



# Shaping Tomorrow's Pharmacists: The Evolving B. Pharm. Curriculum

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## ARTICLE INFO

## ABSTRACT

The Pharmacy Council of India's initiative to establish a nationwide syllabus is commendable, yet it's imperative to continuously update it to align with evolving technological advancements. A structured mechanism for periodic review by expert panels is essential. Technologies such as artificial intelligence (AI), machine learning (ML), internet of things (IoT), 3D printing of organs, and handheld diagnostic devices are rapidly reshaping business strategies, research methodologies, and future projections across all sectors, including healthcare. It's undeniable that incorporating these concepts into various disciplines' syllabi, not limited to pharmaceutical sciences, is urgently warranted. This article provides a concise overview of the current PCI syllabus while highlighting the necessity and impact of recent technological advancements in healthcare and pharmaceutical sciences. Furthermore, it delves into disruptive technologies, explaining their significance and relevance for inclusion in syllabi. Policymakers must recognize the importance of these emerging technologies, blurring the lines between mathematics and biology, to empower students in terms of employability and entrepreneurship. ABCD (Artificial Intelligence, Blockchain, Coding, and Data Analytics) is poised to revolutionize entire ecosystems, altering how we live, communicate, analyze, manage, and approach various tasks.

**Keywords:** PCI, Technologies, Pharmaceutical Industry and syllabus modification,

## Introduction

The Pharmacy Council of India (PCI), an authoritative body under the Government of India, introduced a standardized national syllabus for B. Pharm. programs in 2016-2017. This review aims to analyze key aspects of the curriculum, including internal assessment tools (both theoretical and practical) and supplementary modules, aligned with PCI guidelines. It also identifies essential topics to be integrated to address the rapidly evolving demands of industries. Regular syllabus reviews, ideally conducted every two years, are crucial to accommodate disruptive technologies that necessitate new skill sets from students. This applies not only to recent graduates but also to professionals already in the field, highlighting the importance of continuous skill enhancement. While acknowledging PCI's efforts in instituting a uniform syllabus nationwide, proactive recommendations are provided for enhancing the curriculum's global relevance and effectiveness.

## PCI curriculum summary

The salient features of syllabus for B. Pharmacy framed by PCI under Regulation 6, 7 & 8 of the Bachelor of Pharmacy (B. Pharm.) course regulations 2014 include:

**Credit point:** 1 hour of theory carries 1 credit point, 1 hour of practical carries 0.5 credit point & 1 hour of tutorial carries 1 credit point.

**Non-University Exam (NUE):** It means there is no external evaluation from affiliating university and it is up to the concerned institute how to evaluate performance of students in these NUE subjects. Following are such NUE subjects:

1. B. Pharm. I semester: Remedial Biology/Remedial Mathematics, Communication skills (Theory/Practical)
2. B. Pharm. II semester: Computer Applications in Pharmacy (Theory/Practical) & Environmental sciences (Theory)
3. B. Pharm. VII semester: The Practice School is a mandatory component where each student must engage for 150 hours, evenly spread across the VII semester. Students are required to select one domain for their Practice School experience, as determined by the program committee. Upon completion of the Practice School, each student must submit a printed report (in triplicate) detailing their experience, limited to 25 pages. Evaluation of the knowledge and skills acquired during the Practice School will be conducted by subject matter experts at the college level, with grade points awarded accordingly.

**Project work (VIII semester):** Each student is required to undertake a project under the guidance of a teacher and subsequently submit a report. The chosen project topic must align directly with one of the elective subjects selected by the student in semester VIII. Projects are to be conducted in groups not exceeding five members. The project report must be submitted in triplicate, consisting of a typed and bound copy of no less than 25 pages. Evaluation of the project will be conducted by both internal and external examiners appointed by the university during the practical examinations of other semester(s). Students will be assessed in groups for a duration of four hours, allowing approximately half an hour per group of five students.

**Industrial training (after VI semester & before commencement of VII semester):** Each candidate must commit to a minimum of 150 hours of work within a pharmaceutical industry or hospital, spanning four weeks. This encompasses various sectors such as the production unit, quality control and assurance departments, analytical laboratory, chemical manufacturing unit, pharmaceutical R&D, clinical pharmacy within hospitals, clinical research organizations, community pharmacies, and others. Upon completion, the student is expected to submit a satisfactory report of their experience, along with a certificate signed by the training organization's authority, to the institute's head.

**Improvement of sessional marks:** There is only one improvement sessional exam/candidate/subject/semester.

**Minimum attendance:** Minimum 80% attendance separately in theory and practical of the subjects of particular semester is compulsory.

