**Date: 13/08/2020**

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. Nirmal J**

**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](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Deepak+Chitkara&search-alias=stripbooks), [Anupama Mittal](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Anupama+Mittal&search-alias=stripbooks), [Ram I. Mahato](https://www.amazon.in/s/ref=dp_byline_sr_book_3?ie=UTF8&field-author=Ram+I.+Mahato&search-alias=stripbooks), Molecular Medicines for Cancer: Concepts and Applications of Nanotechnology,  CRC Press; 1 edition, 2018.
4. **Course Plan:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lecture No** | **Learning objectives** | **Topics to be covered** | **Reference** | **Learning Outcome** |
| 1-8 | Biomaterials for Pharmaceutical applications | What is the need for biomaterials? | T2. Section II.5  R2 Ch. 1  Journal articles | Understanding of biomaterials, their uses in pharmaceutical formulations |
| Introduction to biomaterials and its applications in implants and drug delivery systems |
| 9-15 | Polymers for biomedical applications | 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 |
| Synthetic polymers in pharmaceuticals-Polyesters, polyanhydrides, polycarbonates, etc | T1. CH. 9, 10 and 11  R1. Ch. 6, 8, 10 and 11  Journal articles |
| 16-22 | Polymer properties influencing pharmaceutical formulations | Polymer bulk and surface characterization. Thermal/mechanical properties of polymers, surface and morphological characterization. | R1 Ch. 2, 20  R2 Ch. 3 and 4  Journal articles | Understanding properties of the polymers, different characterization techniques |
| 23-28 | Biodegradation | Degradation of materials in biological environment | T2. Section II.4 | Understanding properties of the biodegradation of polymers |
| 29-33 | *In vitro* and *in vivo* assessment of polymer toxicity | 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 |
| 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 |
| 34-42 | Polymers for emerging clinical applications | Polymeric systems for nucleic acid delivery | R3. Ch 10, 11, 16  Journal articles, class notes | Understanding different application of biomaterials in emerging areas |
| Polymers for tissue engineering and regenerative medicine |
| Polymers for nanomedicines |
| Polymers for diagnostic applications |

1. **Evaluation Scheme**:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Remarks** |
| Mid-Semester Test | 90 min | 30 |  | Close book |
| Seminars/Assignments/ Research summaries | -- | 30 | Will be announced in the class | Open book |
| Comprehensive Examination | 120 min | 40 |  | Close book / Open book |

\*: Assignments/seminar topics, mode of evaluation and number will be announced in the regular class.

\*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.

**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. In borderline cases subjective judgment will be exercised for pull-up’s (max. 2%).

1. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge

Course No. PHA G 535