Curriculum of Diploma Programme

in

Medical Laboratory Technology

Department of Science, Technology and Technical

Education (DSTTE), Govt. of Bihar

State Board of Technical Education(SBTE), Bihar

Semester – Fourth
Teaching & Learning Scheme

Course Codes	Category of course	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2476401	**PCC**	Body Fluids & Hematology	3	0	4	2	9	6
2476402	**PCC**	Clinical Biochemistry & Serology	3	0	4	2	9	6
2476403	**PCC**	Clinical Microbiology	3	0	4	2	9	6
2476404	**PCC**	Biomedical Instrumentation	3	0	4	2	9	6
2476406	**PS**	Mini Project		0	2	2	4	2
2476405	**PEC**	a) Environmental Toxicology b) Biomedical Waste Management c) Environmental Health and Safety	3	0		2	5	4
			15	00	18	12	45	30

- **Note: Prefix will be added to Course Code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)**
- **Legend:**
- CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
- LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)
- Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.
- TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)
- SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.
- C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)
- **Note:** TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure

Semester – Fourth

Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2476401	**PCC**	Body Fluids & Hematology	30	70	20	30	20	30	200
2476402	**PCC**	Clinical Biochemistry & Serology	30	70	20	30	20	30	200
2476403	**PCC**	Clinical Microbiology	30	70	20	30	20	30	200
2476404	**PCC**	Biomedical Instrumentation	30	70	20	30	20	30	200
2476405	**PSI**	Mini Project			10	15	10	15	50
2476405	**PEC (ANY ONE)**	a) Environmental Toxicology b) Biomedical Waste Management c) Environmental Health and Safety	30	70	20	30			150
			150	**350**	**110**	**165**	**90**	**135**	**1000**

Note: Prefix will be added to Course Code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note: Separate passing is must for progressive and end semester assessment for both theory and practical.

- ETA & ELA are to be carried out at the end of the term/ semester.

Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist

A) Course Code : 2476401(T2476401/P2476401/S2476401)
B) Course Title : Body Fluids & Hematology

C) Pre- requisite Course(s) : Fundamentals of Biology and Human Physiology

D) Rationale

Body Fluids and Hematology provides the essential technical knowledge required for the analysis of blood and other biological fluids, which are critical for disease diagnosis. This course enables learners to master the skills of specimen collection, manual and automated analysis of blood cells, and examination of urine and other body fluids. It builds the foundation for understanding hematological disorders, hemostasis, and transfusion medicine, fostering the analytical capability necessary for professional laboratory practice.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, the learners will be able to-

CO1: Explain the composition of blood, principles of specimen collection, anticoagulants, and the operation of basic hematology instruments.

CO2: Perform and interpret routine hematological investigations including hemoglobin estimation, total cell counts, and differential leukocyte counts.

CO3: Determine hematological indices, ESR, and PCV to evaluate basic hematological status.

CO4: Analyze the physical, chemical, and microscopic properties of urine and other body fluids (CSF, Semen, Serous fluids) for diagnostic purposes.

CO5: Demonstrate blood grouping techniques, coagulation tests, and identify common hematological abnormalities.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply technical skills in phlebotomy, instrument handling, and manual estimation techniques to perform accurate analysis of body fluids and blood parameters.

PSO-2: Correlate laboratory findings with clinical conditions to support diagnosis, ensuring quality control and safety in hematological procedures.

Course Outcomes (COs)	**PO-1** Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design / Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	-	-	1	-	-
CO-2	3	1	-	-	-	-	1	-	-
CO-3	3	2	3	2	1	1	2	-	-
CO-4	3	2	3	2	1	1	2	-	-
CO-5	3	2	3	2	1	1	2	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	**Course Title**	**Scheme of Studies (Hours/Week)**					
		Classroom Instruction (CI)		**Lab Instruction (LI)**	**Notional Hours (TW+SL)**	**Total Hours (CI+LI+TW+SL)**	**Total Credits(C)**
		L	**T**				
2476401	Body Fluids & Hematology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment	End Theory Assessm	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessmen	
2476401	Body Fluids & Hematology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

a. ETA & ELA are to be carried out at the end of the term/ semester.

b. Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done internally (40%) as well as externally (60%). Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476401