#### Promotion rules:

- a. Students may carry forward all courses from the I, II, and III semesters to the IV semester examinations. However, they may not attend courses from the V semester until they have successfully completed all courses from the I and II semesters. This requirement ensures that students must clear all theory and practical components of the first year to be promoted to the third year.
- b. Students are permitted to carry forward all courses from the III, IV, and V semesters to the VI semester examinations. Nonetheless, they are not eligible to enroll in courses from the VII semester until they have satisfactorily completed all courses from the I, II, III, and IV semesters. This criterion ensures that students must clear all theory and practical components of the second year to be promoted to the fourth year.

#### Examination

**Table 1: Internal Assessment (Theory & Practical)**

<b>2 SEs each of 1 hour &amp; 30 marks</b>	<b>2 SEs, each of 4 hours &amp; 40 marks</b>
<b>Average of 2 SE is calculated &amp; adjusted to 15.</b>	<b>Average of 2 SEs is calculated and adjusted to 10</b>
<b>CM of evaluation of 10 marks.</b>	<b>CM of evaluation of 05 marks</b>
<b>CM=4+3+3 (attendance+ academic activities +student teacher interaction)</b>	<b>CM=2+1.5+1.5 (attendance+ practical records &amp; viva voce etc.)</b>
<b>SE +CM (15+10)</b>	<b>SE+CM (10+05)</b>
<b>Average of 2 SE, each of 25 marks is sent to university as internal assessment marks for theory.</b>	<b>Passing Marks 50%. It means out of 15 students must score 08.</b>
<b>Passing Marks 50%. It means out of 25, students must score 13.</b>	<b>Average of two SEs, each of 15 marks is sent to university as internal assessment marks for practical.</b>

		Continuous mode marks distribution (out of 10 for theory) For I Sessional						Continuous mode marks distribution (out of 10 for theory) II Sessional marks													
		First Sessional as per PCI						Second Sessional as per PCI													
Activity no.	1	2						3	4	5	6										
CO no.	1	2						3	4	5	6										
Maximum marks	3	3						3	3	3	3										
Type of activity	Quiz	OBT	Average (3)	STI (3)	Attendance (4)	Total out of 10 Continuous Mode	ISE Marks (Out of 30)	Converted Marks (Out of 15)	Total Internal Marks (Out of 15)	Seminar	Quiz	OBT	Assignment	Average	STI (3)	Attendance (4)	Total out of 10 Continuous	ISE Marks (Out of 30)	Converted Marks (Out of 15)	Total Internal Marks (Out of 15)	Final marks to be sent to university
Roll No.	a	b	(a+b)/2	d	e	(c+d+e)	g	(g/2) = h	f + h = i	j	k	l	m	J+K+L+M = N	o	p	N+O+P=Q	R	R/2 = s	Q + s = r	I+

SE-Sessional Examination; CM-Continuous Mode (see table 4 & 5)

**Table 2: Question paper pattern**

Theory internal (PCI scheme)		Practical internal (PCI scheme)	
I. 10 Multiple Choice Questions	10x01= 10	Synopsis	=10
or Objective Type Questions	05 x02 = 10	Experiments	= 25
(Answer all questions )		Viva voce	= 05
I. Long Answers (Answer 1 out of 2)	01x10= 10		
II. Short Answers (Answer 2 out of 3)	02x05 = 10		
Total: 30 Marks		Total: 40 Marks	

**Table 3: Question paper pattern for subjects having non university examination**

Long answers (Answer 1 out of 2)	01x10=10
Short answers (Answer 4 out of 6)	04x05=20
Total	30 Marks

**Table 4: Continuous mode marks distribution**

An idea way to conduct CM* theory													
Sr. No.	Type of evaluation	After completion of chapter/unit	Frequency before	No. of questions	No of students	Total marks	Time (Min)	Marks			Total	Marks to be added to internal exam	Final marks to be sent to university
Before first sessional								CM	STI	Attendance	10	This marks will be added to the marks secured in first sessional (Theory)	Average of first and second sessional will be sent to university
1	Quiz	1	1	6	Individual	3	15	Average of three activities	3	4			
2	Open book test	2	1	2	Individual	3	15						
3	Seminar	3	1	PPT compulsory (NMT 10 slides)	Group (NMT 5/group)	3	15						
Before second sessional								Aver	3	4	1	This	

4	GD	4	1	TPO will decide	Individual	3	15	age of three activities			0	marks will be added to the marks secured in first sessional (Theory)
5	Open book test	5	1	2	Individual	3	15					
6	Assignment	Al	1	Routine assignments as per PPPE	Individual	3	15					

*CM: Continuous mode			^Student-Teacher Interaction		PCI curriculum: Scheme of marks (Practical)				
% attendance	Theory marks out of 4	Practical marks out of 2	STI will be calculated based on ABC		First practical Sessional	Second practical Sessional			
95-100	4	2	A	Attitude & aptitude	Record book & viva voce	Attendance	Record book & viva voce	Attendance	Total
90-94	3	1.5	B	Behaviour	3 marks	2 marks	3 marks	2 marks	5 marks
85-89	2	1	C	Co/extracurricular participation	Faculty members have to evaluate performance on same day and must award marks out of 3+2 on same day on journal directly.				
80-84	1	0.5	<u>Faculty may submit these marks before each sessional along with question paper.</u>		For all 6 CM tools students may use a single note book only.				
< 80	0	0							

