kohli, D.P.S., Shah, D.H. (2008). *Drug formulation manual.* New Delhi: Eastern publishers. 13. Sharma, P.P. (2015). *How to practice GMPs.* 7 th Ed., Agra: Vandhana publications. 14. Nash, R.A., Watcher, A.H. (2003). *Pharmaceutical process validation.* 3rd Ed., vol. 129. New York: Marcel Dekker, Inc. 15. Wells, J.I. (1990). *Pharmaceutical preformulation: The physiochemical properties of drug substances.* vol. 79. Chichester: Ellis Horwood. 16. Evans, J.R., Anderson, D.R., Sweeny, D.J., Williams, T.A. (1990). *Applied production and operations management*. 3rd Ed., United States: West. **17.** Swarbrick, J. (2006). *Encyclopaedia of pharmaceutical technology*. 3rd Ed., CRC press. **Suggested e-material:** 1. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 2. https://www.pdfdrive.com/pharmaceutical-books.html 3. http://www.statsoft.com/Textbook 4. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 5. https://accesspharmacy.mhmedical.com/books.aspx?view=library 6. https://www.managementstudyguide.com/elements-of-total-quality-management.htm 7. https://doaj.org/	
Course code PHAR 529 **Course name** Regulatory Affairs	Upon completion of this course student will have an understanding of: • concepts of innovator and generic drugs, drug development process • The Regulatory guidance's for filing and approval process • preparation of dossiers and their submission to regulatory agencies in different countries • post approval regulatory requirements for actives and drug product • clinical trials requirements for approvals for conducting clinical trials	**SECTION-A** **Documentation in Pharmaceutical industry:** Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in –vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. **SECTION-B** **Regulatory requirement for product approval:** API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs CMC, post approval regulatory affairs. Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries. **SECTION-C** **Non clinical drug development:** Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	**SECTION-A** **Documentation in Pharmaceutical industry:** Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in –vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. **SECTION-B** **Regulatory requirement for product approval:** API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs CMC, post approval regulatory affairs. Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries. **SECTION-C** **Non clinical drug development:** Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Clinical trials: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials. **Books recommended:** 1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143 2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers. 3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences,Vol.190. 4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc. 5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus. 6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams 7. www.ich.org/ 8. www.fda.gov/ 9. europa.eu/index_en.htm 10. https://www.tga.gov.au/tga-basics	**Clinical trials:** Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials. **Books recommended:** 1. Shargel, L, Kaufer, I. (2005). *Generic Drug Product Development, Solid Oral Dosage forms*. Vol.143. New York: Marcel Dekker Inc. 2. Berry, I.R., Martin, R.P. (2008). *The Pharmaceutical Regulatory Process*. 2nd Ed., vol. 185. Drugs and the Pharmaceutical Sciences. New York: CRC press. 3. Guarino, R.A. (2004). *New Drug Approval Process: Accelerating Global Registrations*. 5th Ed., vol. 190, New York: Marcel Dekker Inc. 4. Weinberg, S. (2009). *Guidebook for drug regulatory submissions*. 1st Ed., John Wiley & Sons Inc. 5. Pisano, D.J., Mantus, D. (2005). *FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics*. 2nd Ed., New York: CRC press. 6. Rozovsky, F.A., Adams, R.K. (2003). *Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance.* 1st Ed., Washington: John Wiley and Sons. **Suggested e-material:** 1. www.ich.org/ 2. www.fda.gov/ 3. europa.eu/index_en.htm 4. https://www.tga.gov.au/tga-basics	
Course code PHAR 522L **Course name** Pharmaceutics Lab-I	Upon completion of this course the student will develop skills of: • Developing new analytical method • Designing pre-formulation study for new drug • Formulation and characterization of dosage forms	1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry 7. To perform In-vitro dissolution profile of CR/ SR marketed formulation 8. Formulation and evaluation of sustained release matrix tablets 9. Formulation and evaluation osmotically controlled DDS 10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS 11. Formulation and evaluation of Muco adhesive tablets. 12. Formulation and evaluation of trans dermal patches. 13. To carry out preformulation studies of tablets. 14. To study the effect of compressional force on tablets disintegration time.	1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry 7. To perform In-vitro dissolution profile of CR/ SR marketed formulation 8. Formulation and evaluation of sustained release matrix tablets 9. Formulation and evaluation osmotically controlled DDS 10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS 11. Formulation and evaluation of Muco adhesive tablets. 12. Formulation and evaluation of trans dermal patches. 13. To carry out preformulation studies of tablets. 14. To study the effect of compressional force on tablets disintegration time.	No changes

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		15. To study Micromeritic properties of powders and granulation. 16. To study the effect of particle size on dissolution of a tablet. 17. To study the effect of binders on dissolution of a tablet. 18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.	15. To study Micromeritic properties of powders and granulation. 16. To study the effect of particle size on dissolution of a tablet. 17. To study the effect of binders on dissolution of a tablet. 18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.	
Course code **Course name** Pharmacological and Toxicological Screening Methods (Disciplene elective)	Upon completion of this course student will have an understanding of: • Preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. • Maintenance of laboratory animals as per the guidelines, basic knowledge of various *in-vitro* and *in-vivo* preclinical evaluation processes • regulations and ethical requirement for the usage of experimental animals. • various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals • the various screening methods involved in the drug discovery process • correlate the preclinical data to humans	**SECTION-A** **Laboratory Animals, Common laboratory animals:** Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals. Good laboratory practice. Bioassay-Principle, scope and limitations and methods **SECTION-B** Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive). Regulatory guidelines for conducting toxicity studies OECD, ICH,EPA and Schedule Y. OECD principles of Good laboratory practice (GLP).History, concept and its importance in drug development **Acute, sub-acute and chronic-** oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization- importance and methods in regulatory toxicology studies **SECTION-C** **IND enabling studies (IND studies)-** Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. Safety pharmacology studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies. **Toxicokinetics-** Toxicokinetic evaluation in preclinical studies, saturation kinetics, Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing. **Books recommended:** 1. Handbook of Experimental Pharmacology, SK.Kulkarni 2. Fundamentals of experimental Pharmacology by M.N.Ghosh 3. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/ publications/documents/glphandbook. pdf). 4. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 5. 2005, ministry of health and family welfare (department of health) New Delhi 6. Drugs from discovery to approval by Rick NG. 7. Animal Models in Toxicology, 3rd Edition, Lower and Bryan 8. OECD test guidelines. 9. Principles of toxicology by Karen E. Stine, Thomas M. Brown. 10. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals 11. (http://www.fda.gov/downloads/drugs/guidancecompliance	**SECTION-A** **Laboratory Animals:** Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals Good laboratory practice. Bioassay: Principle, scope and limitations and methods. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. **SECTION-B** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, anti-inflammatory and antipyretic agents. Gastrointestinal drugs: anti-ulcer, anti-emetic, antidiarrheal and laxatives. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. **SECTION-C** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Immunomodulators, Immunosuppressants and immunostimulants **General principles of immunoassay**: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin. Anti-cancer agents. Hepatoprotective screening methods. Limitations of animal experimentation and alternate animalexperiments. Extrapolation of in vitro data to preclinical and preclinical to humans **Recommended books (Latest edition):** 1. Kulkarni, S.K. (2013). *Handbook of experimental pharmacology*. New Delhi: Vallabh publications. 2. Ghosh, M.N. (2008). Fundamentals of experimental pharmacology. 5th Ed., Munster: Hilton & Co.	Modified as per PCI prescribed syllabus "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		regulatoryinformation /guidances/ucm073246.pdf)	3. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi. 4. Rick, N.G. (2015). *Drugs: from discovery to approval*. 3rd Ed.,New York: Wiley Blackwell. 5. Gad, S.C. (2015). *Animal Models in Toxicology*. 3rd Ed.,New York: CRC press. 6. Stine, K.E., Brown, T.M. (2015). *Principles of toxicology*. 3rd Ed.,New York: CRC press. 7. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals. **Suggested e-material:** 1. (http://www.fda.gov/downloads/drugs/guidancecompliance regulatoryinformation /guidances/ucm073246.pdf) 2. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/ publications/documents/glphandbook. pdf).	
Course code **Course name** Herbal Cosmetics (Discipline Elective)	After completion of the course, student shall be able to • Understand the basic principles of various herbal/natural cosmetic preparations • Current Good Manufacturing Practices of herbal/natural cosmetics as per the regulatory authorities		**SECTION-A** **Introduction:** Herbal/natural cosmetics, Classification & Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics, commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs. Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation. **SECTION-B** **Herbal Cosmetics:** Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail. Preparation and standardisation of Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails. **SECTION-C** **Cosmeceuticals of herbal and natural origin:** Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams, deodorants. **Analysis of Cosmetics, Toxicity screening and test methods:** Quality control and toxicity studies as per Drug and Cosmetics Act. **Recommended books:** 1. Panda, H. (2000). Herbal Cosmetics: Hand book, New Delhi: Asia Pacific Business Press Inc. 2. Thomson, E.G. (2015). Modern Cosmetics, vol 1, Mumbai: Universal Publishing Corporation. 3. Sharma, P.P. (2014). Cosmetics - Formulation, Manufacturing & Quality	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Control, Ed.5th, New Delhi: Vandana Publications. 4. Supriya, B. (2000). Handbook of Aromatic Plants, Jaipur: Pointer Publishers. 5. Skaria, B.P. (2007). Aromatic Plants: Horticulture Science Series, New Delhi: New India Publishing Agency. 6. Keville, K., Green, M., (2008). Aromatheraphy: A Complete Guide to the Healing Art, New Delhi: Sri Satguru Publications. 7. Balsam, M.S., Edward S. (1974). Cosmetics Science and Technology, vol 3, New York: Wiley Interscience. **Suggested e-material:** https://www.pdfdrive.com/cosmetics-books.html	
Course code **Course name** Advanced Pharmaceutical Biotechnology (Discipline Elective)	Upon completion of this course student will have an understanding of: • Enzyme technology, genetic Engineering, Peptides and its applications. • Transgenic animal, human genome and signal transduction. • 3 Microbial transformation, biodegradation and biosensors.		**SECTION-A** **Enzyme Technology:** Classification, general properties of enzymes, dynamics of enzymatic activity, sources of enzymes, extraction and purification, pharmaceutical, therapeutic and clinical application. Production of amyloglucosidase, glucose isomerase,amylase and trypsin. **Genetic Engineering:** Techniques of gene manipulation, cloning strategies,procedures, cloning vectors expression vectors, recombinant selection and screening, expression in E.coli and yeast. Site directed mutagenesis, polymerase chain reaction, and analysis of DNAsequences. Gene library and cDNA Applications of the above technique in the production of, • Regulatory proteins - Interferon, Interleukins • Blood products - Erythropoietin • Vaccines - Hepatitis-B • Hormones – Insulin **Therapeutic peptides:** Study on controlled and site specified delivery of therapeutic peptides and proteins through various routes of administration. **SECTION-B** **Transgenic animals:** Production of useful proteins in transgenic animals and gene therapy. **Human Genome:** The human genome project-a brief study, Human chromosome – Structure and classification, chromosomal abnormalities – Syndromes **Signal transduction:** Introduction, cell signaling pathways, Ion channels, Sensors and effectors, ON and OFF mechanisms, Spatial and temporal aspects of signaling, cellular process, development, cell cycle and proliferation, neuronal signaling, cell stress, inflammatory responses and cell death, signaling defects and diseases. **SECTION-C** **Oncogenes:** Introduction, definition, various oncogenes and their proteins. **Microbial Biotransformation:** Biotransformation for the synthesis of chiral drugs and steroids.	Introduced as Discipline Elective using PCI prescribed syllabus. “Suggested e-material:” has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Microbial Biodegradation: Biodegradation of xenobiotics, chemical and industrial wastes, Production of single-cell protein, Applications of microbes in environmental monitoring. **Biosensors:** Definition, characteristics of ideal biosensors, types of biosensors, biological recognition elements, transducers, application of biosensors. **Recommended books:** 1. Trevan, M.D., Boffey, S., Goulding, K.H., Stanbury, P.F. (1987). Biotechnology-The biological principles. Ed. 1, Stony Stratford: Open University Press. 2. Bickerstaff, G.F. (1997). Immobilization of cells and enzymes. Totowa: Humana Press Inc. 3. Old, R.W., Primrose, S.B. (1981). Principles of Gene Manipulating. University of California Press 4. Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D. Darnell, J. (1999). Molecular Cell Biology. 4th ed. W. H. Freeman Publishers. 5. Primrose, S.B. (1991). Modern Biotechnology. 2nd Ed. London: Blackwell Scientific Publications Ltd. 6. Murray E.T. (1991). Gene transfer and expression protocols-methods in Molecular Biology, vol. VII, Totowa: Humana Press Inc. 7. Asubel, F.M. (2003). Current protocols in Molecular Biology, Vo1.I & II, John Wiley Publishers. **Suggested e-material** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code **Course name** Intellectual Property Rights (Discipline Elective)	Upon completion of this course student will have an understanding of: • patent and copyright for their innovative works. They also get the knowledge of plagiarism in their innovations which can be questioned legally. • selected IP issues that might arise in practice. • federal and state IP protection: • tools and activities of IP practitioners such as the Copyright, Patent, and Trademark websites, searching, reading patents, and more.		**SECTION-A** **Intellectual property rights (IPR):** Definition, scope, objectives, Concepts and fundamentals: intellectual property (IP), intellectual property protection (IPP) and intellectual property rights (IPR); economic importance, mechanism for protection of intellectual property. **Patents:** (Criteria for patentability, Indian patent act. 1970, filing of a patent application, precautions before patenting-disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application- provisional, non-provisional, PCT and convention patent applications, international patenting requirement procedures and costs. **Patent infringement:** Meaning, scope, litigation, drug related patents infringements, case studies and examples, patenting by research students.), **SECTION-B** **Copyright**, **Trademarks:** (Introduction, meaning of trademark, criteria for eligibility, filling application for trademark registration).	Introduced as Discipline Elective using PCI prescribed syllabus. “Suggested e-material:” has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Trade secrets: Scope modalities and protection case studies. Role of IP in pharmaceutical industry. **Trade related aspects of intellectual property rights:** Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). **WTO**-objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization **SECTION-C** **Technology development/transfer commercialization related aspects:** Meaning, drug related technology development, bioequivalence (BE), scale-up, semi-commercialization and commercialization– practical aspects and problems, significance of transfer of technology (TOT), bottlenecks, managing technology transfer, guidelines for research students, scientists and related personnel, TOT agencies in India APCTD, NRDC, TIFAC, IBCIL, TBSE/SIDBI. **TOT related documentation:** Confidentiality agreements, licensing, MOUs, legal issues, compulsory licensing and issuing of access to medicines, DOHA declaration. **Related quality systems:** Objectives and brief review of US-FDA, UK-MCA, and TGA guidelines. **Standard institutes and certification agencies like**: ISI, BSS, ASTM. **Recommended books (Latest edition):** 1. Treece, D.J. (2003). *Managing Intellectual Capital: Organizational, Strategic and Policy Dimension*. England: Oxford University Press. 2. Wadedhra, B.L. (2004). *Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications*. New Delhi: Universal Law Publishing. 3. Bansal, P. (2008) *IPR Handbook for Pharma Students and Researchers*. Hyderabad: Pharma Book Syndicate. 4. Trivedi, P.R. (2008). *Encylcopedia of Intellectual Property Rights*. New Delhi: Jnanada Prakashan. 5. Willig, S.H. (1982). *Good Manufacturing Practices for Pharmaceuticals*. vol 78, New York: Marcel Dekker,. 6. Das, P., Das, G. (2008). *Protection of Industrial Property Rights Kolkata*: Kamal Law House. 7. Katju, S.N. (2002). *Law and Drugs*, Delhi Law House. **Suggested e-material:** 1. www.fda.gov 2. https://www.ich.org/products/guidelines.html 3. Copyright Protection in India [website: http:copyright.gov.in]. 4. Information on orange book [website: www.fda.gov/cder/ob/default.htm]. 5. World Trade Organization [website: www.wto.org].	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code **Course name** Regulatory aspects of food and nutraceuticals (Discipline Elective)	Upon completion of the course, the student shall be able to • Know the regulatory Requirements for nutraceuticals • Understand the regulation for registration and labeling of nutraceuticals • food supplements in India, USA and Europe.		**SECTION-A** **Nutraceuticals:** Introduction, History of Food and Nutraceutical, Regulations, Meaning of Nutraceuticals, Dietary Supplements, Functional Foods, Medical Foods, Scope and Opportunities in Nutraceutical Market. **Global Aspects:** WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food And Dietary Supplements. Good Manufacturing Practices for Nutraceuticals **SECTION-B** **India:** Food Safety and Standards Act, Food Safety and Standards Authority of India: Organization and Functions, Regulations for import, manufacture and sale of nutraceutical products in India, Recommended Dietary Allowances (RDA) in India. **USA**: US FDA Food Safety Modernization Act, Dietary Supplement Health and Education Act. U.S. regulations for manufacture and sale of nutraceuticals and dietary supplements, Labelling Requirements and Label Claims for Dietary Supplements, Recommended Dietary Allowances (RDA) in the U.S. **SECTION-C** **European Union:** European Food Safety Authority (EFSA): Organization and Functions. EU Directives and regulations for manufacture and sale of nutraceuticals and dietary supplements. Nutrition labelling. European Regulation on Novel Foods and Novel Food Ingredients. Recommended Dietary Allowances (RDA) in Europe. **Books recommended:** 1. Hasler, Clare M. (2005). Regulation of Functional Foods and Nutraceuticals: A Global Perspective. Vol.1, Delhi: Blackwell Publishing. 2. Bagchi, D. (2014). Nutraceutical and Functional Food Regulations in the United States and Around the World. Elsevier. 3. Pathak, Y. (2009). *Handbook of Nutraceuticals*. Vol 1. CRC Press. 4. Fortin, N.D. (2007). *Food Regulation: Law, Science, Policy and Practice.* Vol 1. Wiley Publishers. **Suggested e-material** 1. http://www.who.int/publications/guidelines/nutrition/en/ 2. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/536324/IPOL_STU(2015)536324_EN.pdf	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added
Course code **Course name** Regulatory Aspects of Medical Devices (Discipline Elective)	Upon completion of the course, the student shall be able to know • basics of medical devices and IVDs, process of development, ethical and quality considerations • harmonization initiatives for approval and marketing of medical devices and IVDs • regulatory approval process for		**SECTION A** **Medical Devices:** Introduction, Definition, Risk based classification and Essential Principles of Medical Devices and IVDs. Differentiating medical devices IVDs and Combination Products from that of pharmaceuticals. History of Medical Device Regulation, Product Lifecycle of Medical Devices and Classification of Medical Devices. **IMDRF/GHTF:** Introduction, Organizational Structure, Purpose and Functions, Regulatory Guidelines, Working Groups, Summary Technical	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	medical devices and IVDs in India, US, Canada, EU, Japan and ASEAN • clinical evaluation and investigation of medical devices and IVDs		Document (STED), Global Medical Device Nomenclature (GMDN). **SECTION B** **Ethics:** Clinical Investigation of Medical Devices, Clinical Investigation Plan for Medical Devices, Good Clinical Practice for Clinical Investigation of medical devices (ISO 14155:2011) **Quality:** Quality System Regulations of Medical Devices: ISO 13485, Quality Risk Management of Medical Devices: ISO 14971, Validation and Verification of Medical device, Adverse Event Reporting of Medical device **USA:** Introduction, Classification, Regulatory approval process for Medical Devices (510k) Premarket Notification, Pre-Market Approval (PMA), Investigational Device Exemption (IDE) and In vitro Diagnostics, Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI). Basics of In vitro diagnostics, classification and approval process. **SECTION C** **European Union**: Introduction, Classification, Regulatory approval process for Medical Devices (Medical Device Directive, Active Implantable Medical Device Directive) and In vitro Diagnostics (In Vitro Diagnostics Directive), CE certification process. Basics of In vitro diagnostics, classification and approval process. **ASEAN, China & Japan**: Medical Devices and IVDs, Regulatory registration procedures, Quality System requirements and clinical evaluation and investigation. IMDRF study groups and guidance documents. **Books recommended:** 1. Pisano, D. J., Mantus, D. (2008). *FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices and Biologics*. 2nd Ed., CRC Press. 2. Kahan, J. S. (2000). *Medical Device Development: A Regulatory Overview*. PAREXEL International Corporation. 3. Tobin, J. J., Walsh, G. (2008). *Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics Medical, Devices.* Wiley-Blackwell 4. Medina, C. (2003). *Compliance Handbook for Pharmaceuticals, Medical Devices and Biologics*. CRC Press. **Suggested e-material** 1. Country Specific Guidelines from official websites. 2. Code of Federal regulations (Annual Edition) from official websites, US government. 3. www.fda.gov	