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Explain blood composition, functions, and hematopoiesis. **TSO 1.2** Describe anticoagulants, blood collection procedures, and safety. **TSO 1.3** Explain the principle and use of common hematology instruments.	**Unit I – Introduction to Blood, Collection & Instrumentation** 1.1 Blood: Composition, functions, normal values; Plasma vs. Serum. 1.2 Hematopoiesis: Formation of blood cells (simple idea). 1.3 Anticoagulants: Types (EDTA, Citrate, Heparin, Oxalate), preparation, and uses. 1.4 Blood Collection: Venous & Capillary procedure, labeling, and precautions.	**CO-1**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
	1.5 Instrumentation: Microscope, Hemoglobinometer, WBC/RBC pipettes, ESR stand, Cell counter (overview).	
TSO 2.1 Explain principles and methods of hemoglobin estimation. **TSO 2.2** Describe manual procedures for Total RBC and WBC counts. **TSO 2.3** Explain smear preparation and staining for Differential Leukocyte Count (DLC).	**Unit II – Routine Hematology & Cytometry** 2.1 Hemoglobin estimation: Sahli's and Cyanmethemoglobin methods. 2.2 Total RBC Count (Manual): Principle, diluting fluids, counting chamber procedure. 2.3 Total WBC Count (Manual): Principle, diluting fluids, procedure. 2.4 Platelet Count: Introductory method and clinical significance. 2.5 Differential Leukocyte Count (DLC): Blood smear preparation, staining (Leishman/Giemsa), and cell identification.	**CO-2**
TSO 3.1 Describe the principle and methods for ESR and PCV. **TSO 3.2** Calculate and interpret blood indices (MCV, MCH, MCHC).	**Unit III – Hematological Indices & Sedimentation** 3.1 Erythrocyte Sedimentation Rate (ESR): Principle, Westergren & Wintrobe methods. 3.2 Packed Cell Volume (PCV): Microhematocrit and Macrohematocrit methods. 3.3 Blood Indices: Formulas and clinical importance of MCV, MCH, MCHC (Beginner level). 3.4 Correlation of indices with anemia classification.	**CO-3**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 4.1 Explain urine analysis parameters (Physical, Chemical, Microscopic). **TSO 4.2** Describe composition and routine tests for CSF and Semen. **TSO 4.3** Overview of Synovial and Serous fluids.	**Unit IV – Body Fluids Analysis** 4.1 Introduction to body fluids and diagnostic importance. 4.2 Urine: Physical exam, Chemical tests (Sugar, Protein, Ketones), Microscopic exam (Cells, Casts, Crystals). 4.3 Cerebrospinal Fluid (CSF): Normal composition, collection precautions, routine tests (Cell count, Glucose, Protein). 4.4 Semen: Collection guidelines, volume, motility, and morphology (introductory). 4.5 Synovial, Pleural, and Peritoneal Fluids: General concepts.	**CO-4**
TSO 5.1 Explain Blood Grouping and Cross-matching principles. **TSO 5.2** Describe hemostasis and coagulation tests (BT, CT). **TSO 5.3** Identify common hematological abnormalities.	**Unit V – Immunohematology, Coagulation & Abnormalities** 5.1 Blood Grouping: ABO & Rh systems – Principle (Agglutination), Slide & Tube methods, Precautions. 5.2 Cross matching: Major and Minor (Introduction). 5.3 Coagulation & Hemostasis: Introduction to clotting mechanism. 5.4 Coagulation Tests: Bleeding Time (BT) and Clotting Time (CT) procedures. 5.5 Abnormalities: Anemia, Polycythemia, Leukocytosis, Leukopenia, Thrombocytopenia.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2476401

LSO No.	Laboratory Session Outcome (LSO)	Practical / Experiment Title	Relevant CO(s)
LSO 1.1	Demonstrate proper blood collection technique and handling of instruments.	1. Demonstration of Venous and Capillary blood collection with safety precautions.	CO-1
LSO 1.2	Identify parts and use of microscope and pipettes.	2. Handling and maintenance of Compound Microscope and identification of RBC/WBC pipettes.	CO-1
LSO 2.1	Perform Hemoglobin estimation accurately.	3. Estimation of Hemoglobin by Sahli's Acid Hematin method.	CO-2
LSO 2.2	Perform manual Total Leukocyte Count.	4. Total WBC Count (Manual method) using Neubauer chamber.	CO-2
LSO 2.3	Perform manual Total RBC Count.	5. Total RBC Count (Manual method) using Neubauer chamber.	CO-2
LSO 2.4	Prepare and stain blood smear for cell identification.	6. Preparation of peripheral blood smear and staining by Leishman's stain for DLC.	CO-2
LSO 3.1	Determine ESR and PCV values.	7. Determination of ESR (Westergren method) and PCV.	CO-3

