BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

FIRST SEMESTER 2021-2022

Course Handout (Part II)

07/08/2021

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 G537**
***Course Title*:** **Parenteral Product Development**
***Instructor-in-charge* :** **Dr. Akash Chaurasiya**
Instructor: **Dr. Akash Chaurasiya**

1. Course Description:

Introduction to parenteral Product & their types, products characteristics; Vehicles requirement for Parenteral Products manufacturing; Formulation & process consideration for development of parenteral products; Introduction & understanding of various aspects of unit operation in parenteral product manufacturing; Critical Quality attributes of Parenteral Product; Various Sterilization techniques for parenteral products; Understanding of key requirements for aseptic processing; Understanding of Lyophilization techniques of stable product development; Regulatory consideration for safety assessment of Parenteral Products; Packaging requirement for Parenteral Drug Products; Regulatory perspective for Complex Injectable products development and filing.

2. Scope and Objective of the course:

This course will provide overview on parenteral product development & designed for students to understand critical aspect of parenteral product development and manufacturing. This course covers basic information, understanding and application of key operations followed during parenteral product manufacturing like lyophilization, aseptic processing, & filtration along with Quality Assurance, control & packaging requirement. This course also covers regulatory consideration for parenteral product assessment with respect to safety for intended application.

3. Learning outcome:

- Complete understanding of formulation, process, manufacturing and packaging aspect of parenteral drug product
- Complete understanding, importance & application of lyophilization process
- Knowledge of critical quality attributes in parenteral product development.
- Knowledge of regulatory expectation for safety assessment of parenteral products

4. Text Books:

1. Niazi SK, "Handbook of Pharmaceutical Manufacturing Formulations – Sterile Products" INforma healthcare, New York, 2nd Edn, Vol. 6, 2009.
2. Akers M.J., Sterile Drug Products: Formulation, Packaging, Manufacturing and Quality, CRC Press, 1st Edition, 2010.

Reference Books:

1. Sandeep Nema, John D. Ludwig, “Pharmaceutical Dosage Forms: Parenteral Medications”, Vol. 1-3, CRC Press, 3rd Edition, 2010.
2. Adeboye Adejare “Remington: The Science and Practice of Pharmacy” Pharmaceutical Press, 23nd Edition, 2020.
3. Parenteral Drug Association (PDA) Technical Reports.
4. U.S. Pharmacopeia, U.S. Pharmacopeial Convention Inc., Rockville, MD, 43rd Edn., 2020.

5. Course Plan:

Lecture No.	Learning Objectives	Topic to be covered	Ref
1-2	Parenteral Drug product	• Introduction, Historical Perspective, Characteristics & Types	T2 Ch 1-3 R1(V1) Ch1
3	Vehicles for Parenteral Products	• Aqueous - Key requirement for High Quality water system (WFI) for parenteral product • Non-aqueous solvents	T2 Ch 6 R1(V1) Ch5
4-6	Formulation & process development of parenteral products	• Formulation development - Selection & optimization of various excipients like Buffers, antioxidants, surfactants, pH adjusting agents, tonicity modifiers, etc. to obtain desired quality attributes • Process development – Key consideration for process development and control of parameters like temperature, light, oxygen, hydrolysis, etc.	T2 Ch 5, 6, 8 R1(V1) Ch 4, 5
7-9	Unit Operations in Parenteral Product Manufacturing	• Introduction & understanding of various aspects of parenteral product manufacturing unit operations like dispensing, compounding, filling, stoppering, sealing, inspection, labelling & packaging	T2 Ch 12 R1(V2) Ch1
10-15	Critical Quality attributes of Parenteral Product	Introduction, understanding & compendial requirement for various quality attributes like • Physical – Surface Tension, Viscosity, Particulate Matter, Color, Clarity, etc. • Chemical – Assay, Impurities, content of functional excipients, etc. • Microbiological – Bioburden, BET, Sterility, CCIT, etc.	T2 Ch 27, 28, 29, 30 R1(V2) Ch5, 6, 7 R1(V3) Ch9
16-24	Sterilization	• Selection of sterilization method – Decision	T2 Ch 17,