Name of Programme: Master of Pharmacy (Pharmaceutics)

Course details: Second Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 502 **Course name** Advanced Biopharmaceutics and Pharmacokinetics	Upon completion of this course student will have an understanding of: • The basic concepts in biopharmaceutics and pharmacokinetics. • The critical evaluation of biopharmaceutical studies involving drug product performance. • compartment modelling and nonlinear • Bioavailability – bioequivalence (BA-BE) study. • PK-PD.	**SECTION-A** **Drug Absorption from the Gastrointestinal Tract:** Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods, Formulation and processing factors. Physiological factors related to drug absorption. **SECTION-B** **Biopharmaceutic considerations in drug product design and in vitro drug product performance:** Introduction, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. In vitro–in vivo correlation, dissolution profile comparisons, drug product stability, considerations in the design of a drug product. **Pharmacokinetics:** Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model: two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of kmax and vmax. **Drug interactions:** introduction, the effect of protein binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters. **SECTION–C** **Bioavailability and Bioequivalence:** Drug product performance, purpose of bioavailability studies, relative and absolute availability. Methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, ~~study submission and drug review process.~~ Biopharmaceutics classification systems. In-vitro, in-situ and In-vivo permeability methods. ~~Generic biologics (biosimilar drug products),~~ clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies. ~~**Modified-Release Drug Products, Targeted Drug Delivery Systems.**~~ **Introduction to Pharmacokinetics and pharmacodynamic (PK-PD).** **Pharmacokinetics and pharmacodynamics of biotechnology drugs**: Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies. **Books recommended:** 1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi,	**SECTION-A** **Drug Absorption from the Gastrointestinal Tract:** Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods, Formulation and processing factors. Physiological factors related to drug absorption. **SECTION-B** **Biopharmaceutic considerations in drug product design and in vitro drug product performance:** Introduction, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. In vitro–in vivo correlation, dissolution profile comparisons, drug product stability, considerations in the design of a drug product. **Pharmacokinetics:** Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model: two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of kmax and vmax. **Drug interactions:** introduction, the effect of protein binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters. **SECTION–C** **Bioavailability and Bioequivalence:** Drug product performance, purpose of bioavailability studies, relative and absolute availability. Methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, Biopharmaceutics classification systems. In-vitro, in-situ and In-vivo permeability methods. Clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies. **Introduction to Pharmacokinetics and pharmacodynamic (PK-PD).** **Pharmacokinetics and pharmacodynamics of biotechnology drugs**: Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.**Recommended Books (Latest edition):** 1. Gibaldi, M. (1991). *Biopharmaceutics and Clinical Pharmacokinetics*. 4th Ed. Philadelphia: Lea and Febiger. 2. Treatise, A., Brahmankar, D.M., Jaiswal, S.B. (2015). *Biopharmaceutics and Pharmacokinetics.* Delhi:	“Suggested e-material:” has been added. **Modified-Release Drug Products, Targeted Drug Delivery Systems’** chapter is removed as it is covered in section A of ‘**Drug Delivery System’ (M Pharm I sem.)** and Section A of ‘**Molecular Pharmaceutics’ (M Pharm II sem)** in detailed. **Topic** ‘Generic biologics (biosimilar drug products)’ and ‘study submission and review process’ is removed due to duplicacy of content as it is covered in section B of paper **‘Regulatory Affairs’. (M Pharm I sem.)**