LSO No.	Laboratory Session Outcome (LSO)	Practical / Experiment Title	Relevant CO(s)
LSO 4.1	Perform routine urine analysis.	8. Routine Examination of Urine: Physical and Chemical (using strips/reagents).	CO-4
LSO 5.1	Determine blood group of a sample.	9. Determination of Blood Group (ABO and Rh) by Slide method.	CO-5
LSO 5.2	Perform basic coagulation tests.	10. Determination of Bleeding Time (BT) and Clotting Time (CT).	CO-5

L) Suggested Term Work and Self-Learning: S2476401 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Anticoagulants in Hematology: Mechanism and Application	To understand the mechanism of action, specific uses, and correct proportions of different anticoagulants like EDTA, Citrate, and Heparin.	CO-1
2	Sources of Error in Manual Cell Counting	To identify potential pre-analytical and analytical errors in manual RBC and WBC counts to improve precision and accuracy.	CO-2
3	Clinical Significance of Erythrocyte Sedimentation Rate (ESR)	To analyze the factors affecting ESR and its diagnostic value in distinguishing between physiological and pathological conditions.	CO-3
4	Diagnostic Importance of Urine Microscopy	To explain the clinical significance of finding casts, crystals, and cells in	CO-4

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
		urine and their correlation with renal disorders.	
5	ABO and Rh Incompatibility and Transfusion Reactions	To understand the immunological basis of blood grouping and the severe consequences of mismatched blood transfusions.	CO-5

b. **Micro Projects**

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Preparation of a "Hematopoiesis Flowchart"	To visually represent the developmental stages of blood cells from stem cells to mature forms, enhancing retention of cell lineage concepts.	CO-1
2	Model construction of ABO Blood Group System	To demonstrate antigen-antibody reactions using creative models, reinforcing the principle of agglutination.	CO-5
3	Collection and Atlas of Urinary Sediment Images	To create a visual reference guide of urine sediments (crystals, casts) observed during lab sessions for future identification.	CO-4
4	Comparative study of Anemia types based on Blood Indices	To calculate indices (MCV, MCH, MCHC) from hypothetical data and classify them into Microcytic, Normocytic, and Macrocytic anemias.	CO-3
5	Design of a Standard Operating Procedure (SOP) for Phlebotomy	To draft a professional SOP for venous blood collection, emphasizing patient safety, labeling, and biomedical waste management.	CO-1

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Automation vs. Manual Methods in Hematology	To compare the advantages, limitations, and sources of error between automated cell counters and traditional manual methods.	CO-1, CO-2
2	Hemophilia and Common Coagulation Disorders	To discuss the genetic basis, clinical presentation, and laboratory findings of bleeding disorders like Hemophilia.	CO-5
3	The Role of CSF Analysis in Meningitis Diagnosis	To understand how physical, chemical, and microscopic examination of CSF helps differentiate between bacterial and viral meningitis.	CO-4
4	Interpretation of the Differential Leukocyte Count (DLC)	To analyze how shifts in specific white blood cell types (neutrophilia, eosinophilia, lymphocytosis) correlate with different infections.	CO-2
5	Safety Precautions and Bio-Medical Waste Management in Lab	To promote awareness of Universal Safety Precautions and proper disposal of sharp and biological waste in a hematology lab.	CO-1

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Survey on Awareness of Blood Donation Myths and Facts	To assess public knowledge and misconceptions regarding blood donation to help design better awareness campaigns.	CO-5
2	Prevalence of Anaemia Symptoms among Students	To identify common symptoms of anemia (fatigue, pallor) among peer groups and correlate with dietary habits.	CO-5

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
3	Survey on Knowledge of Rh Factor in Pregnancy	To assess awareness about Rh incompatibility (Erythroblastosis Fetalis) among women and the importance of antenatal testing.	CO-5
4	Assessment of Hydration Habits and Urinary Issues	To understand the relationship between water intake and common urinary complaints (burning micturition, concentrated urine).	CO-4
5	Usage of Point-of-Care Hematology Devices (Glucometers/Hb meters)	To survey the availability and reliability of rapid diagnostic devices used in local clinics or homes.	CO-1

