Course Title:	**Down Stream Processing**
Course Code:	**BTL 3536**
Course Coordinator	**Arvind Kumar Yadav**
Credits	**3-0-0**

Evaluation Scheme Total 100 Marks

Quiz (Total 20 Marks)				Assignment/Project (Total 20 marks) (Minimum Two Assignments or one Project)		Mid-Term	Major Examination	Total
Quiz I (5marks	Quiz II (5marks)	Quiz III (5marks)	Quiz IV (5marks)			20marks) (1 ½ Hour Duration)	(40 marks) (3 Hour Duration	100 Marks

WEEKS	TOPICS TO BE COVERED
Week1	**Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses**
Week 2	**Cell disruption for product release – mechanical, enzymatic and chemical methods**
Week 3	**Pre-treatment and stabilization of bio-products. Unit operations for solid-liquid separation**
Week 4	**Filtration**
Week 5	**Centrifugation**
Week 6	**Adsorption**
Week 7	**Liquid-Liquid Extraction, Aqueous two phase Extraction**
Week 8	**Membrane separation-ultrafiltration , microfiltration, nanofiltration**
Week 9	**Reverse osmosis, Dialysis**
Week10	**Precipitation of proteins by different methods**
Week11 (17th -21st March, 2025)	**Mid-Term**
2nd May, 2025	**Showing of Mid-Term Answer Sheets**
Week 13	**Chromatography – principles, instruments and practice**
Week14	**Adsorption, reverse phase, ion exchange, size exclusion Chromatographic techniques**

Week15	**Hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques**
Week 16	**Drying& Crystallization**
Week 17 (5th -9th May, 2025)	**Revision Week**
Week18(13th – 22nd May, 2025)	**Major Examinations**
29th May, 2025	**Showing of Major Exams Answer Sheets**

Course Outcomes:

CO1: Explain the basic principles of downstream processing for recovering products
CO2: Comprehend the prerequisites for effective downstream processing processes
CO3: Describe the components of downstream equipment and explain the purpose of each
CO4: Utilize unit operation concepts in downstream processing to improve problem-solving skills

Recommended Books:

1. Bioprocess Engineering, Shular M&Kargi F, Prentice Hall, 2005.
2. Belter, P.A., E.L. Cussler and Wei-Houhu "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 1988.
3. Sivasankar, B. "Bioseparations: Principles and Techniques"., Prentice Hall, 2021.

Calendar of Quizzes/Assignment etc. to be provided as per below details and exact dates to be fixed in consultation with other course coordinators to avoid overlap of Quizzes of different courses.

Component	Date
Quiz-I	**27th -31st, January 2025**
Quiz-II	**24th -28th February, 2025**
Assignment-I	**10th -12th February, 2025**
Mid-Term	**17-21st March, 2025**
Assignment-II/ **Project Submission**	**21st – 24th April, 2025**
Quiz-III	**7th – 11th April, 2025**
Quiz-IV	**28th April-2nd, May, 2025**
Major Exam	**13th – 22nd May, 2025**

Note:

1. **One surprise Quiz may be fixed out of Quiz-II, Quiz-III or Quiz-IV.**

Signature of Course Coordinator :