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		4th edition, Philadelphia, Lea and Febiger, 1991 2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., Vallabh Prakashan, Pitampura, Delhi 3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2ndedition, Connecticut Appleton Century Crofts, 1985 4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath, Prism Book 5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc., New York, 1982 6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, Lea and Febiger, Philadelphia, 1970 7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by Malcolm Rowland and Thom N. Tozer, Lea and Febiger, Philadelphia, 1995 8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack Publishing Company, Pennsylvania 1989 9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, revised and expande by Robert. E. Notari, Marcel Dekker Inc, New York and Basel, 1987. 10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M. Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971. 11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996. 12. Basic Pharmacokinetics,1 st edition, Sunil S Jambhekar and Philip J Breen, pharmaceutical press, RPS Publishing,2009. 13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc,2003.	VallabhPrakashanPitampura. 3. Shargel, L., Yu, A., Pong, S.W. (2012). *Applied Biopharmaceutics and Pharmacokinetics*. 6th Ed. New York: Mcgraw hill education / medical. 4. Rani, S., Hiremath R. (2012). *Textbook of Biopharmaceutics and Pharmacokinetics*. 2nd Ed. Delhi: Prism publications. 5. Gibaldi, M., Perrier, D. (1982). *Pharmacokinetics*. 2nd Ed. Revised and expanded. New York: CRC press. 6. Swarbrick, J. (1970). *Current Concepts in Pharmaceutical Sciences: Biopharmaceutics*. Philadelphia: Lea and Febiger. 7. Rowland, M. Tozer, T.N.(1995). *Clinical Pharmacokinetics, Concepts and Application,* 3rd edition, Philadelphia: Lippincott Williams and Wilkins. 8. Mack, H.M. (1989). *Dissolution, Bioavailability and Bioequivalence,* Pennsylvania: Mack Publishing Company. 9. Notari, R.E. (1987). *Biopharmaceutics and Clinical Pharmacokinetics, An Introduction*, 4th edition, revised and expanded, New York: Marcel Dekker. 10. Wagner, J.G. Pemarowski, M.(1971). *Biopharmaceutics and Relevant Pharmacokinetics,* 1st edition, Illinois: Drug Intelligence Publications. 11. Swarbrick, J. Boylan, J.G. (1996). *Encyclopedia of Pharmaceutical Technology*, New York: Marcel Dekker. 12. Jambhekar, S.S. Breen, P.J. (2009). *Basic Pharmacokinetics,* 1st edition: Pharmaceutical press, RPS Publishing. 13. Avdeef, A. (2003).*Absorption and Drug Development- Solubility, Permeability, and Charge State*, New york: John Wiley & Sons Inc. **Suggested e-material:** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code PHAR 512 **Course name** Computer Aided Drug Development	Upon completion of this course student will have an understanding of: • Computational modeling of drug for its pharmacokinetic evaluation. • Usage of software in designing and optimizing pharmaceutical formulations. • Application of artificial intelligence and robotics in pharmaceutical automation. • implementation of computational fluid dynamics (cfd) to overcome challenges in pharmaceutical product development.	**SECTION-A** **Computers in Pharmaceutical Research and Development:** A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling **Quality-by-Design In Pharmaceutical Development:** Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD - examples of application. **SECTION–B** **Computational Modeling Of Drug Disposition:** Introduction ,Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution ,Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter. **Computer-aided formulation development:** Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis **Computer-aided biopharmaceutical characterization:** Gastrointestinal	**SECTION-A** **Computers in Pharmaceutical Research and Development:** A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling **Quality-by-Design In Pharmaceutical Development:** Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD - examples of application. **SECTION–B** **Computational Modeling Of Drug Disposition:** Introduction ,Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution ,Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter. **Computer-aided formulation development:** Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis **Computer-aided biopharmaceutical characterization:** Gastrointestinal	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro in vivo correlation, Biowaiver considerations **SECTION–C** **Computer Simulations in Pharmacokinetics and Pharmacodynamics:** Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. **Computers in Clinical Development:** Clinical Data Collection and Management, Regulation of Computer Systems **Artificial Intelligence (AI), Robotics and Computational fluid dynamics:** General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions. **Books recommended:** 1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons. 2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, Jelena Djuris, Woodhead Publishing 3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.	absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro in vivo correlation, Biowaiver considerations **SECTION–C** **Computer Simulations in Pharmacokinetics and Pharmacodynamics:** Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. **Computers in Clinical Development:** Clinical Data Collection and Management, Regulation of Computer Systems **Artificial Intelligence (AI), Robotics and Computational fluid dynamics:** General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions. **Recommended books (Latest edition):** 1. Ekins, S. (2006). *Computer Applications in Pharmaceutical Research and Development,* John Wiley & Sons. 2. Djuris, J. (2013). *Computer-Aided Applications in Pharmaceutical Technology*, 1st Ed. Cambridge: Woodhead Publishing. 3. Swarbrick, J., Boylan, J.G. (1996). *Encyclopedia of Pharmaceutical Technology*. vol 13. New York: Marcel Dekker Inc. 4. Bolton, S., Bon, C. (2010). *Pharmaceutical Statistics*. 5th Ed. vol 203. New York: Informa **Suggested e-material:** 1. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.710.2898&rep=rep1&type=pdf 2. http://file.zums.ac.ir/ebook/235-Drug%20Design%20and%20Discovery%20-%20Methods%20and%20Protocols%20(Methods%20in%20Molecular%20Biology)-Seetharama%20D.pdf	
Course code PHAR 513 **Course name** Cosmetics and Cosmeceuticals	Upon completion of this course student will have an understanding of: • Various key ingredients and basic science to develop cosmetics and Cosmeceuticals • Scientific knowledge to develop cosmetics and cosmeceuticals with desired safety, stability and efficacy with compliance to Indian Regulatory Authority.	**SECTION–A** **Cosmetics – Regulatory:** Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics, Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. **Cosmetics - Biological aspects :** Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. **SECTION–B** **Formulation Building blocks:** Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste.	**SECTION–A** **Cosmetics – Regulatory:** Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics, Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. **Cosmetics - Biological aspects :** Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. **SECTION–B** **Formulation Building blocks:** Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste.	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Soaps and syndetbars. **Perfumes:** Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane. **SECTION–C** **Design of cosmeceutical products:** Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor, dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations. **Herbal Cosmetics:** Herbal ingredients used in Hair care, skincare and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics. **Books recommended:** 1. Harry's Cosmeticology. 8th edition. 2. Poucher'sperfumecosmeticsandSoaps,10th edition. 3. Cosmetics - Formulation, Manufacture and quality control, PP.Sharma,4th edition 4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3 rd edition 5. Cosmetic and Toiletries recent suppliers catalogue. 6. CTFA directory.	Soaps and syndetbars. **Perfumes:** Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane. **SECTION–C** **Design of cosmeceutical products:** Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor, dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations. **Herbal Cosmetics:** Herbal ingredients used in Hair care, skincare and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics. **Recommended books (Latest edition):** 1. Harry, R.G., Reiger, M.M. (2000). *Harry's Cosmeticology*. 8th Ed. New York: Chemical publishing company. 2. Butler, H. (2000). *Poucher's perfume cosmetics and Soaps*, 10th Ed. London: Kluwar academic publishers. 3. Sharma, P.P. (2008). *Cosmetics - Formulation, Manufacture and quality control.* 4th Ed. New Delhi: Vardhan publishing pvt ltd. 4. Barel, A.O., Paye M, Maibach H.I. (2001). *Handbook of cosmetic science and Technology.* 3rd Ed. NewYork: Marcel Decker Inc. 5. Cosmetic and Toiletries recent suppliers catalogue. **6.** CTFA directory. **Suggested e-material:** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code PHAR 518 **Course name** Molecular Pharmaceutics	Upon completion of this course student will have an understanding of: • the criteria for selection of drugs and polymers for the development of Targeted drug delivery. • the various approaches for development of novel drug delivery systems. • the formulation and evaluation of novel drug delivery systems.	**SECTION-A** **Targeted Drug Delivery Systems:** Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery. **Targeting Methods:** Introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation. **SECTION-B** **Micro Capsules / Micro Spheres:** Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes. **Pulmonary Drug Delivery Systems :** Aerosols, propellents, ContainersTypes, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation. **SECTION-C** **Nucleic acid based therapeutic delivery system:** Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. **Biodistribution and Pharmacokinetics:** Knowledge of therapeutic antisense molecules and aptamers as drugs of future.	**SECTION-A** **Targeted Drug Delivery Systems:** Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery. **Targeting Methods:** Introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation. **SECTION-B** **Micro Capsules / Micro Spheres:** Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes. **Pulmonary Drug Delivery Systems:** Aerosols, propellents, ContainersTypes, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation. **SECTION-C** **Nucleic acid based therapeutic delivery system:** Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. **Biodistribution and Pharmacokinetics:** Knowledge of therapeutic antisense molecules and aptamers as drugs of future.	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Books recommended: 1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992. 2. S.P. Vyas and R.K. Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002. 3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).	**Recommended books (Latest edition):** 1. Chien, Y.W. (1992). *Novel Drug Delivery Systems*. 2nd Ed. revised and expanded. New York: Marcel Dekker. 2. Vyas, S.P., Khar R.K. (2002). *Controlled Drug Delivery - concepts and advances*. New Delhi: Vallabh Prakashan. 3. Jain, N.K. (2001). *Controlled and Novel Drug Delivery.* 1st Ed. New Delhi: CBS Publishers & Distributors. **Suggested e-material:** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code PHAR 523L **Course name** Pharmaceutics Lab-II	**Learning outcomes** Upon completion of this course student will have an understanding of: • Formulation and characterization of NDDS. • Various pharmacokinetic and statistical softwares. • Clinical and nonclinical data collection.	1. To study the effect of temperature change , non solvent addition, incompatible polymer addition in microcapsules preparation 2. Preparation and evaluation of Alginate beads 3. Formulation and evaluation of gelatin /albumin microspheres 4. Formulation and evaluation of liposomes/niosomes 5. Formulation and evaluation of spherules 6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique. 7. Comparison of dissolution of two different marketed products /brands 8. Protein binding studies of a highly protein bound drug & poorly protein bound drug 9. Bioavailability studies of Paracetamol in animals. 10. Pharmacokinetic and IVIVC data analysis by WinnolineR software 11. In vitro cell studies for permeability and metabolism 12. DoE Using Design Expert® Software 13. Formulation data analysis Using Design Expert® Software 14. Quality-by-Design in Pharmaceutical Development 15. Computer Simulations in Pharmacokinetics and Pharmacodynamics 16. Computational Modeling of Drug Disposition 17. To develop Clinical Data Collection manual 18. To carry out Sensitivity Analysis, and Population Modeling. 19. Development and evaluation of Creams 20. Development and evaluation of Shampoo and Toothpaste base 21. To incorporate herbal and chemical actives to develop products 22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff	1. To study the effect of temperature change , non solvent addition, incompatible polymer addition in microcapsules preparation 2. Preparation and evaluation of Alginate beads 3. Formulation and evaluation of gelatin /albumin microspheres 4. Formulation and evaluation of liposomes/niosomes 5. Formulation and evaluation of spherules 6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique. 7. Comparison of dissolution of two different marketed products /brands 8. Protein binding studies of a highly protein bound drug & poorly protein bound drug 9. Bioavailability studies of Paracetamol in animals. 10. Pharmacokinetic and IVIVC data analysis by WinnolineR software 11. In vitro cell studies for permeability and metabolism 12. DoE Using Design Expert® Software 13. Formulation data analysis Using Design Expert® Software 14. Quality-by-Design in Pharmaceutical Development 15. Computer Simulations in Pharmacokinetics and Pharmacodynamics 16. Computational Modeling of Drug Disposition 17. To develop Clinical Data Collection manual 18. To carry out Sensitivity Analysis, and Population Modeling. 19. Development and evaluation of Creams 20. Development and evaluation of Shampoo and Toothpaste base 21. To incorporate herbal and chemical actives to develop products 22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff	No changes

Name of Programme: Master of Pharmacy (Pharmacology)