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Hospital Hematology Laboratory	To observe routine hematological investigations, laboratory workflow, safety practices, and reporting procedures.	CO2, CO3, CO4
2	Blood Bank / Transfusion Center	To understand blood grouping, cross-matching, storage, and transfusion safety protocols.	CO3, CO5
3	Diagnostic Pathology Laboratory	To observe handling and examination of blood and body fluid samples using automated analyzers.	CO3, CO4
4	Community Health Center (CHC) / Primary Health Centre (PHC)	To understand screening of anemia and common blood disorders at primary healthcare level.	CO1, CO5
5	Awareness Program on Blood Donation (Activity)	To learn blood donation procedures, donor eligibility, and promote awareness of safe blood practices.	CO5

c. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Principles of Automated Cell Counters (Coulter Principle)	To understand the physics and technology behind how modern machines count and size blood cells.	CO-1
2	Quality Control (QC) in the Hematology Laboratory	To learn about internal quality control measures, Levey-Jennings charts, and calibration to ensure accurate results.	CO-1, CO-2
3	Thalassemia: Screening and Interpretation	To explore the laboratory methods used for screening Thalassemia (e.g., NESTROFT) and interpreting Hb electrophoresis basics.	CO-5
4	Semen Analysis: WHO Guidelines for Infertility	To update knowledge on the standard parameters for semen analysis as per the latest World Health Organization (WHO) manuals.	CO-4
5	Role of Platelets in Wound Healing and Inflammation	To go beyond coagulation and understand the role of platelets in tissue repair and inflammatory responses.	CO-5

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	**Course Evaluation Matrix**						
	Theory Assessment (TA)**		**Sessional Work Assessment (SWA)**			**Lab Assessment (LA)#**	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	**End Theory Assessment (ETA)**	**Sessional Work & Self Learning Assessment**			**Progressive Lab Assessment (PLA)**	**End Laboratory Assessment (ELA)**
			Assignments	**Micro Projects**	**Other Activities ***		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%

CO-5	15%	15%	20%	20%	--	15%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

a. The percentage given are approximate

b. In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.

c. For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	**Total Classroom Instruction (CI) Hours**	**Relevant COs Number(s)**	**Total Marks**	**ETA – Remember (R)**	**ETA – Understanding (U)**	**ETA – Application & Above (A)**
Unit I – Introduction to Blood, Collection & Instrumentation	8	CO1	12	4	6	2
Unit II – Routine Hematology & Cytometry	12	CO2	18	4	6	8
Unit III – Hematological Indices & Sedimentation	8	CO3	12	2	4	6

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA – Remember (R)	ETA – Understanding (U)	ETA – Application & Above (A)
Unit IV – Body Fluids Analysis	10	CO4	14	4	6	4
Unit V – Immunohematology, Coagulation & Abnormalities	10	CO5	14	2	6	6
Total	**48**	**-**	**70**	**16**	**28**	**26**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs	PLA/ELA Performance (%)	Viva-Voce (%)
1	Demonstration of Venous and Capillary blood collection	CO-1	60	40
2	Estimation of Hemoglobin by Sahli's method	CO-2	50	50
3	Total WBC Count (Manual method)	CO-2	50	50

S. No.	Laboratory Practical Titles	Relevant COs	PLA/ELA Performance (%)	Viva-Voce (%)
4	Total RBC Count (Manual method)	CO-2	50	50
5	Preparation of blood smear and staining for DLC	CO-2	60	40
6	Determination of ESR and PCV	CO-3	50	50
7	Routine Examination of Urine (Physical/Chemical)	CO-4	50	50
8	Determination of Blood Group (ABO and Rh)	CO-5	60	40
9	Determination of Bleeding Time (BT) and Clotting Time (CT)	CO-5	60	40

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies:

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
1	Compound Microscope	Binocular/monocular, 10× & 40× objectives, coarse & fine adjustment	1, 4, 5, 6, 7, 8

