**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**
**INSTRUCTION DIVISION**
**SECOND SEMESTER 2020-2021**
**Course Handout (Part II)**

11/03/2021

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 G537**
***Course Title*: Parenteral Product Development**
***Instructor-in-charge* : Dr. Anupama Mittal**

**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<br>R1(V1) Ch1 |
| 3 | Vehicles for Parenteral Products | • Aqueous - Key requirement for High Quality water system (WFI) for parenteral product<br>• Non-aqueous solvents | T2 Ch 6<br>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<br>• Process development – Key consideration for process development and control of parameters like temperature, light, oxygen, hydrolysis, etc. | T2 Ch 5, 6, 8<br>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<br>R1(V2) Ch1 |
| 10-15 | Critical Quality attributes of Parenteral Product | • Introduction, understanding & compendial requirement for various quality attributes like<br>• Physical – Surface Tension, Viscosity, Particulate Matter, Color, Clarity, etc.<br>• Chemical – Assay, Impurities, content of functional excipients, etc.<br>• Microbiological – Bioburden, BET, Sterility, CCIT, etc. | T2 Ch 27, 28, 29, 30<br>R1(V2) Ch5, 6, 7<br>R1(V3) Ch9 |
| 16-24 | Sterilization techniques for parenteral products | • Selection of sterilization method – Decision Tree<br>• Terminal Sterilization – Dry Heat and moist heat Sterilization, Cycle | T2 Ch 17, 18<br>R1(V2) Ch8, 9, 10, 11, 12, 13<br>T1 Ch 4 |

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| | | development, D-value determination, validation, Indicator, Minimum Maximum load<br>• 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.<br>• Basic understanding and application of other techniques like Ethylene oxide sterilization, Gamma Sterilization, E-beam sterilization, X-ray sterilization, etc. | |
| 25-29 | Aseptic Processing | • Understanding of key requirements for aseptic processing like<br>• Personnel, Equipment and building requirement<br>• Cleaning, disinfection & sterilization requirement – CIP, SIP, VHP, etc.<br>• Media fill trials – overview and approaches | T2 Ch 21<br>T1 Ch 4 |
| 30-33 | Lyophilization of Parenterals | • Introduction – Principle<br>• Application of Freeze Drying<br>• Formulation aspects of freeze dried products<br>• Development of Lyophilization Cycle and Controls<br>• Key challenges and defects in lyophilized product<br>• Design and Key components lyophilizer | T2 Ch 20<br>R1(V2) Ch15<br>USFDA Guidelines<br>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<br>• Extractable and Leachable Study<br>• Elemental impurity assessment<br>• Glass Delamination Study<br>• Shelf life assessment using stability studies | R1(V3) Ch10<br>T2 Ch 6<br>USP Chapters |
| 37-39 | Packaging requirement for Parenteral Drug Products | • Introduction to various type of packaging system for parenteral drug product | T2 Ch 6<br>R1(V1) Ch11, 12, 13<br>R1(V3) Ch5<br>Class notes |

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| | | • Innovation in Drug Device Combinations - Prefilled syringes, Pen devices, cartridges system, etc. | |
| 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** |
|---|---|---|---|
| Mid-semester Test | 90 min | 30 | As give in timetable |
| Quizzes/Seminars/Assignments | - | 30 | |
| Comprehensive exam | 180 min | 40 | 23/06 AN |

**7. Chamber Consultation Hour**: Every Thursday (03:00- 04:00 pm)

**8. Notices:** Notices, if any, concerning the course will be displayed on the Nalanda.

**9. Make-up Policy:** The facility of make-up test is meant to take care of 'Unavoidable' absence from scheduled tests. It is expected that the students will "keep faith" in this respect and avoid any misuse of this useful feature.

**10. Note (if any): ---**

**Instructor-in-Charge**
**PHA G537**