Course details: First Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 505 **Course name** Advanced Pharmacology-I	Upon completion of this course student will have an understanding of: • The basic knowledge in the field of pharmacology pertaining to the drugs and its therapeutic applications • Recent advances in the drugs used for the treatment of various diseases. • Concepts of drug action and mechanisms involved. • Pathophysiology and pharmacotherapy of certain diseases • Underlying mechanism of drug actions at cellular and molecular level. • Adverse effects, contraindications and clinical uses of drugs used in treatment of diseases	**SECTION-A** **Pharmacokinetics:** The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. **Pharmacodynamics:** Mechanism of drug action and the relationship between drug concentration, effect and its quantitation. **Neurotransmission:** General aspects and steps involved in neurotransmission. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetylcholine). Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine]. Non adrenergic non cholinergic transmission (NANC). Cotransmission **SECTION-B** **Systemic pharmacology:** A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems. **Autonomic pharmacology:** Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction. **Central nervous system pharmacology:** General and local anesthetics, Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics. **SECTION-C** **Cardiovascular Pharmacology:** Diuretics, antihypertensives, antiischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants, anticoagulants, fibrinolytics and antiplatelet drugs **Autocoid Pharmacology:** The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonists. **Books recommended:** 1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's 2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers. 3. Basic and Clinical Pharmacology by B.G Katzung 4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott. 5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu. 6. Graham Smith. Oxford textbook of Clinical Pharmacology.	**SECTION-A** **Pharmacokinetics:** The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. **Pharmacodynamics:** Mechanism of drug action and the relationship between drug concentration, effect and its quantitation. **Neurotransmission:** General aspects and steps involved in neurotransmission. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetylcholine). Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine]. Non adrenergic non cholinergic transmission (NANC). Cotransmission **SECTION-B** **Systemic pharmacology:** A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems. **Autonomic pharmacology:** Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction. **Central nervous system pharmacology:** General and local anesthetics, Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics. **SECTION-C** **Cardiovascular Pharmacology:** Diuretics, antihypertensives, antiischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants, anticoagulants, fibrinolytics and antiplatelet drugs **Autocoid Pharmacology:** The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonists. **Recommended books (Latest edition):** **1.** Brunton, L., Chabner, A.B., Knollman, B. (2011). *Goodman & Gillman's The Pharmacological Basis of Therapeutics*, 3rd Ed., India: Mc Graw-Hill Education. **2.** Golan, D.E., Tashjian, A.H., Armstrong, E.J., Armstrong, A.W., Kluwer, L.W. (2011). *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy*, 3rd Ed., Kluwer-Lippincott Williams & Wilkins Publishers. **3.** Katzung, B.G. (2017). *Basic and Clinical Pharmacology*, 14th Ed., McGraw-Hill Education Publishers. **4.** Gibaldi, M., Prescott, L. (1983). *Hand book of Clinical Pharmacokinetics*, New York: ADIS Health Science Press. **5.** Yu, A., Shargel, L. (2016). *Applied Biopharmaceutics and Pharmacokinetics*, 8th Ed., New York: McGraw-Hill Education	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		7. Avery Drug Treatment 8. Dipiro Pharmacology, Pathophysiological approach. 9. Green Pathophysiology for Pharmacists. 10. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology) 11. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company 12. KD.Tripathi. Essentials of Medical Pharmacology. 13. Modern Pharmacology with Clinical Applications, Craig Charles R. & Stitzel Robert E., Lippincott Publishers. 14. Clinical Pharmacokinetics & Pharmacodynamics : Concepts and Applications – Malcolm Rowland and Thomas N.Tozer, Wolters Kluwer, Lippincott Williams & Wilkins Publishers. 15. Applied biopharmaceutics and Pharmacokinetics, Pharmacodynamics and Drug metabolism for industrial scientists. 16. Modern Pharmacology, Craig CR. & Stitzel RE, Little Brown & Company.	Publishers. **6.** Smith, G., Aronson, J. (2002). *Oxford Textbook of Clinical Pharmacology and Drug Therapy*, 3rd Ed., OUP Oxford Publishers. **7.** Speight, M.T. (2011). *Holford HGN Avery's Drug Treatment*, 4th Ed., Wiley India Pvt Ltd. **8.** Dipiro, T.J., Talbert, L.R., Yee, C.G., Matzke, R.G., Wells, G.B., Posey, M. (2011). *Pharmacotherapy: A Pathophysiologic Approach*, 10th Ed., New York: Mc Graw-Hill Education Publishers. **9.** Zdanowicz, M.M. (2002). *Essentials of Pathophysiology for Pharmacy*, 3rd Ed., Routledge Publishers. **10.** Kumar, V., Abbas, K.A., Aster, C.J. (2014). *Robbins & Cortan Pathologic Basis of Disease*, 9th Ed., Amsterdam: Elsevier. **11.** Srivastava, S.K. (2017). *A Complete Textbook of Medical Pharmacology*, New Delhi: Avichal Publishing Company. **12.** Tripathi, K.D. (2018). *Essentials of Medical Pharmacology*, 8th, New Delhi: Jaypee Brothers Medical Publishers. **13.** Craig, R.C., Stitzel, R.E (2004). *Modern Pharmacology with Clinical Applications,* Lippincott Publishers. **14.** Rowland, M., Tozer, N.T. (2010). *Clinical Pharmacokinetics & Pharmacodynamics: Concepts and Applications*, 4th Ed., Philadelphia: Lippincott Williams & Wilkins Publishers. **15.** Yu, A., Shargel, L. (1999). *Applied Biopharmaceutics and Pharmacokinetics*, 4th Ed., New York: Appleton & Lange Publishers. **16.** Craig, C.R., Stitzel, R.E. (1990). *Modern Pharmacology*, 3rd Ed., Boston: Little Brown and Company. **Suggested e-material:** 1. Pharmacology (Miles Hacker, William S. Messer) http://www.sciencedirect.com/science/book/9780123695215 2. Therapeutic drug monitoring Dasgupta, Amitava http://www.sciencedirect.com/science/book/9780123854674 3. A comprehensive guide to toxicology in preclinical drug development Faqi, Ali S. http://www.sciencedirect.com/science/book/9780123878151 4. Biomarkers in toxicology Gupta, Ramesh C. http://www.sciencedirect.com/science/book/9780124046306 5. Biased signaling in physiology, pharmacology and therapeutics Arey, Brian http://www.sciencedirect.com/science/book/9780124114609 6. Drug-induced liver disease Kaplowitz, Neil http://www.sciencedirect.com/science/book/9780123878175	
Course code PHAR 508 **Course name** Cellular and Molecular Pharmacology	Upon completion of this course student will have an understanding of: • Fundamental knowledge on the structure and functions of cellular components • Interaction of these components with drugs. • Drug discovery and receptor signal transduction processes. • Molecular pathways affected by drugs. • Applicability of molecular pharmacology and	**SECTION-A** **Cell biology:** Structure and functions of cell and its organelles, Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing, Cell cycles and its regulation. Cell death– events, regulators, intrinsic and extrinsic pathways of apoptosis. Necrosis and autophagy. **Cell signaling:** Intercellular and intracellular signaling pathways. Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol. Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase	**SECTION-A** **Cell biology:** Structure and functions of cell and its organelles, Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing, Cell cycles and its regulation. Cell death– events, regulators, intrinsic and extrinsic pathways of apoptosis. Necrosis and autophagy. **Cell signaling:** Intercellular and intracellular signaling pathways. Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol. Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	biomarkers in drug discovery process. • Molecular biology techniques as applicable for pharmacology.	(JAK)/signal transducer and activator of transcription (STAT) signaling pathway. **SECTION-B** Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting, Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant DNA technology. Gene therapy- Various types of gene transfer techniques, clinical applications and recent advances in gene therapy. **Immunotherapeutics:** Types of immunotherapeutics, humanisation antibody therapy, Immunotherapeutics in clinical practice **SECTION-C** **Cell culture techniques:** Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application. Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays Principles and applications of flow cytometry. **Biosimilars** **Pharmacogenomics:** Gene mapping and cloning of disease gene. Genetic variation and its role in health/ pharmacology Polymorphisms affecting drug metabolism. Genetic variation in drug transporters. Genetic variation in G protein coupled receptors. **Books recommended:** 1. The Cell, A Molecular Approach. Geoffrey M Cooper. 2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J.Licinio and M -L. Wong 3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al 4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al 5. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller 6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor) 7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor) 8. Current porotocols in molecular biology vol I to VI edited by Frederick M.Ausuvel et la.	(JAK)/signal transducer and activator of transcription (STAT) signaling pathway. **SECTION-B** Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting, Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant DNA technology. Gene therapy- Various types of gene transfer techniques, clinical applications and recent advances in gene therapy. **Immunotherapeutics:** Types of immunotherapeutics, humanisation antibody therapy, Immunotherapeutics in clinical practice **SECTION-C** **Cell culture techniques:** Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application. Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays Principles and applications of flow cytometry. **Biosimilars** **Pharmacogenomics:** Gene mapping and cloning of disease gene. Genetic variation and its role in health/ pharmacology Polymorphisms affecting drug metabolism. Genetic variation in drug transporters. Genetic variation in G protein coupled receptors. **Books recommended:** **1.** Cooper, M.G., Hausman, E.R. (2013). *The Cell: A Molecular Approach,* 6th Ed., Sinauer Associates. **2.** Licinio, J., Wong, Li. (2002). *Pharmacogenomics: The Search for Individualized Therapies*, 1st Ed., Weinheim: Wiley VCH Publishers. **3.** Bradshaw, A.R., Dennis, A.E. (2003). *Handbook of Cell Signaling,* 2nd Ed., Cambridge: Academic Press. **4.** Dickenson, J., Freeman, F., Mills, L.C, Thode, C (2012). *Molecular Pharmacology: From DNA to Drug Discovery*, 1st Ed., Wiley-Blackwell Publishers. **5.** Helgason, D.C., Miller, L.C. (2005). *Basic Cell Culture protocols*, 3rd Ed., New York: Humana Press. **6.** Davis, M.J. (1995). *Basic Cell Culture: A Practical Approach,* OUP Oxford Press. **7.** Masters, J. (2000). *Animal Cell Culture: A Practical Approach*, 3rd Ed., OUP Oxford Publishers. **8.** Ausubel, M.F. (1987). *Current Protocols in Molecular Biology*, Hoboken: John Wiley & Sons Inc Publishers. **Suggested e-material:** 1. Pharmacology (Miles Hacker, William S. Messer) http://www.sciencedirect.com/science/book/9780123695215 2. Therapeutic drug monitoring Dasgupta, Amitava http://www.sciencedirect.com/science/book/9780123854674 3. A comprehensive guide to toxicology in preclinical drug development Faqi, Ali S. http://www.sciencedirect.com/science/book/9780123878151 4. Biomarkers in toxicology Gupta, Ramesh C.	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			http://www.sciencedirect.com/science/book/9780124046306 5. Biased signaling in physiology, pharmacology and therapeutics Arey, Brian http://www.sciencedirect.com/science/book/9780124114609 6. Drug-induced liver disease Kaplowitz, Neil http://www.sciencedirect.com/science/book/9780123878175	