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
2	Hemoglobinometer (Sahli's)	Comparator with calibrated Hb tube, Sahli pipette	3
3	Hemocytometer (Neubauer Chamber)	Improved Neubauer counting chamber with special cover slip	4, 5
4	ESR Stand (Westergren / Wintrobe)	Vertical stand with calibrated ESR tubes	7
5	RBC and WBC Pipettes	Calibrated glass pipettes with color coding	4, 5
6	Centrifuge	Bench-top centrifuge, 3000–5000 rpm	8
7	Microhematocrit Reader & Capillary Tubes	Heparinized capillary tubes, reader scale	8
8	Blood Grouping Kit	Anti-A, Anti-B, Anti-D sera with slides/tubes	9
9	Lancets & Sterile Needles	Disposable, sterile, single-use	3, 4, 5, 9, 10
10	Stopwatch / Timer	Digital timer with seconds display	7, 10
11	Glassware Set	Test tubes, slides, cover slips, droppers	2, 6, 9
12	Personal Protective Equipment (PPE)	Gloves, lab coat, mask	All Practicals

R) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher & ISBN
1	Textbook of Hematology	Dr. Tejinder Singh	CBS Publishers
2	Practical Hematology	Dr. S. K. Jain	Jaypee Brothers
3	Clinical Pathology	Dr. B. K. Sharma	Elsevier India
4	Textbook of Medical Laboratory Technology	Dr. Ramnik Sood	Jaypee Brothers

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Module
1	Govt. OER	DIKSHA – Hematology & pathology modules	Govt. of India	Units I–V
2	MOOC	NPTEL – Basic Human Physiology	SWAYAM	Unit I
3	OER	e-Pathshala biology resources	NCERT	Units I–IV
4	Videos	Blood grouping & hematology tests	MoHFW India	Units II–V
5	Guidelines	Blood bank standards	National Blood Transfusion Council	Unit V

A) Course Code : 2476402(T2476402/P2476402/S2476402)

B) Course Title : Clinical Biochemistry & Serology

C) Pre- requisite Course(s) : Fundamentals of Biology / Basic Life Sciences

D) Rationale

Clinical Biochemistry and Serology deals with the biochemical and immunological investigations essential for diagnosis, monitoring, and prognosis of diseases. The course provides foundational knowledge of biochemical constituents of blood, enzymes, metabolic functions, and immune responses, along with practical skills in laboratory testing and result interpretation. Emphasis is given to sample handling, quality control, safety practices, and commonly used biochemical and serological diagnostic tests relevant to clinical laboratories.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, the learners will be able to-

CO1: Explain basic concepts of homeostasis, buffers, sample handling, and quality control in clinical biochemistry.

CO2: Describe carbohydrate, protein, and lipid metabolism and interpret related biochemical tests.

CO3: Explain the diagnostic significance of enzymes and organ function tests.

CO4: Understand principles of immunity, antigen–antibody reactions, and serological safety practices.

CO5: Apply principles of biochemical and serological tests for disease diagnosis and reporting.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply fundamental microbiological knowledge to identify, analyze, and interpret clinical samples for diagnosis of infectious diseases.

PSO-2: Utilize basic laboratory skills, biosafety practices, and infection control principles in clinical microbiology laboratories and healthcare settings.

Course Outcomes (COs)	PO-1 Basic & Discipline Knowledge	PO-2 Problem Analysis	PO-3 Design / Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability & Environment	PO-6 Project Management	PO-7 Life-Long Learning	PSO-1	PSO-2
CO1: Explain basic concepts, scope and	3	1	–	–	2	–	2	3	1

Course Outcomes (COs)	**PO-1 Basic & Discipline Knowledge**	**PO-2 Problem Analysis**	**PO-3 Design / Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability & Environment**	**PO-6 Project Management**	**PO-7 Life-Long Learning**	**PSO-1**	**PSO-2**
importance of microbiology									
CO2: Describe structure, growth and identification of bacteria	3	2	–	1	1	–	2	3	2
CO3: Apply basic microbiological techniques and laboratory practices	3	2	2	2	2	–	2	2	3
CO4: Understand clinical specimen handling and diagnosis of infections	3	3	2	2	3	1	2	2	3
CO5: Identify viral, fungal and parasitic infections and prevention	3	2	1	1	3	–	3	3	2

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Studies (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits(C)
		L	T				
2476402	Clinical Microbiology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)			
		Theory Assessment (TA)	Term Work & Self-Learning Assessment	Lab Assessment (LA)	