Lecture No.	Learning Objectives	Topic to be covered	Ref
	techniques for parenteral products	Tree • Terminal Sterilization – Dry Heat and moist heat Sterilization, Cycle development, D-value determination, validation, Indicator, Minimum Maximum load • Filtration – Types of filters like Cartridge, Capsule, Depth, Membrane filters, etc.; Filter Material of Construction like PES, PVDF, Nylon, PTFE, etc.; Modes of filtration – Series filtration, Parallel filtration, etc.; Filter validation studies. • Basic understanding and application of other techniques like Ethylene oxide sterilization, Gamma Sterilization, E-beam sterilization, X-ray sterilization, etc.	18 R1(V2) Ch8, 9, 10, 11, 12, 13 T1 Ch 4
25-29	Aseptic Processing	Understanding of key requirements for aseptic processing like • Personnel, Equipment and building requirement • Cleaning, disinfection & sterilization requirement – CIP, SIP, VHP, etc. • Media fill trials – overview and approaches	T2 Ch 21 T1 Ch 4
30-33	Lyophilization of Parenterals	• Introduction – Principle • Application of Freeze Drying • Formulation aspects of freeze dried products • Development of Lyophilization Cycle and Controls • Key challenges and defects in lyophilized product • Design and Key components lyophilizer	T2 Ch 20 R1(V2) Ch15 USFDA Guidelines Class notes
34-36	Regulatory consideration for safety assessment of Parenteral Products	Understanding of various tests needs to be done to assess safety of parenteral products like • Extractable and Leachable Study • Elemental impurity assessment • Glass Delamination Study • Shelf life assessment using stability studies	R1(V3) Ch10 T2 Ch 6 USP Chapters
37-39	Packaging requirement	• Introduction to various type of packaging system for parenteral drug product	T2 Ch 6

Lecture No.	Learning Objectives	Topic to be covered	Ref
	for Parenteral Drug Products	• Innovation in Drug Device Combinations - Prefilled syringes, Pen devices, cartridges system, etc.	R1(V1) Ch11, 12, 13 R1(V3) Ch5 Class notes
40-41.	Regulatory perspective for Complex Injectable products	• Regulatory consideration with respect to design, development and filing strategy for complex injectable products like Nanoparticles, liposomes, microspheres, nanosuspensions, etc.	Class notes

6. **Evaluation Scheme:**

Component	Duration	Weightage (%)	Date & Time	Remarks
Mid-semester Test	90 min	30		CB
Seminars/Assignments/Research Summary	-	30		OB
Comprehensive exam	120 min	40		OB(10)+CB(30)

***OB: Open Book; CB: Closed Book**

Closed Book Exam: No reference material of any kind will be permitted inside the exam hall.

Open Book Exam: Use of any printed / written reference material (books and notebooks) will be permitted inside the exam hall. Loose sheets of paper will not be permitted. Computers of any kind will not be allowed inside the exam hall. Use of calculators will be allowed in all exams. No exchange of any material will be allowed.

7. **Mid-semester evaluation:** Will be announced after the Test.

Attendance: Regularity in attendance will be one of the criteria in deciding the borderline cases at the time of final grading.

8. **Grading Procedure:**
    1. It is not necessary that all the grades would be awarded.
    2. In borderline cases subjective judgment will be exercised for pull-up's (max. 1%). Basic guiding factors will be regularity, consistency in performance (above average) or/and steady improvement throughout the semester.

9. **Make-up:** Make-up will be given only for genuine reasons. It is expected that students shall avoid misuse of this feature.

10. **Consultation hours:** 2 - 3 pm; Thursday & Friday

11. **Notices:** Notices pertaining to this course will be displayed only on online platform.

12. **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
PHA G537