Course code PHAR 516 **Course name** Modern Pharmaceutical Analytical Techniques	Upon completion of this course student will have an understanding of: • Understand the significance of Pharmaceutical Analysis in the profession. • Learn the various tools and techniques available for the analysis of drugs. • Principles of various conventional analytical techniques. • Application of Pharmacopoeial purity and identity tests for samples. • Proper handling of laboratory equipments and glassware. • Interpretation of spectra and correlate with sample. • Converting the observations to meaningful results and drawing the inferences. • Comparing various methods of analysis and their outcomes.	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography **Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X ray Crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application	**SECTION-A** **UV-visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy. **Infra-red spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications. **NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **SECTION-B** **Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography **Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **SECTION-C** **X-ray crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, Types of crystals and applications of X-ray diffraction. **Immunological assays:** RIA (Radio immuno assay), ELISA, Bioluminescence assays. **Potentiometry:** Principle, working, Ion selective electrodes and application	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		of potentiometry. **Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Books recommended:** 1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004. 2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998. 3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers. 4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997. 5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991. 6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997. 7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series	of potentiometry. **Thermal techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. **Recommended books (Latest edition):** 1. Silverstein, R.M. (2004). *Spectrometric Identification of Organic compounds*, 6th Ed., John Wiley & Sons. 2. Skoog, D.A, Holler, F.J., Nieman, T.A. (1998). *Principles of Instrumental Analysis*, 5th Ed., Bangalore: Eastern press, Bangalore. 3. Beckett, A.H., Stenlake, J.B. (1987). *Practical Pharmaceutical Chemistry,* 4th Ed., New Delhi: CBS publishers. 4. Kemp, W. (1991). *Organic Spectroscopy*, 3rd Ed., ELBS. 5. Sethi, P.D. (1987). *Quantitative Analysis of Drugs in Pharmaceutical formulation*, 3rd Ed., New Delhi: CBS Publishers. 6. Munson, J.W. (2012). *Pharmaceutical Analysis- Modern methods* – Part B, Informa Health care Publishers. **Suggested e-material:** 1. http://www.sciencedirect.com/science/book/9780123869845 Infrared and Raman spectroscopy Larkin, Peter 2. http://www.sciencedirect.com/science/book/9780124115897 Solving problems with NMR spectroscopy Atta-ur-Rahman, Muhammad Iqbal **3.** http://lib.myilibrary.com/?id=543351 Quantum Chemistry and Spectroscopy: Pearson New International Edition Engel, Thomas	
Course code PHAR **Course name** Pharmacological and Toxicological Screening Methods-I	Upon completion of this course student will have an understanding of: • Preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. • Maintenance of laboratory animals as per the guidelines, basic knowledge of various *in-vitro* and *in-vivo* preclinical evaluation processes • regulations and ethical requirement for the usage of experimental animals. • various animals used in the drug discovery process and good laboratory practices in maintenance and	**SECTION-A** **Laboratory Animals, Common laboratory animals:** Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals. Good laboratory practice. Bioassay-Principle, scope and limitations and methods **SECTION-B** Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive). Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y. OECD principles of Good laboratory practice (GLP).History, concept and its importance in drug development **Acute, sub-acute and chronic-** oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization- importance and methods in regulatory toxicology studies	**SECTION-A** **Laboratory Animals:** Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals Good laboratory practice. Bioassay: Principle, scope and limitations and methods. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. **SECTION-B** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.**	Title and content of subject has been modified as per PCI prescribed syllabus "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	handling of experimental animals • various screening methods involved in the drug discovery process.	**SECTION-C** **IND enabling studies (IND studies)-** Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. Safety pharmacology studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies. **Toxicokinetics-** Toxicokinetic evaluation in preclinical studies, saturation kinetics, Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing. **Books recommended:** 1. Handbook of Experimental Pharmacology, SK.Kulkarni 2. Fundamentals of experimental Pharmacology by M.N.Ghosh 3. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/ publications/documents/glphandbook. pdf). 4. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 5. 2005, ministry of health and family welfare (department of health) New Delhi 6. Drugs from discovery to approval by Rick NG. 7. Animal Models in Toxicology, 3rd Edition, Lower and Bryan 8. OECD test guidelines. 9. Principles of toxicology by Karen E. Stine, Thomas M. Brown. 10. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals 11. (http://www.fda.gov/downloads/drugs/guidancecompliance regulatoryinformation /guidances/ucm073246.pdf)	Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, anti-inflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti-emetic, antidiarrheal and laxatives. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. **SECTION-C** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Immunomodulators, Immunosuppressants and immunostimulants **General principles of immunoassay**: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin. Anti cancer agents. Hepatoprotective screening methods. Limitations of animal experimentation and alternate animalexperiments. Extrapolation of in vitro data to preclinical and preclinical to humans **Recommended books (Latest edition):** 1. Kulkarni SK. *Handbook of Experimental Pharmacology*,Vallabh Prakashan, 2013. 2. Ghosh MN, *Fundamentals of Experimental Pharmacology*, Hilton & Company Publishers: edi 5th, 2008 3. *Hand book on GLP, Quality practices for regulated non-clinical research and development*, World Health Organisation, edi 2nd, 2008 4. Schedule Y , *Guideline: Drugs and cosmetics (second amendment) Rules, CDSCO,* 1945 5. *Annual Report to the People on Health*, Ministry of Health and Family Welfare, New Delhi, 2005 6. Rick NG. *Drugs from discovery to approval*, 3rd edition, Wiley-Blackwell Publishers, 2015 7. Gad CS. *Animal Models in Toxicology*, CRC Press, edio 3rd, 2015 8. OECD (452) guidelines for the Testing of Chemicals, 2018 9. Stine ER, Brown MT. *Principles of toxicology,* CRC Press, edi 3rd, 2015 10. *Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals*, U.S. Department of Health and Human Services, ICH, 2010 11. *Guidance for Industry Patient-Reported Outcome Measures: Use in Medical Product Development to Support Labeling Claims*, U.S. Department of Health and Human Services Food and Drug Administration, 2009 **Suggested e-material:** 1. (http://www.fda.gov/downloads/drugs/guidancecompliance regulatoryinformation /guidances/ucm073246.pdf) 2. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			publications/documents/glphandbook. pdf).	
Course code PHAR 528 **Course name** Principles of Drug Discovery	• drug designing and methods for their analysis. factor to design new drug against particular target	**SECTION-A** **Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists. **Stereochemistry and drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination. **Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **SECTION-B** **Drug biotransformation, prodrugs and soft Drugs:** Drug biotransformation and its role in development of new drug molecules, Prodrug Concept, Prodrugs of various functional groups like carbonyl, hydroxyl, amide, amines. Application of prodrug approach to- improvement of bioavailability, prevention of first pass metabolism, reduction of side effects, prolonging duration of action, site specific delivery, improvement of membrane permeability, removal of undesirable properties. Soft drug design. **Prodrug design:** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **Enzyme Inhibitors:** Rational design of enzyme inhibitors, enzyme kinetics & principles of enzyme inhibitors, enzyme inhibitors in medicine, enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors. **SECTION-C** **An overview of target discovery and validation.** **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Peptidomimetics:** Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. **Computational prediction of protein structure:** Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction **Books recommended:** 1. Medicinal Chemistry by Burger, Vol I –VI. 2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lppincott Williams &	**SECTION-A** **Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. **Biological drug targets**: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists. **Stereochemistry and drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination. **Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **SECTION-B** **Drug biotransformation:** Drug biotransformation and its role in development of new drug molecules. **Prodrug design:** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **Enzyme Inhibitors:** Rational design of enzyme inhibitors, enzyme kinetics & principles of enzyme inhibitors, enzyme inhibitors in medicine, enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors. **SECTION-C** **An overview of target discovery and validation.** **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Peptidomimetics:** Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. **Computational prediction of protein structure:** Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction **Recommended books (Latest edition):** 1. Abraham, D.J., Rotella, D.P. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development*, 7th Ed., New Delhi: Willey Publishers. 2. Beale, J.M. (2010). *Wilson and Gisvold's: Text book of Organic Medicinal and Pharmaceutical Chemistry*, 12th Ed., New Delhi: Lippincott Williams & Wilkins, Wolters Kluwer (India) Pvt. Ltd. 3. Chackalamannil, S., Rotella D., Ward, S. (2017). *Comprehensive Medicinal Chemistry III*, 3rd Ed., Elsevier. 4. Martin, Y.C. (2010). *Quantitative Drug Design: A critical Introduction*, 3rd Ed., New York: CRC Press. 5. Lemke, T.S., Williams, D.A., Roche, V.F., Zito S.W., Foye, S. (2013). *Principles of Medicinal Chemistry*, 7th Ed., New Delhi: Lippincott Williams & Wilkins, Wolters Kluwer (India) Pvt. Ltd. 6. Arienes, E.J. (1975). *Drug Design,* 1st Ed., Academic Press, Elsevier. 7. Smith, W. (2005). *Introduction to the Principles of Drug Design and Action*, 4th Ed., New York: CRC Press.	Nomencalture of course is changed from "Principles of Drug Discovery" to "Principles of Medicinal Chemistry". The course has been shifted to discipline elective. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi. 3. Comprehensive Medicinal Chemistry – Corwin and Hansch. 4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore 5. Introduction to Quantitative Drug Design by Y.C. Martin. 6. Principles of Medicinal Chemistry by William Foye, 7th Edition, Ippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi. 7. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh.. 8. Principles of Drug Design by Smith. 9. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, II Edition, Elsevier Publishers, New Delhi. 10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA. 11. Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B. Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi. 12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.	8. Silverman, R.B. (2012). *The Organic Chemistry of the Drug Design and Drug Action*, 2nd Ed., Elsevier Publishers. 9. Patrick, G.L. (1995). *An Introduction to Medicinal Chemistry,* 1st Ed., Oxford University Press. 10. Brahmankar, D.M., Jaiswal, S.B. (2014). *Biopharmaceutics and Pharmacokinetics*, 2nd Ed., New Delhi: Vallabh Prakashan. 11. Guarna, A., Trabocchi, A. (2014), *Peptidomimetics in Organic and Medicinal Chemistry,* 1st Ed., New Delhi: Wiley publishers. **Suggested e-material:** 1. https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC 2. https://www.wiley.com/en-us/Burger%27s+Medicinal+Chemistry%2C+Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154	
Course code PHAR 526L **Course name** Pharmacology Lab-I		1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry **Handling of laboratory animals.** 1. Various routes of drug administration. 2. Techniques of blood sampling, anesthesia and euthanasia of experimental animals. 3. Functional observation battery tests (modified Irwin test) 4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity. 5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity. 6. Evaluation of diuretic activity. 7. Evaluation of antiulcer activity by pylorus ligation method. 8. Oral glucose tolerance test. 9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver). 10. Isolation of RNA from yeast 11. Estimation of proteins by Braford/Lowry's in biological samples.	1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry **Handling of laboratory animals.** 1. Various routes of drug administration. 2. Techniques of blood sampling, anesthesia and euthanasia of experimental animals. 3. Functional observation battery tests (modified Irwin test) 4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity. 5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity. 6. Evaluation of diuretic activity. 7. Evaluation of antiulcer activity by pylorus ligation method. 8. Oral glucose tolerance test. 9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver). 10. Isolation of RNA from yeast 11. Estimation of proteins by Braford/Lowry's in biological samples. 12. Estimation of RNA/DNA by UV Spectroscopy	No changes