				(TWA)				
		Progressive Theory Assessment (PTA)	End Theory Assessment	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment	
2476402	Clinical Microbiology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA:Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

a. ETA & ELA are to be carried out at the end of the term/ semester.

b. Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476402

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Explain the concept of homeostasis and its importance in human health. **TSO 1.2** Describe pH and buffer systems of blood. **TSO 1.3** Explain principles of sample collection, handling, and quality control in biochemistry laboratory.	**Unit I – Basic Clinical Biochemistry & Laboratory Practices** • Homeostasis – concept and importance • pH and buffer systems (blood buffers – overview) • Sample collection, handling, storage, and preservation • Serum vs plasma – differences and preparation • Quality control in biochemistry laboratory • Factors affecting biochemical test results: diet, drugs, hemolysis, posture	**CO1**
TSO 2.1 Explain carbohydrate metabolism and blood glucose regulation. **TSO 2.2** Describe protein metabolism and plasma proteins. **TSO 2.3** Explain lipid metabolism and clinical significance of lipid profile.	**Unit II – Carbohydrates, Proteins & Lipids** • Carbohydrates: types and metabolism (overview) • Blood glucose estimation and Glucose Tolerance Test (GTT)• Proteins: types and plasma proteins • Total protein and albumin estimation • A/G ratio • Lipids: cholesterol, triglycerides, HDL, LDL and clinical importance	**CO2**
TSO 3.1 Explain the role of enzymes in disease diagnosis. **TSO 3.2** Describe renal and liver function tests and their interpretation.	**Unit III – Clinical Enzymology & Organ Function Tests** • Clinical enzymology: ALT, AST, ALP, CK-MB, LDH – diagnostic significance • Renal Function Tests (RFT): urea, creatinine, uric acid • Liver Function Tests (LFT): bilirubin, proteins, enzymes	**CO3**
TSO 4.1 Explain components of the immune system. **TSO 4.2** Describe antigens, antibodies, and antigen–antibody reactions. **TSO 4.3** Understand hypersensitivity and immunization concepts.	**Unit IV – Immunology & Serology Basics** • Immune system: innate and acquired immunity • Antigens and antibodies – types and structure	**CO4**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
	• Antigen–antibody reactions – principles • Hypersensitivity – types (basic understanding) • Vaccines and immunization schedule (overview) • Safety measures and waste disposal in serology laboratory	
TSO 5.1 Explain principles of common serological tests. **TSO 5.2** Interpret serological test results. **TSO 5.3** Understand quality assurance and reporting in serology.	**Unit V – Serological Diagnostic Tests & Interpretation** • Agglutination and precipitation reactions • Widal test – interpretation of titres • VDRL test for syphilis • CRP and RA factor – latex agglutination tests • HIV and HBsAg rapid card tests – principles & precautions • ELISA – basic concept and clinical significance • Record maintenance, reporting formats, quality assurance in serology	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2476402

LSO No.	Laboratory Session Outcome	Practical / Experiment	Relevant CO
LSO 1.1	Perform blood collection and sample separation	1) Blood sample collection and separation of serum & plasma	CO1

LSO No.	Laboratory Session Outcome	Practical / Experiment	Relevant CO
LSO 2.1	Estimate blood glucose	2) Blood glucose estimation (GOD-POD method)	CO2
LSO 2.2	Understand glucose metabolism	3) Oral Glucose Tolerance Test (Demonstration)	CO2
LSO 2.3	Estimate plasma proteins	4) Total protein and albumin estimation	CO2
LSO 2.4	Estimate lipid profile	5) Total cholesterol / triglycerides (any one)	CO2
LSO 3.1	Perform renal function test	6) RFT – urea / creatinine / uric acid (any one)	CO3
LSO 3.2	Observe liver function tests	7) LFT – bilirubin / ALT / AST (Demonstration)	CO3
LSO 4.1	Perform agglutination test	8) Widal test – slide / tube method	CO5
LSO 4.2	Perform latex agglutination test	9) VDRL / CRP / RA factor (any one)	CO5
LSO 4.3	Understand rapid diagnostic tests	10) HIV / HBsAg rapid card test (Demonstration)	CO5

