



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 10/03/2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No : PHA G 535
Course Title : Biomaterials
Instructor-in-Charge : Dr. Deepak Chitkara
Instructor(s) :
Tutorial/Practical Instructors : NA

1. Course Description:

Introduction to biomaterials for pharmaceutical applications; polymeric biomaterials; Natural and synthetic polymers for drug delivery, regenerative medicine and nanomedicines; Polymer properties including crystallinity, glass transition, polymer degradation influencing pharmaceutical formulations; biocompatibility; biodegradation; in-vitro and in-vivo assessment of polymer toxicity.

2. Scope and Objective of the Course:

The objective of this course is to impart knowledge on various aspects of materials used in biomedical and pharmaceutical applications. The primary focus would be on the natural and synthetic polymers, their design, characterization, properties, assessment and applications in pharmaceuticals.

3. Text Books:

1. Abraham J. Domb, Neeraj Kumar and Aviva Ezra, Biodegradable Polymers in Clinical Use and Clinical Development, Published by John Wiley and Sons, Inc
2. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterials Science An Introduction to Materials in Medicine, 2nd Edition, Elsevier Academic Press.

4. Reference Books:

1. Sangamesh G. Kum-bar, Cato Laurencin, Meng Deng, Natural and Synthetic Biomedical Polymer (1st edition), published by Elsevier Science.
2. Johnna S. Temenoff, Antonios G. Mikos, Biomaterials: The Intersection of Biology and Materials Science, 1st edition, Published by Pearson (January 2nd 2008)
3. Deepak Chitkara, Anupama Mittal, Ram I. Mahato, Molecular Medicines for Cancer: Concepts and Applications of Nanotechnology, CRC Press; 1 edition, 2018

5. Course Plan:

Module Number	Lecture session/Tutorial Session.	Reference	Learning Outcome
1. Biomaterials for Pharmaceutical applications	L1.1. Introduction to biomaterials and its applications L 1.2. Different types of polymers for drug, gene and protein delivery L1.3. Polymers for regenerative medicine	T2. Section II.5 R2 Ch. 1 Journal articles	Understanding of biomaterials, their uses in pharmaceutical formulations



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2. Polymers for biomedical applications	L2.1 Polymers of natural origin in pharmaceuticals- Gelatin, collagen, chitosan, alginate, Dextrans	T1. CH. 2, 3, 4, 5 and 6 R1. Ch 4, 5 Journal articles	Understanding polymers of different origins, their structures, synthesis and properties
	L2.2. Synthetic polymers in pharmaceuticals-Polyesters, polyanhydrides, polycarbonates, etc	T1. CH. 9, 10 and 11 R1. Ch. 6, 8, 10 and 11 Journal articles	
3. Polymer properties influencing pharmaceutical formulations	L3.1. Polymer bulk and surface characterization. Thermal/mechanical properties of polymers, surface and morphological characterization. L3.2. Characterization techniques such as gel permeation chromatography, NMR, viscometry L3.2. Crystallinity, glass transition, polymer degradation	R1 Ch. 2, 20 R2 Ch. 3 and 4 Journal articles	Understanding properties of the polymers, different characterization techniques
4. Biodegradation	L4.1. Degradation of materials in biological environment	T2. Section II.4	Understanding properties of the biodegradation of polymers
5. Polymers for emerging clinical applications	L5.1. Polymeric systems for nucleic acid delivery L5.2 Polymers for tissue engineering and regenerative medicine L5.3. Polymers for nanomedicines L5.4. Polymers for diagnostic applications	R3. Ch 10, 11, 16 Journal articles, class notes	Understanding different application of biomaterials in emerging areas
6. <i>In vitro</i> and <i>in vivo</i> assessment of polymer toxicity	L5.1. Biological response to biomaterials, immune response to foreign materials, Blood-material interactions	T2 Section II.2.1, II2.3, II.2.6 R2 Ch. 9, 12 Journal articles	Understanding the biological response towards polymers and their assessment
	L5.2. Biological Testing of biomaterials, concept and assessment of biocompatibility, in vitro and in vivo assessment, Evaluation of blood material interactions	T2 Section II.3 Journal articles, class notes	

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	30	<TEST_1>	CB/OB
Comprehensive Examination	3 h	40	<TEST_C>	CB/OB
Literature Survey, Seminars/ Research Summaries/Assignments		30		



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Students are strongly advised to prepare their own notes based on class lectures and relevant information from textbook and reference material, as only these notes would only be allowed for consultation during assessments of open book evaluation components. Photocopies of any material, written or printed will not be permitted. Stapled sheets, loose sheets of information written or printed will not be allowed.

*Slides used during class hours provide key information for which additional supportive information is expected to be collected from sources aforementioned. Recent developments in the area/topic will be discussed in class based on their significance to healthcare delivery and hence some information on therapeutic benefits and toxicity effects, besides others, may differ from the information in text, reference material and hence students are expected to take note of such key discussions during contact hours. Such discussions held in class will be considered as primary source of information in assessments.

Quiz(zes) may/will be conducted as a part of evaluation component, at random, during contact hours including lecture, tutorial hours, as convenient, with/without prior intimation and sometimes outside class contact hours and hence it is expected that the students come prepared to every class on topics covered in earlier contact hours. Regular classes will be held in designated tutorial hour to maintain continuity.

7. Chamber Consultation Hour: To be announced in the class.

8. Notices: Pharmacy Notice Board.

9. Make-up Policy: Make-ups are not given as a routine. It is solely dependent on the “genuineness” of the circumstances under which a student fails to appear in a scheduled evaluation component. Prior permission should be sought from the instructor-in-charge in advance.

10. Note (if any): Grading Procedure: As specified in Handout – Part I, appended to the timetable, the instructor in-charge reserves the right to award a NC report in case the student does not make himself/ herself available for any of the evaluation component mentioned above. Also it is not imperative on part of the instructor in-charge to award all the grades. Borderline cases during grading will be judged on the basis of regularity to classes and consistency or progress in the performance in evaluation components. The maximum pull-up to be exercised by the instructor in-charge will be announced in the class and shall be based on the subjective judgment of the evaluator.

All evaluation components are equally important, irrespective of weightage. Hence, students failing to attend scheduled classes, or absenting themselves in one or many of the evaluation components, may become ineligible for obtaining a valid grade at the end of the semester. Attendance in lectures are all equally important as they are all integral components of learning, irrespective of weightage and may be taken into consideration, during grading.

Hence, students are strongly advised to keep away from absenting themselves from all aforementioned contact sessions. Clearing the course would require adequate performance (i.e. procuring low marks in evaluation components, aforementioned would not suffice, to clear the course).

Instructor-in-charge
Course No. PHA G 535