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		12. Estimation of RNA/DNA by UV Spectroscopy 13. Gene amplification by PCR. 14. Protein quantification Western Blotting. 15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase). 16. Cell viability assays (MTT/Trypan blue/SRB). 17. DNA fragmentation assay by agarose gel electrophoresis. 18. DNA damage study by Comet assay. 19. Apoptosis determination by fluorescent imaging studies. 20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares 21. Enzyme inhibition and induction activity 22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV) 23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)	13. Gene amplification by PCR. 14. Protein quantification Western Blotting. 15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase). 16. Cell viability assays (MTT/Trypan blue/SRB). 17. DNA fragmentation assay by agarose gel electrophoresis. 18. DNA damage study by Comet assay. 19. Apoptosis determination by fluorescent imaging studies. 20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares 21. Enzyme inhibition and induction activity 22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV) 23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)	
Course code **Course name** Principles of Medicinal Chemistry (Discipline Elective)	**Learning outcomes** Upon completion of this course student will have an understanding of: • Various aspects of drug designing and methods for their analysis. • Factor to design new drug against particular biochemical. • Medicinal and stereochemistry of various class of drugs.		**SECTION-A** **Drug discovery:** Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. **Biological drug targets:** Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes. **Prodrug Design and Analog design:** **a) Prodrug design:** Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design. **b) Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **c) Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance. **SECTION-B** **Medicinal chemistry aspects of the following class of drugs** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: **a)** Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic	Introduced as Discipline Elective using PCI prescribed syllabus.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			agents, Antineoplastic and Antiviral agents. **b) Stereochemistry and Drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination. **SECTION-C** **Rational Design of Enzyme Inhibitors** Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors. **Peptidomimetics** Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones. **Recommended books (Latest edition):** 1. Abraham, D.J., Rotella, D.P. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development*, 7th Ed., New Delhi: Willey Publishers. 2. Beale, J.M. (2010). *Wilson and Gisvold's: Text book of Organic Medicinal and Pharmaceutical Chemistry*, 12th Ed., New Delhi: Lippincott Williams & Wilkins, Wolters Kluwer (India) Pvt. Ltd. 3. Chackalamannil, S., Rotella D., Ward, S. (2017). *Comprehensive Medicinal Chemistry III*, 3rd Ed., Elsevier. 4. Martin, Y.C. (2010). *Quantitative Drug Design: A critical Introduction*, 3rd Ed., New York: CRC Press. 5. Lemke, T.S., Williams, D.A., Roche, V.F., Zito S.W., Foye, S. (2013). *Principles of Medicinal Chemistry*, 7th Ed., New Delhi: Lippincott Williams & Wilkins, Wolters Kluwer (India) Pvt. Ltd. 6. Arienes, E.J. (1975). *Drug Design,* 1st Ed., Academic Press, Elsevier. 7. Smith, W. (2005). *Introduction to the Principles of Drug Design and Action*, 4th Ed., New York: CRC Press. 8. Silverman, R.B. (2012). *The Organic Chemistry of the Drug Design and Drug Action*, 2nd Ed., Elsevier Publishers. 9. Patrick, G.L. (1995). *An Introduction to Medicinal Chemistry,* 1st Ed., Oxford University Press. 10. Brahmankar, D.M., Jaiswal, S.B. (2014). *Biopharmaceutics and Pharmacokinetics*, 2nd Ed., New Delhi: Vallabh Prakashan. 11. Guarna, A., Trabocchi, A. (2014), *Peptidomimetics in Organic and Medicinal Chemistry,* 1st Ed., New Delhi: Wiley publishers. **Suggested e-material:** https://books.google.co.in/books/about/Foye_s_Principles_of_Medicinal_Chemistry.html?id=R0W1ErpsQpkC https://www.wiley.com/en-us/Burger%27s+Medicinal+Chemistry%2C+Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154	
Course code **Course name** Herbal Cosmetics (Discipline Elective)	After completion of the course, student shall be able to • Understand the basic principles of various herbal/natural cosmetic preparations • Current Good Manufacturing Practices of herbal/natural cosmetics as per the regulatory		**SECTION-A** **Introduction:** Herbal/natural cosmetics, Classification & Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics, commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs.	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	authorities		Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation. **SECTION-B** **Herbal Cosmetics:** Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail. Preparation and standardisation of Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails. **SECTION-C** **Cosmeceuticals of herbal and natural origin:** Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams, deodorants. **Analysis of Cosmetics, Toxicity screening and test methods:** Quality control and toxicity studies as per Drug and Cosmetics Act. **Recommended books:** 1. Panda, H. (2000). Herbal Cosmetics: Hand book, New Delhi: Asia Pacific Business Press Inc. 2. Thomson, E.G. (2015). Modern Cosmetics, vol 1, Mumbai: Universal Publishing Corporation. 3. Sharma, P.P. (2014). Cosmetics - Formulation, Manufacturing & Quality Control, Ed.5th, New Delhi: Vandana Publications. 4. Supriya, B. (2000). Handbook of Aromatic Plants, Jaipur: Pointer Publishers. 5. Skaria, B.P. (2007). Aromatic Plants: Horticulture Science Series, New Delhi: New India Publishing Agency. 6. Keville, K., Green, M., (2008). Aromatheraphy: A Complete Guide to the Healing Art, New Delhi: Sri Satguru Publications. 7. Balsam, M.S., Edward S. (1974). Cosmetics Science and Technology, vol 3, New York: Wiley Interscience. **Suggested e-material:** https://www.pdfdrive.com/cosmetics-books.html	
Course code **Course name** Advanced Pharmaceutical Biotechnology (Discipline Elective)	Upon completion of this course student will have an understanding of: • Enzyme technology, genetic Engineering, Peptides and its applications. • Transgenic animal, human genome and signal transduction. • 3 Microbial transformation, biodegradation and biosensors.		**SECTION-A** **Enzyme Technology:** Classification, general properties of enzymes, dynamics of enzymatic activity, sources of enzymes, extraction and purification, pharmaceutical, therapeutic and clinical application. Production of amyloglucosidase, glucose isomerase,amylase and trypsin. **Genetic Engineering:** Techniques of gene manipulation, cloning strategies,procedures, cloning vectors expression vectors, recombinant selection and screening, expression in E.coli and yeast. Site directed mutagenesis, polymerase chain reaction, and analysis of DNAsequences. Gene library and cDNA	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Applications of the above technique in the production of, • Regulatory proteins - Interferon, Interleukins • Blood products - Erythropoietin • Vaccines - Hepatitis-B • Hormones – Insulin **Therapeutic peptides:** Study on controlled and site specified delivery of therapeutic peptides and proteins through various routes of administration. **SECTION-B** **Transgenic animals:** Production of useful proteins in transgenic animals and gene therapy. **Human Genome:** The human genome project-a brief study, Human chromosome – Structure and classification, chromosomal abnormalities – Syndromes **Signal transduction:** Introduction, cell signaling pathways, Ion channels, Sensors and effectors, ON and OFF mechanisms, Spatial and temporal aspects of signaling, cellular process, development, cell cycle and proliferation, neuronal signaling, cell stress, inflammatory responses and cell death, signaling defects and diseases. **SECTION-C** **Oncogenes:** Introduction, definition, various oncogenes and their proteins. **Microbial Biotransformation:** Biotransformation for the synthesis of chiral drugs and steroids. **Microbial Biodegradation:** Biodegradation of xenobiotics, chemical and industrial wastes, Production of single-cell protein, Applications of microbes in environmental monitoring. **Biosensors:** Definition, characteristics of ideal biosensors, types of biosensors, biological recognition elements, transducers, application of biosensors. **Recommended books:** 1. Trevan, M.D., Boffey, S., Goulding, K.H., Stanbury, P.F. (1987). Biotechnology-The biological principles. Ed. 1, Stony Stratford: Open University Press. 2. Bickerstaff, G.F. (1997). Immobilization of cells and enzymes. Totowa: Humana Press Inc. 3. Old, R.W., Primrose, S.B. (1981). Principles of Gene Manipulating. University of California Press 4. Lodish, H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D. Darnell, J. (1999). Molecular Cell Biology. 4th ed. W. H. Freeman Publishers. 5. Primrose, S.B. (1991). Modern Biotechnology. 2nd Ed. London: Blackwell Scientific Publications Ltd. 6. Murray E.T. (1991). Gene transfer and expression protocols-methods in Molecular Biology, vol. VII, Totowa: Humana Press Inc. 7. Asubel, F.M. (2003). Current protocols in Molecular Biology, Vo1.I & II, John Wiley Publishers. **Suggested e-material** 1. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 2. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			3. https://www.pdfdrive.com/pharmaceutical-books.html	
Course code **Course name** Intellectual Property Rights (Discipline Elective)	Upon completion of this course student will have an understanding of: • patent and copyright for their innovative works. They also get the knowledge of plagiarism in their innovations which can be questioned legally. • selected IP issues that might arise in practice. • federal and state IP protection: • tools and activities of IP practitioners such as the Copyright, Patent, and Trademark websites, searching, reading patents, and more.		**SECTION-A** **Intellectual property rights (IPR):** Definition, scope, objectives, Concepts and fundamentals: intellectual property (IP), intellectual property protection (IPP) and intellectual property rights (IPR); economic importance, mechanism for protection of intellectual property. **Patents:** (Criteria for patentability, Indian patent act. 1970, filing of a patent application, precautions before patenting-disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application- provisional, non-provisional, PCT and convention patent applications, international patenting requirement procedures and costs. **Patent infringement:** Meaning, scope, litigation, drug related patents infringements, case studies and examples, patenting by research students.), **SECTION-B** **Copyright**, **Trademarks:** (Introduction, meaning of trademark, criteria for eligibility, filling application for trademark registration). **Trade secrets:** Scope modalities and protection case studies. Role of IP in pharmaceutical industry. **Trade related aspects of intellectual property rights:** Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). **WTO**-objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization **SECTION-C** **Technology development/transfer commercialization related aspects:** Meaning, drug related technology development, bioequivalence (BE), scale-up, semi-commercialization and commercialization– practical aspects and problems, significance of transfer of technology (TOT), bottlenecks, managing technology transfer, guidelines for research students, scientists and related personnel, TOT agencies in India APCTD, NRDC, TIFAC, IBCIL, TBSE/SIDBI. **TOT related documentation:** Confidentiality agreements, licensing, MOUs, legal issues, compulsory licensing and issuing of access to medicines, DOHA declaration. **Related quality systems:** Objectives and brief review of US-FDA, UK-MCA, and TGA guidelines. **Standard institutes and certification agencies like**: ISI, BSS, ASTM. **Recommended books (Latest edition):** 1. Treece, D.J. (2003). *Managing Intellectual Capital: Organizational, Strategic and Policy Dimension*. England: Oxford University Press. 2. Wadedhra, B.L. (2004). *Law Relating to Patents, Trademarks, Copyright*	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Design and Geographical Indications. New Delhi: Universal Law Publishing. 3. Bansal, P. (2008) *IPR Handbook for Pharma Students and Researchers*. Hyderabad: Pharma Book Syndicate. 4. Trivedi, P.R. (2008). *Encylcopedia of Intellectual Property Rights*. New Delhi: Jnanada Prakashan. 5. Willig, S.H. (1982). *Good Manufacturing Practices for Pharmaceuticals*. vol 78, New York: Marcel Dekker,. 6. Das, P., Das, G. (2008). *Protection of Industrial Property Rights Kolkata*: Kamal Law House. 7. Katju, S.N. (2002). *Law and Drugs*, Delhi Law House. **Suggested e-material:** 6. www.fda.gov 7. https://www.ich.org/products/guidelines.html 8. Copyright Protection in India [website: http:copyright.gov.in]. 9. Information on orange book [website: www.fda.gov/cder/ob/default.htm]. 10. World Trade Organization [website: www.wto.org].	
Course code **Course name** Regulatory aspects of food and nutraceuticals (Discipline Elective)	Upon completion of the course, the student shall be able to • Know the regulatory Requirements for nutraceuticals • Understand the regulation for registration and labeling of nutraceuticals • food supplements in India, USA and Europe.		**SECTION-A** **Nutraceuticals:** Introduction, History of Food and Nutraceutical, Regulations, Meaning of Nutraceuticals, Dietary Supplements, Functional Foods, Medical Foods, Scope and Opportunities in Nutraceutical Market. **Global Aspects:** WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food And Dietary Supplements. Good Manufacturing Practices for Nutraceuticals **SECTION-B** **India:** Food Safety and Standards Act, Food Safety and Standards Authority of India: Organization and Functions, Regulations for import, manufacture and sale of nutraceutical products in India, Recommended Dietary Allowances (RDA) in India. **USA**: US FDA Food Safety Modernization Act, Dietary Supplement Health and Education Act. U.S. regulations for manufacture and sale of nutraceuticals and dietary supplements, Labelling Requirements and Label Claims for Dietary Supplements, Recommended Dietary Allowances (RDA) in the U.S. **SECTION-C** **European Union:** European Food Safety Authority (EFSA): Organization and Functions. EU Directives and regulations for manufacture and sale of nutraceuticals and dietary supplements. Nutrition labelling. European Regulation on Novel Foods and Novel Food Ingredients. Recommended Dietary Allowances (RDA) in Europe. **Books recommended:** 5. Hasler, Clare M. (2005). Regulation of Functional Foods and Nutraceuticals: A Global Perspective. Vol.1, Delhi: Blackwell	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Publishing. 6. Bagchi, D. (2014). Nutraceutical and Functional Food Regulations in the United States and Around the World. Elsevier. 7. Pathak, Y. (2009). *Handbook of Nutraceuticals*. Vol 1. CRC Press. 8. Fortin, N.D. (2007). *Food Regulation: Law, Science, Policy and Practice.* Vol 1. Wiley Publishers. **Suggested e-material** 3. http://www.who.int/publications/guidelines/nutrition/en/ 4. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/536324/IPOL_STU(2015)536324_EN.pdf	
Course code **Course name** Regulatory Aspects of Medical Devices (Discipline Elective)	Upon completion of the course, the student shall be able to know • basics of medical devices and IVDs, process of development, ethical and quality considerations • harmonization initiatives for approval and marketing of medical devices and IVDs • regulatory approval process for medical devices and IVDs in India, US, Canada, EU, Japan and ASEAN • clinical evaluation and investigation of medical devices and IVDs		**SECTION A** **Medical Devices:** Introduction, Definition, Risk based classification and Essential Principles of Medical Devices and IVDs. Differentiating medical devices IVDs and Combination Products from that of pharmaceuticals. History of Medical Device Regulation, Product Lifecycle of Medical Devices and Classification of Medical Devices. **IMDRF/GHTF:** Introduction, Organizational Structure, Purpose and Functions, Regulatory Guidelines, Working Groups, Summary Technical Document (STED), Global Medical Device Nomenclature (GMDN). **SECTION B** **Ethics:** Clinical Investigation of Medical Devices, Clinical Investigation Plan for Medical Devices, Good Clinical Practice for Clinical Investigation of medical devices (ISO 14155:2011) **Quality:** Quality System Regulations of Medical Devices: ISO 13485, Quality Risk Management of Medical Devices: ISO 14971, Validation and Verification of Medical device, Adverse Event Reporting of Medical device **USA:** Introduction, Classification, Regulatory approval process for Medical Devices (510k) Premarket Notification, Pre-Market Approval (PMA), Investigational Device Exemption (IDE) and In vitro Diagnostics, Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI). Basics of In vitro diagnostics, classification and approval process. **SECTION C** **European Union**: Introduction, Classification, Regulatory approval process for Medical Devices (Medical Device Directive, Active Implantable Medical Device Directive) and In vitro Diagnostics (In Vitro Diagnostics Directive), CE certification process. Basics of In vitro diagnostics, classification and approval process. **ASEAN, China & Japan**: Medical Devices and IVDs, Regulatory registration procedures, Quality System requirements and clinical evaluation and investigation. IMDRF study groups and guidance documents. **Books recommended:** 1. Pisano, D. J., Mantus, D. (2008). *FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices and Biologics*. 2nd Ed., CRC Press. 2. Kahan, J. S. (2000). *Medical Device Development: A Regulatory Overview*. PAREXEL International Corporation. 3. Tobin, J. J., Walsh, G. (2008). *Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics Medical, Devices.* Wiley-Blackwell	Introduced as Discipline Elective using PCI prescribed syllabus. "Suggested e-material:" has been added