## Topics which are expected to be in syllabus on urgent basis

**Artificial Intelligence (AI):** AI is one of the largest technology revolutions with the potential to disrupt many aspects of human existence. To keep pace with this fast growing and highly demanding technology, Central Board of Secondary Education (CBSE) has decided to introduce AI as an elective subject for grades 8, 9 & 10. Results are seen as average qualification rate of Topper JEE students has gone to 36% against normal success rate of 20%. Another app is EduGorilla which answers career related queries, study material, search institutes. Rohit Manglik, CEO says company uses Big Data to analyses 600,000 primary schools and greater than 70,000 training centers to endow with apex quality results. Embibe is another AI powered learning platform. None of above apps really caters for classroom teaching of AI syllabus as prescribed by CBSE for class 8, 9& 10. Syllabus of class 9 is attached. Trained AI school teachers will not be easily available<sup>3</sup>.

**Table 2: Definitions of terms**

Term	Definition
Artificial intelligence	The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision making and translation between languages
Block chain	A time-stamped series of immutable record of data that is managed by cluster of computers not owned by any single entity. Each of these blocks of data (i.e. block) are secured and bound to each other using cryptographic principles (i.e. chain)
Coding	Coding is computer language used to develop apps, websites and software. Without it, major technologies such as Facebook, smart phones, the browser to view our favorite blogs or even the blogs themselves.
Data analytics	Data analytics is the science of analyzing raw data in order to make conclusions about that information. Many of the techniques and processes of data analytics have been automated into mechanical processes and algorithms that work over raw data for human consumption
Python	Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace
Internet of things	The interconnection via the internet of computing devices embedded in everyday objects, enabling them to send and receive data
Augmented reality	A process of combining or "augmenting" video or photographic displays by overlaying the images with useful computer-generated data. The earliest applications of augmented reality were almost certainly the "heads-up-displays" (HUDs) used in military airplanes and tanks, in which instrument panel-type information is projected onto the same cockpit canopy or viewfinder through which a crew member sees the external surroundings.
Virtual reality	Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds

## Technologies that have power to change Pharma Industry<sup>3</sup>

Artificial Intelligence & Machine Learning Computerized reasoning in Pharma alludes to the utilization of mechanized calculations toper form under takings which generally depend on human insight.

List of top ten Pharma Industry working with AI;

1. AbbVie
2. Amgen
3. Astellas
4. AstraZeneca
5. BASF
6. Bayer
7. Boehringer Ingelheim
8. Bristol Myers Squibb (BMS)
9. Celgene

10. Eli Lilly.

### Internet of Medical Things

The Internet of Medical Things (IoMT) is the Accumulation of therapeutic gadgets and applications that interface with human services IT frameworks through online PC systems. Restorative gadgets outfitted with Wi-Fi enable the machine-to-machine correspondence that is the premise of IoMT<sup>3</sup>.

### 3-D Bio Printing

Bio-printing includes the genuine 3 D printing of two materials:

1. The bio material or non-living platform
2. The "bio-ink" or living pieces of the structure

**Fig. 1.** 3D bio-printing of tissues and organs<sup>6,7</sup>



### Discussion and conclusion:

It's commendable that PCI has developed its own nationwide syllabus. However, the dynamic nature of technology necessitates frequent updates to the syllabus. Therefore, there should be a system in place for regular review by an expert panel.

The landscape of business planning and research in healthcare is swiftly evolving due to advancements like machine learning and the Internet of Things. Researchers are exploring innovative techniques such as bio-printing, which involves assembling live cells layer-by-layer to create basic tissues. Companies like Organovo are providing these tissues to facilitate experimental testing for potential therapeutic candidates. Additionally, the utilization of three-dimensional (3D) printing for creating replacement body parts is gaining traction, as evidenced by discussions at events like the Inside 3D Printing conference in April 2015.

In this article, we summarize the current syllabus developed by PCI and explore various disruptive technologies, along with their significance and relevance to the syllabus. PCI should pay attention to these emerging technologies, which are blurring the lines between mathematics and biology. This transformation of biology into coding, facilitated by non-medical experts, underscores the necessity of training pharmacy students in these areas.

The importance of these disruptive technologies is evident from the forecast that the top pharmaceutical companies in the next decade will likely include newcomers from the technology or internet sectors. To remain competitive and contribute to the rapidly evolving diagnostic and pharmaceutical industries, it's imperative to adapt and update the syllabus accordingly.

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