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			4. Medina, C. (2003). *Compliance Handbook for Pharmaceuticals, Medical Devices and Biologics*. CRC Press. **Suggested e-material** 1. Country Specific Guidelines from official websites. 2. Code of Federal regulations (Annual Edition) from official websites, US government. 3. www.fda.gov	

Name of Programme: Master of Pharmacy (Pharmacology)

Course details: Second Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code PHAR 506 **Course name** Advanced Pharmacology-II	Upon completion of this course student will have an understanding of: • The basic knowledge in the field of pharmacology pertaining to the drugs and its therapeutic applications • Recent advances in the drugs used for the treatment of various diseases. • Concepts of drug action and mechanisms involved. • The pathophysiology and pharmacotherapy of certain diseases • Underlying mechanism of drug actions at cellular and molecular level. • Adverse effects, contraindications and clinical uses of drugs used in treatment of diseases	**SECTION-A** **GIT Pharmacology:** Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritable bowel syndrome. **Endocrine Pharmacology:** Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids. Drugs affecting calcium regulation **SECTION-B** **Chemotherapy:** Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs. **Chemotherapy:** Drugs used in Protozoal Infections, Drugs used in the treatment of Helminthiasis. Chemotherapy of cancer, Immunopharmacology, Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immunosuppressants and Immunostimulants **SECTION-C** **Chronopharmacology:** Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer **Free radicals Pharmacology:** Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant Recent Advances in Treatment: Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus **Books recommended:** 1. The Pharmacological basis of therapeutics- Goodman and Gill man's 2. Principles of Pharmacology. The Pathophysiologic basis of drug therapy by David E Golan et al. 3. Basic and Clinical Pharmacology by B.G -Katzung 4. Pharmacology by H.P. Rang and M.M. Dale. 5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott. 6. Text book of Therapeutics, drug and disease management by E T.	**SECTION-A** **GIT Pharmacology:** Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritable bowel syndrome. **Endocrine Pharmacology:** Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids. Drugs affecting calcium regulation **SECTION-B** **Chemotherapy:** Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs. **Chemotherapy:** Drugs used in Protozoal Infections, Drugs used in the treatment of Helminthiasis. Chemotherapy of cancer, Immunopharmacology, Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immunosuppressants and Immunostimulants **SECTION-C** **Chronopharmacology:** Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer **Free radicals Pharmacology:** Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant Recent Advances in Treatment: Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus **Recommended books (Latest edition):** 1. Brunton, L., Chabner, A.B, Knollman, B. (2017). *Goodman & Gilman's: The Pharmacological Basis of Therapeutics*, 3rd Ed., McGraw-Hill Education. 2. Golan, D.E., Tshjian, A.H., Armstrong, E.J., Armstron, A.W.	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Herfindal and Gourley. 7. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu. 8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists 9. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology) 10. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company. 11. KD.Tripathi. Essentials of Medical Pharmacology 12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers	(2016). *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy*, 3rd Ed., Wolters Kluwer Health/Lippincott Williams & Wilkins: 2016. 3. Katzung, B.G. (2017), *Basic and Clinical Pharmacology*, 14th Ed., McGraw-Hill Companies. 4. Ritter, J., Flower, R., Henderson, R., Rang, H. (2015). *Rang & Dale's Pharmacology*, 8th Ed., Churchill Livingstone. 5. Gibaldi, M., Prescott, L. (1983). *Handbook of Clinical Pharamacokinetics*, New York: ADIS Health Science. 6. Herfindal, E.T., Hirschman, J.L., Gourley, D.R. (2000), *Textbook of therapeutics: drug and disease management,* 7th Ed., Lippincott Williams & Wilkins. 7. Shargel, L., Yu, A. (2016). *Applied Biopharmaceutics & Pharmacokinetics*, 8th Ed., New York: McGraw-Hill Companies. 8. Younggil K. (2002). *Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists*, Springer. 9. Kumar, V., Abbas, A., Aster, J. (2014). *Robbins & Cotran Pathologic Basis of Disease*, 9th Ed., Amsterdam: Elsevier. 10. Srivastava, S.K. (2017). *A Complete Textbook of Medical Pharmacology*, Avichal Publishing Company. 11. Tripathi, K.D. (2018). *Essentials of Medical Pharmacology*, 8th Ed., New Delhi: Jaypee Brothers Medical Publishers. **Suggested e-material:** 1. Pharmacology (Miles Hacker, William S. Messer) http://www.sciencedirect.com/science/book/9780123695215 Therapeutic drug monitoring Dasgupta, Amitava http://www.sciencedirect.com/science/book/9780123854674 A comprehensive guide to toxicology in preclinical drug development Faqi, Ali S. http://www.sciencedirect.com/science/book/9780123878151 Biomarkers in toxicology Gupta, Ramesh C. http://www.sciencedirect.com/science/book/9780124046306 Biased signaling in physiology, pharmacology and therapeutics Arey, Brian http://www.sciencedirect.com/science/book/9780124114609 Drug-induced liver disease Kaplowitz, Neil http://www.sciencedirect.com/science/book/9780123878175	
Course code PHAR 510 **Course name** Clinical Research and Pharmacovigilance	Upon completion of this course student will have an understanding of: • The clinical research. • Regulatory requirements for conducting clinical trial. • Responsibilities of key players involved in clinical trials • Safety monitoring, reporting and close-out activities. • Principles of pharmacovigilance	**SECTION-A** Regulatory Perspectives of Clinical Trials: Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines. Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant- Schedule Y, ICMR. Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process, Clinical Trials: Types and Design, Experimental Study- RCT and Non RCT. Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team. Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management **SECTION-B** Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring- Safety Monitoring in CT Adverse Drug Reactions:	**SECTION-A** Regulatory Perspectives of Clinical Trials: Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines. Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant- Schedule Y, ICMR. Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process, Clinical Trials: Types and Design, Experimental Study- RCT and Non RCT. Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team. Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management **SECTION-B** Clinical Trial Documentation- Guidelines to the preparation of	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Definition and types. Detection and reporting methods. Severity and seriousness assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR. Pharmacoepidemiology, pharmacoeconomics, safety pharmacology **SECTION-C** Basic aspects, terminologies and establishment of pharmacovigilance History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance Methods, ADR reporting and tools used in Pharmacovigilance International classification of diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety data. **Books recommended:** 1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health;2001. 2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996. 3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi. 4. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons. 5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications. 6. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone. 7. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.	documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring- Safety Monitoring in CT Adverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR. Pharmacoepidemiology, pharmacoeconomics, safety pharmacology **SECTION-C** Basic aspects, terminologies and establishment of pharmacovigilance History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance Methods, ADR reporting and tools used in Pharmacovigilance International classification of diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety data. **Books recommended:** 1. Central Drugs Standard Control Organization- *Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India*. New Delhi: Ministry of Health: 2001. 2. *International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline.* Guideline for Good Clinical Practice.E6; May 1996. 3. *Ethical Guidelines for Biomedical Research on Human Subjects*, Indian Council of Medical Research, New Delhi: 2006. 4. Machin, D., Day, S., Green, S. (2006). *Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, John Wiley and Sons*, 6th Ed., England: John Wiley & Sons Ltd. 5. Rondels, R.K., Varley, S.A., Webbs, C.F. (2000). *Clinical Data Management*, 2nd Ed., England: Wiley Publications. 6. Lloyd, J., Raven, A. (1994). *Handbook of clinical Research*, 2nd Ed., New York: Churchill Livingstone. 7. Giovanna, D.L., Haynes, G. (2001). *Principles of Clinical Research*, 1st Ed., Routledge publisher. **Suggested e-material:** 1. Pharmacology (Miles Hacker, William S. Messer) http://www.sciencedirect.com/science/book/9780123695215 Therapeutic drug monitoring Dasgupta, Amitava http://www.sciencedirect.com/science/book/9780123854674 A comprehensive guide to toxicology in preclinical drug development Faqi, Ali S. http://www.sciencedirect.com/science/book/9780123878151	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Biomarkers in toxicology Gupta, Ramesh C. http://www.sciencedirect.com/science/book/9780124046306 Biased signaling in physiology, pharmacology and therapeutics Arey, Brian http://www.sciencedirect.com/science/book/9780124114609 Drug-induced liver disease Kaplowitz, Neil http://www.sciencedirect.com/science/book/9780123878175	
Course code PHAR 511 **Course name** Computer Aided Drug Design	Upon completion of this course student will have an understanding of: : • Different CADD techniques and their applications in drug discovery. • The use of software in identifying drug receptor interactions and pharmacophore mapping. • The applicability of *in silico* virtual screening protocols in drug research.	**SECTION-A** Introduction to Computer Aided Drug Design (CADD) History, different techniques and applications. Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters. **SECTION-B** **Quantitative Structure Activity Relationships:** Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters. **Molecular Modeling and Docking:** Molecular and Quantum Mechanics in drug design. Energy Minimization Methods, comparison between global minimum conformation and bioactive conformation. Molecular docking and drug receptor interactions, Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE) **SECTION-C** **Molecular Properties and Drug Design:** Prediction and analysis of ADMET properties of new molecules and its importance in drug design. De novo drug design, Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. Homology modeling and generation of 3D-structure of protein. **Pharmacophore Mapping and Virtual Screening:** Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In Silico drug design and virtual screening techniques, similarity based methods and pharmacophore based screening, structure based In-silico virtual screening protocols. **Books recommended:** 1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers. 2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group.. 3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers. 4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis. 5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers. 6. Medicinal Chemistry by Burger, Wiley Publishing Co. 93 7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press. 8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical	**SECTION-A** **Introduction to Computer Aided Drug Design (CADD)** History, different techniques and applications. **Quantitative Structure Activity Relationships**: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters. **SECTION-B** **Quantitative Structure Activity Relationships:** Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters. **Molecular Modeling and Docking:** Molecular and Quantum Mechanics in drug design. Energy Minimization Methods, comparison between global minimum conformation and bioactive conformation. Molecular docking and drug receptor interactions, Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE) **SECTION-C** **Molecular Properties and Drug Design:** Prediction and analysis of ADMET properties of new molecules and its importance in drug design. De novo drug design, Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. Homology modeling and generation of 3D-structure of protein. **Pharmacophore Mapping and Virtual Screening:** Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In Silico drug design and virtual screening techniques, similarity based methods and pharmacophore based screening, structure based In-silico virtual screening protocols. **Books recommended:** 1. Robert, M. (2007). *Computational and structural approaches to drug discovery*, 1st Ed., Italy: RCS Publishers. 2. Martin, Y.C. (2010). *Introduction to Quantitative Drug Design*, 2nd Ed., New York: CRC Press, Taylor & Francis group. *3.* Ariens (1975). *Drug Design*, Academic Press, Elsevier Publishers, 1975. 4. Smith, H.J., Williams, H. (2005). Smith *Principles of Drug Design*. CRC Press, Taylor & Francis.	Nomencalture of course is changed from "Computer Aided Drug Design" to "Principles of Drug Discovery" No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Chemistry, Ippincott Williams & Wilkins. 9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers. 10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore	5. Silverman, R.B. (2010). *The Organic Chemistry of the Drug Design and Drug action*, Elsevier Publishers. 6. Abraham, D.J., Rotella, D.P (2010). Burger's *Medicinal Chemistry*, 7th Ed., Wiley Publishing Co. 7. Patrick, G.L. (1995). *An Introduction to Medicinal Chemistry,* Oxford University Press. 8. Gisvold's, W. (2004). *Text book of Organic Medicinal and Pharmaceutical Chemistry,* 11th Ed., Lippincott Williams & Wilkins.	
Course code PHAR 525 **Course name** Pharmacological and Toxicological Screening Methods-II	Upon completion of this course student will have an understanding of: • preclinical safety and toxicological evaluation of drug & new chemical entity. • regulatory aspects for the toxicological evaluation of drugs and chemicals. • types of toxicity studies and their procedure. • importance of ethical and regulatory requirements for toxicity studies. • practical skills required to conduct the preclinical toxicity studies. • use of experimental animals for the different toxicological studies.	**SECTION-A** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Pam, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, antiinflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti -emetic, antidiarrheal and laxatives. **SECTION-B** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic antidyslipidemic agents. Anti cancer agents. Hepatoprotective screening methods. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** immunomodulators, Immunosuppressants and immunostimulants. **SECTION-C** **General principles of immunoassay:** theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin Limitations of animal experimentation and alternate animal experiments. Extrapolation of in vitro data to preclinical and preclinical to humans **Reproductive toxicology studies**: Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenecity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies. **Books recommended:** 1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin 2. Screening methods in Pharmacology by Robert Turner. A 3. Evaluation of drugs activities by Laurence and Bachrach 4. Methods in Pharmacology by Arnold Schwartz. 5. Pharmacological experiment on intact preparations by Churchill Livingstone 6. Drug discovery and Evaluation by Vogel H.G. 7. Experimental Pharmacology by R.K.Goyal. 8. Preclinical evaluation of new drugs by S.K. Gupta 9. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.	**SECTION-A** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Pam, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, antiinflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti -emetic, antidiarrheal and laxatives. **SECTION-B** **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic antidyslipidemic agents. Anti cancer agents. Hepatoprotective screening methods. **Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.** immunomodulators, Immunosuppressants and immunostimulants. **SECTION-C** **General principles of immunoassay:** theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin Limitations of animal experimentation and alternate animal experiments. Extrapolation of in vitro data to preclinical and preclinical to humans **Reproductive toxicology studies**: Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenecity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies. **Books recommended:** 1. Burn, D.J., Finney, D.J., Goodwin, I.G.. *Biological standardization*. (1952) London: Oxford University Press. 2. Turner, A.R. (2013). *Screening methods in Pharmacology,* Cambridge: Academic Press.	No changes in the syllabus. "Suggested e-material:" has been added.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		10. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK. 11. Screening Methods in Pharmacology, Robert A.Turner. 12. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee. 13. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi (Author), Ajay Prakash (Author)	3. Laurence, R.D., Bacharach, L.A (2013). *Evaluation of drugs activities : Pharmacometrics,* Cambridge: Academic Press. 4. Schwartz, A. (2013). *Methods in Pharmacology,* 1st Ed., New York: Springer. 5. Mcleod, J.L. (1970). *Pharmacological experiment on intact preparations,* London: Churchill Livingstone. 6. Vogel, H. (2008). *Drug Discovery and Evaluation: Pharmacological assays,* 3rd Ed., New York: Springer. 7. Goyal, R.K. (2017). *Practical In Pharmacology*, B.S.Shah Prakashan. 8. Gupta, S.K. (2009). *Drug Screening Methods (Preclinical Evaluation of New Drugs)*, Jaypee Brothers Medical Publishers (P) Ltd . 9. Kulkarni, S.K. (2008). *Practical Pharmacology and Clinical Pharmacy*, Delhi: Vallabh Pub. 10. David, R.G. (2009) *Animal Models in Cardiovascular Research*, New York: Springer. 11. Robert, A.T. (2013) *Screening Methods in Pharmacology*, Elsevier Publishers. 12. Chatterjee, T.K. (2018) *Rodents for Pharmacological Experiments*, Pharma Med Publication. 13. Medhi, B., Prakash, A. (2010). *Practical Manual of Experimental and Clinical Pharmacology,* 1st Ed., New Delhi: Jaypee Medical Publishers. **Suggested e-material:** 1. Pharmacology (Miles Hacker, William S. Messer) http://www.sciencedirect.com/science/book/9780123695215 2. Therapeutic drug monitoring Dasgupta, Amitava http://www.sciencedirect.com/science/book/9780123854674 3. A comprehensive guide to toxicology in preclinical drug development Faqi, Ali S. http://www.sciencedirect.com/science/book/9780123878151 4. Biomarkers in toxicology Gupta, Ramesh C. http://www.sciencedirect.com/science/book/9780124046306 5. Biased signaling in physiology, pharmacology and therapeutics Arey, Brian http://www.sciencedirect.com/science/book/9780124114609 6. Drug-induced liver disease Kaplowitz, Neil http://www.sciencedirect.com/science/book/9780123878175	
Course code PHAR 527L **Course name** Pharmacology Lab -II		1. To record the DRC of agonist using suitable isolated tissues preparation. 2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation. 3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation. 4. To determine to the strength of unknown sample by interpolation bioassay by using suitable tissue preparation	1. To record the DRC of agonist using suitable isolated tissues preparation. 2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation. 3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation. 4. To determine to the strength of unknown sample by interpolation	No changes

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation 6. To determine to the strength of unknown sample by multiple point bioassay by using suitable tissue preparation. 7. Estimation of PA2 values of various antagonists using suitable isolated tissue preparations. 8. To study the effects of various drugs on isolated heart preparations 9. Recording of rat BP, heart rate and ECG. 10. Recording of rat ECG 11. Drug absorption studies by averted rat ileum preparation. 12. Acute oral toxicity studies as per OECD guidelines. 13. Acute dermal toxicity studies as per OECD guidelines. 14. Repeated dose toxicity studies- Serum biochemical, haematological, urine analysis, functional observation tests and histological studies. 15. Drug mutagenicity study using mice bone-marrow chromosomal aberration test. 16. Protocol design for clinical trial. (3 Nos.) 17. Design of ADR monitoring protocol. 18. In-silico docking studies. (2 Nos.) 19. In-silico pharmacophore based screening. 20. In-silico QSAR studies. 21. ADR reporting	bioassay by using suitable tissue preparation 5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation 6. To determine to the strength of unknown sample by multiple point bioassay by using suitable tissue preparation. 7. Estimation of PA2 values of various antagonists using suitable isolated tissue preparations. 8. To study the effects of various drugs on isolated heart preparations 9. Recording of rat BP, heart rate and ECG. 10. Recording of rat ECG 11. Drug absorption studies by averted rat ileum preparation. 12. Acute oral toxicity studies as per OECD guidelines. 13. Acute dermal toxicity studies as per OECD guidelines. 14. Repeated dose toxicity studies- Serum biochemical, haematological, urine analysis, functional observation tests and histological studies. 15. Drug mutagenicity study using mice bone-marrow chromosomal aberration test. 16. Protocol design for clinical trial. (3 Nos.) 17. Design of ADR monitoring protocol. 18. In-silico docking studies. (2 Nos.) 19. In-silico pharmacophore based screening. 20. In-silico QSAR studies. 21. ADR reporting	

Name of Programme: Master of Pharmacy (Pharmaceutical Chemistry, Pharmaceutics & Pharmacology)

Course details: Third Semester & Fourth Semester

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
PHAR 601P		Project (Part-I)		**No Changes**
PHAR 602P		Project (Part-II)		**No Changes**
Course code Pharmacovigilance (Reading Elective)	Upon completion of this course student will have an understanding of: • Types of clinical trial designs. • Responsibilities of key players involved in clinical trials • Safety monitoring, reporting and close-out activities. Principles of pharmacovigilance		**Section A** Introduction to Pharmacovigilance, Basic terminologies used in pharmacovigilance, Regulatory terminologies, History and development of Pharmacovigilance Importance of safety monitoring of Medicine, WHO international drug monitoring programme , Pharmacovigilance Program of India(PvPI), WHO adverse reaction terminologies, WHO drug dictionary, Introduction to adverse drug reactions, Terminologies of adverse medication related events, Specialised resources for ADRs, Definitions and classification of ADRs, Detection and reporting, Methods in Causality	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			assessment, Severity and seriousness assessment, Predictability and preventability assessment Management of adverse drug reactions. **Section B** Drug and disease classification, Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, Daily defined doses International Nonproprietary Names for drugs Drug dictionaries and coding in pharmacovigilance Information resources in pharmacovigilance, Basic drug information resources, Establishing pharmacovigilance programme in hospital & industry Pharmacovigilance methods Passive surveillance – Spontaneous reports and case series Active surveillance – Sentinel sites, drug event monitoring and registries Comparative observational studies – Cross sectional study, case control study and cohort study **Section C** Communication in pharmacovigilance, Drug Safety Crisis management, Contract Research Organisations (CROs) Establishing a national programme, Vaccine Pharmacovigilance Regulatory Agencies, Business Partners, Healthcare facilities & Media Safety data generation, Pre-clinical phase & Clinical phase Post approval phase, ICH Guidelines for Pharmacovigilance Pharmacovigilance planning, good clinical practice in pharmacovigilance studies Drug safety evaluation in special population Paediatrics, Pregnancy and lactation, Geriatrics CIOMS, D&C Act and Schedule Y Differences in Indian and global pharmacovigilance requirements Pharmacogenomics of adverse drug reactions **Books recommended:** 1. Waller, P. and Harrison-Woolrych, Mira. (2017). *An Introduction to Pharmacovigilance*. Second edition, New Jersy: John Wiley & Sons Ltd 2. Cobert, B.L. (2015).*Manual of Drug Safety and Pharmacovigilance*. Burlington: Jones and Bartlett Publishers. 3. Gupta, S.K. (2018). *Textbook of Pharmacovigilance Icri Institute of Clinical Research (India)*, New Delhi: Jaypee Brothers Medical Publishers. **Suggested e-material**: 1. http://apps.who.int/medicinedocs/pdf/s4893e/s4893e.pdf; 200 (World Health Organization. The Importance of Pharmacovigilance: Safety Monitoring of Medicinal Products. Geneva: WHO) 2. http://ec.europa.eu/enterprise/pharmaceuticals/pharmacovigilance/docs/acs_consultation_final.pdf; 2006. (Assessment of the European Community System of Pharmacovigilance) 3. http://www.fda.gov/Drugs/DevelopmentApprovalProcess/HowDrugsareDevelopedandApproved/ApprovalApplications/ Investigational New Drug IND Application/ucm226358.html	

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			4. (Rule: Investigational New Drug Safety Reporting Requirements for Human Drug and Biological Products and Safety Reporting Requirements for Bioavailability and Bioequivalence Studies in Humans,) 5. Common Terminology Criteria for Adverse Events (The Importance of Pharmacovigilance and Common Terminology Criteria for Adverse Events) 6. www.cdsco.nic.in/writereaddata/pharmacovigilanceGuidance.pdf (Guidance for industry on PharmacoviGilance requirements)	
Course code Nutraceuticals (Reading Elective)	Upon completion of the course, the student shall be able to understand • Concept of nutraceuticals and their use in various aspect of health. • Chemical aspects of Nutraceuticals and their anti-nutritional factors. • Nutraceuticals regulations.		**SECTION A** **Nutraceuticals as Science:** Introduction, historical perspective, classification, current trends and future scope. Sources of nutraceuticals. Applied aspects of Nutraceutical in Medicine, Human physiology, genetics, food technology, chemistry and nutrition. **Nutraceutical Supplements**: Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibers, Cereals and grains, Health drinks of natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functional foods. **SECTION B** **Properties, structure and functions of:** Glucosamine, Octacosanol, Lycopene, Carnitine, Melatonin and Ornithine alpha ketoglutarate. Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals. **Anti-nutritional Factors present in Foods:** Types of inhibitors present in various foods and how they can be inactivated. Role of Probiotics and Prebiotics as nutraceuticals. Recent advances in techniques & feeding of substrates. Assessment of nutritional status and Recommended Daily allowances. **SECTION C** **Food as remedies:** Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc. Formulation and standardization of Nutraceuticals, Regulatory aspects, FSSAI guidelines. **Books recommended:** 1. Pathak, Y., Selvamuthukumaran, M. (2019). *Flavors for Nutraceuticals and functional foods*, Taylor & Francis Ltd. 2. Matthews, K.R. (2014). *Practical Food Safety: Contemporary Issues and Future Directions,* John Wiley & Sons, Ltd. **3.** Hasler, C.M., (2005).*Regulation of Functional Foods and Nutraceuticals: A Global Perspective,* Blackwell publishing. 4. Gupta, R.C. (2016). *Nutraceuticals, Efficacy, safety and toxicity*, Mica Haley publisher. 5. Aluko, R.E. (2012). *Functional foods and Nutraceuticals*, Springer. **Suggested e-material** 1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257668/	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
Course code Toxicology (Reading Elective)	Upon completion of course student will have understanding of: • Principles of toxicology & clinical toxicology • Management of poision individual • Role of antidotes in various poisoning • Clinical management of various types of drug poisioning		**Section A** Introduction to toxicology, definitions, sub disciplines, types and scope of toxicology, Principles of toxicology & clinical toxicology, mechanisms of toxicities, Pharmacological factors, physiological factors, pathophysiological factors principles of toxicokinetics, clearance, volume of distribution and half-life, Drug-Induced Diseases, adverse drug reactions. **Section B** General principles involved in the management of poisoning, Antidotes and the clinical applications, Supportive care in clinical Toxicology, Gut Decontamination, Elimination Enhancement. Diagnostic test and their interpretation. Clinical symptoms and management of acute poisoning with the following agents : Heavy metals poisoning, Pesticide poisoning, Opiates overdose, antidepressants, barbiturates and benzodiazepines, Alcohol poisoning. **Section C** Clinical symptoms and management of acute poisoning with the following agents Paracetamol and salicylates poisoning, Food poisoning, Hydrocarbons: Petroleum products and PEG, Caustics: inorganic acids and alkali poisoning, CNS stimulants: amphetamine, Radiation poisoning, tobacco, venomous snake bites, clinical effects of venoms, general management as first aid, early manifestations, complications and snake bite injuries, plants poisoning. Mushrooms, Mycotoxins **Books recommended:** 1. Ellenhorn, M.J. (1997), Medical *toxicology – Diagnosis and Treatment of Poisoning*. Second edition. London: Williams and Willkins publication. 2. Hodgson, A. (2010). *Textbook of Modern Toxicology*. New York: J Wiley & Sons. 3. Smart, RC. (2008). *Molecular and Biochemical Toxicology*. 4th ed, New York: J Wiley & Sons. 4. Gilbert, S.G. (2004). *A Small Dose of Toxicology: The health effects of common chemicals*. Boca Raton: CRC Press.	Introduced as Reading Elective.
Pharmaceutical Industrial Management (Reading Elective)	Upon completion of this course student will have an understanding of: • Principles of management • techniques used in marketing • application of the marketing in the pharmaceutical industry • sales promotion		**Section-A** **Marketing:** Definition, general concepts, and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research. **Section-B** **Product decision:** Meaning, Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry. **Promotion**: Meaning and methods, determinants of promotional mix,	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products. **Pharmaceutical marketing channels**: Designing channel, channel members, selecting the appropriatechannel, conflict in channels, physical distribution management: Strategic importance, tasks in physicaldistribution management. **Section-C** **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR. **Pricing:** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issuesin price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing**: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing. **Books recommended:** 1. Kotler, P. Keller, K.L. (2011). *Marketing Management*, New Delhi: Prentice Hall of India. 2. Walker, O.C., Boyd, H.W. and Larreche, J.C. (2006). *Marketing Strategy- Planning and Implementation*, New Delhi: Tata MC GrawHill. 3. Grewal, D. Levy, M. *Marketing*. (2012). 6th edition, New Delhi: Tata MC GrawHill. 4. Kumar, A. Menakshi, N. (2011). *Marketing Management*, New Delhi: Vikas Publishing. **5.** Saxena, R. (2009). *Marketing Management*. New Delhi: Tata MC GrawHill.	
Product Development (Reading Elective)	Upon completion of this course student will be able: • To understand the concept of pre-formulation and their influence on formulation and stability of products. • To develop understanding of BCS Classification, rheology and solubilization in context to dosage form development. • To develop understanding of students about in vitro dissolution study of solids and interpretation of dissolution data.		**SECTION-A** **Preformulation studies:** Introduction, goals of preformulation, physicochemical properties, criteria for selection of drug and excipients, compatibility tests. **Solubility and solubilization:** Development of theoretical relationships of prognostic relevance, techniques of solubilization of drugs including surfactant systems, co-solvents, solid state manipulations, complexation and chemical modifications. **SECTION-B** **BCS classification**: Introduction, classification and its applications. **Partition coefficient:** Pharmaceutical significance of partition coefficient, correlation with in-vivo performance, techniques to estimate log P values, shake flask method, choice of solvent systems, chromatographic determination, effect of various variants like temperature, pH, etc. on partition coefficient. **SECTION-C** **Rheology:** Concepts of rheology, viscoelastic analysis of semisolids, applications and practice of rheology, viscometers. **Performance evaluation, in vitro: Dissolution**: Introduction, Dissolution test apparatus – designs, dissolution testing for conventional and controlled release products, methods of interpretation of dissolution data: model dependent and model independent methods, dissolution profile	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			comparison. **Books recommended:** 1. Wells, J.I. (1990). Pharmaceutical Prefomulation: The Physicochemical Properties of Drug Substances. London: Ellis Horwood, Chiechester. 2. Yalkowsky, S.H. (1981). Techniques of Solubilization of Drugs. New York: Marcel Dekker. 3. Lewis, G.A. (2007). Optimization Methods. In Encyclopedia of Pharmaceutical Technology. New York: Informa Healthcare. 4. Banker, G.S. Rhode, C.T. (1979). Modern Pharmaceutics. New York: Marcel Dekkar Inc. 5. Bean, H.S. Beckett, A.H., Careless, A.H. (1982). Advances in pharmaceutical sciences, Vol. I, II, III & IV, London: Academic Press. **Suggested e-material**: 1. https://pharmaclub.in/free-pharmacy-ebooks-pharmaceutics/ 2. https://www.pdfdrive.com/pharmaceutical-books.html 3. http://202.74.245.22:8080/xmlui/handle/123456789/39/browse?type=subject 4. http://swepub.kb.se/ 5. https://ethos.bl.uk/Home.do	
Molecular Basis Of Drug Discovery (Reading Elective)	Upon completion of the course, the student shall be able to:- • understand receptors and enzymes, the body's molecules most often targeted by drugs. • learn pharmacokinetics (drug adsorption, elimination, and half-life) and metabolism		**SECTION-A** **Drug Target Identification**: Direct biochemical and genetic methods as well as computational inferences can be used to identify and validate small molecule drug targets. To fully delineate "on-target" and "off-target" effects, a blend of these approaches is merited. **Assay development/HTS**: Development and validation of assays for hit identification and confirmation. **Protein Structure determination**: Protein mechanistic and functional studies, as well as rational inhibitor design are often facilitated by the protein structure determination. Basic techniques and procedures for structural biology are described. **SECTION-B** **Rational Small-Molecule Inhibitor Design**: Introduction of ligand-, structure-, as well as computer-aided drug design targeting a protein. Interested students may have hands-on training in computational drug design using the Schrödinger drug design software after class. **Concepts toward Developing Screening Collections for Drug Discovery**: Natural products and their analogs account for over 50% of the pharmacopeia. Fragmentbased drug discovery relies on the identification of smaller ligands to disease targets and their optimization toward more potent lead compounds. Diversity-oriented synthesis aims to produce compound libraries with expanded diversity in molecular architecture. Each of these areas is vitally represented in modern day drug discovery. The lecture will focus on general merits and challenges within each of these drug discovery paradigms. **SECTION-C** **Lead optimization/Medicinal Chemistry:** Upon identification of lead compounds, medicinal chemistry optimization is required to find	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			compounds with improved biological potency as well as drug properties (e.g., pharmacokinetics, Lipinski's rule of 5). **Pharmacokinetics, Toxicology and Formulation**: Many small molecule drug leads showing excellent in vitro activity have failed in vivo mainly due to their poor pharmacokinetics and biodistribution. Drug delivery techniques can improve the pharmacokinetics and enhance the drug accumulation at the pathological site. An overview of drug delivery techniques will be introduced. In addition, some basics in pharmacokinetics and toxicology will also be discussed. **Books recommended:** 1. Beale, J.M., Block, J., Wilson, G. (2010). Organic medicinal and Pharmaceutical Chemistry, 12th Ed., Philadelphia: Lippincott Williams and Wilkins. 2. Lemke, T.L., Williams, D.A., Rocho, V.F., Zito, S.W. (2012). Foye's Principles of Medicinal Chemistry, 7th Ed., Philadelphia: Lippincott Williams and Wilkins. 3. Abraham, D.J., Rotella, R.J. (2010). Burger's Medicinal Chemistry, Drug Discovery and Development, 7th Ed., New York: John Wiley and Sons. 4. Smith, J.H., Williams, H. (2010). Introduction to principles of drug design, 3rd Ed., Harwood Academic Publishers. 5. Remington, P.J., Beringer, P. (2006). Remington's Pharmaceutical Sciences, 21st Ed., Philadelphia: Lippincott Williams and Wilkins. 6. Buckley, G. (1988). Martindale's extra pharmacopoeia, 29th Ed., British journal of general practice. 7. Finar, I.L. (2002). Organic Chemistry: 5th Ed. Volume 2., London:Pearson. 8. Lednicer, D. (1997). The Organic Chemistry of Drug Synthesis, 5th Edition, New York: John Wiley and Sons Ltd. 9. Indian Pharmacopoeia. 10. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. (2009). Vogel's Tatchell-Text book of practical organic chemistry, 5th Ed., London: Pearson. **Suggested e-material:** 1. https://www.wiley.com/enus/Burger%27s+Medicinal+Chemistry%2C+ Drug+Discovery%2C+and+Development%2C+7th+Edition-p-9780470278154 (Burger's Medicinal Chemistry)	
Pharmaceutical Quality Assurance (Reading Elective)	On the completion of this course student shall be able to know • the cGMP aspects in a pharmaceutical industry • the importance of documentation • scope of quality certifications applicable to Pharmaceutical industries • responsibilities of QA & QC departments		**SECTION – A** Introduction: An understanding of the concepts of Quality Assurance, Current Good Manufacturing Practice (cGMP), TQM and Quality Control as applied to the pharmaceutical industry. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation. **SECTION-B** cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical Inspection Convention (PIC), WHO and EMEA covering: Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation, environmental control, utilities andmaintenance of sterile areas, control of contamination and Good	Introduced as Reading Elective.

Course List	Learning outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Warehousing Practice. Documentation in pharmaceutical industry: Three tier documentation, Policy, Procedures and Work instructions, and records (Formats), Basic principles- How to maintain, retention andretrieval etc. Standard operating procedures (How to write), Master Formula Record, Batch Formula Record, Quality audit plan and reports, Protocols and reports, Distribution records. **SECTION C** Manufacturing operations and controls: Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, IPQC, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging. **Books recommended:** 1. Quality Assurance Guide (1996) by Organization of Pharmaceutical Procedures of India, 3rd revised Ed., Volume I & II. 2. Weinberg, S. (1995). Good Laboratory Practice Regulations. 2nd Ed., Vol. 69, New York: Marcel Dekker, Inc. 3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999. 4. Sharma, P. P. (1991). How to Practice GMP's. Agra:Vandana Publications. 5. The International Pharmacopoeia (2005)– Vol I, II, III, IV & V - General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms, 3rd Ed., WHO, Geneva. 6. Hirsch, A. F. (1989). Good Laboratory Practice Regulations. Vol 38, New York: Marcel Dekker Inc. 7. Deshpande, S. W., Gandhi, N. The Drugs and Cosmetics Act 1940 and Rules 1945. 8th Ed., Mumbai:Susmit Publishers. 8. Shah, D. H. (2000). QA Manual. 1st Ed., Business Horizons, Elsevier. 9. Willig, S. H., Stoker J. (1991). Good Manufacturing Practices for Pharmaceuticals A Plan For Total Quality Control. Vol. 52, 3rd Ed., New York: Marcel Dekker Inc. 10. Steinborn L. (2003). GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis. 11. Sarker, D.K. (2008). Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons. **Suggested e-material**: 1. www.ich.org 2. www.iso.org 3. www.fda.gov	Verified Offg. Secretary Banasthali Vidyapith P.O. Banasthali Vidyapith Distt. Tonk (Raj.)-304022