L) Suggested Term Work and Self-Learning:S2476402 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a) **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Homeostasis and Buffer Systems of Blood	To understand regulation of pH and physiological balance	CO1
2	Factors Affecting Biochemical Test Results	To analyze pre-analytical variables influencing lab results	CO1
3	Interpretation of Blood Glucose and GTT Reports	To interpret carbohydrate metabolism disorders	CO2
4	Clinical Significance of Lipid Profile	To understand cardiovascular risk assessment	CO2
5	Role of Enzymes in Disease Diagnosis	To explain enzyme markers in organ damage	CO3

b) **Micro Projects**

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Comparative Study of Serum and Plasma	To understand sample selection for biochemical tests	CO1
2	Case Study on Diabetes Mellitus Using GTT	To correlate glucose tests with clinical conditions	CO2
3	Analysis of LFT and RFT Reports	To interpret organ function test values	CO3
4	Study of Antigen–Antibody Reactions in Diagnosis	To understand serological testing principles	CO4
5	Quality Assurance in Clinical Biochemistry Laboratory	To appreciate accuracy and reliability in lab testing	CO5

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Quality Control in Clinical Biochemistry	To understand laboratory standardization practices	CO1
2	Diagnostic Importance of Enzymes	To explain enzymology in clinical diagnosis	CO3
3	Immunization and Vaccines	To understand public health importance of vaccines	CO4
4	Rapid Diagnostic Tests in Serology	To learn principles and applications of rapid tests	CO5
5	Role of ELISA in Disease Detection	To understand advanced serological techniques	CO5

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Prevalence of Diabetes in Local Community	To understand epidemiology using biochemical data	CO2
2	Awareness of Lipid Profile Testing	To assess public knowledge on cardiac risk	CO2
3	Knowledge of Liver and Kidney Function Tests	To evaluate awareness of organ health	CO3
4	Awareness of Vaccination Programs	To understand immunization coverage	CO4

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
5	Laboratory Safety Awareness among Students	To promote biosafety and quality practices	CO1

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Visit to Clinical Biochemistry Laboratory	To observe routine biochemical investigations	CO1, CO2
2	Visit to Diagnostic Center / Hospital Lab	To understand enzyme and organ function testing	CO3
3	Visit to Blood Bank	To learn sample handling and serological testing	CO4
4	Demonstration of ELISA Laboratory	To observe advanced immunodiagnostic methods	CO5
5	Biomedical Waste Management Facility	To understand waste disposal and lab safety	CO1, CO4

4. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Video Learning on pH and Buffers	To reinforce basic biochemical concepts	CO1
2	Online Module on Lipid Metabolism	To enhance understanding of dyslipidemia	CO2
3	Virtual Lab on Enzyme Estimation	To understand enzymatic assays	CO3
4	Online Course on Immunology Basics	To strengthen concepts of immunity	CO4
5	ELISA Demonstration Videos	To understand test procedure and interpretation	CO5

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

	Course Evaluation Matrix		
	Theory Assessment	**Sessional Work Assessment**	**Lab**

COs	(TA)**		(SWA)			Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities *		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%
CO-5	15%	15%	20%	20%	--	15%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

a. The percentage given are approximate

b. In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.

c. For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit I – Basic Clinical Biochemistry & Laboratory Practices	10	CO1	14	14	6	6	2
Unit II – Carbohydrates, Proteins & Lipids	12	CO2	18	18	4	8	6

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit III – Clinical Enzymology & Organ Function Tests	10	CO3	16	16	3	6	7
Unit IV – Immunology & Serology Basics	8	CO4	11	11	3	5	3
Unit V – Serological Diagnostic Tests & Interpretation	8	CO5	11	11	3	5	3
Total	**48**	—	**70**	**70**	**19**	**30**	**21**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA (%)	PDA (%)	
1	Blood sample collection and separation of serum & plasma	CO1	50	40	10
2	Blood glucose estimation (GOD-POD method)	CO2	50	40	10
3	Oral Glucose Tolerance Test (Demonstration)	CO2	50	40	10

4	Total protein and albumin estimation	CO2	45	45	10
5	Total cholesterol / triglycerides (any one)	CO2	50	40	10
6	RFT – urea / creatinine / uric acid (any one)	CO3	50	40	10
7	LFT – bilirubin / ALT / AST (Demonstration)	CO3	50	40	10
8	Widal test – slide / tube method	CO5	50	40	10
9	VDRL / CRP / RA factor (any one)	CO5	50	40	10
10	HIV / HBsAg rapid card test (Demonstration)	CO5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies:

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
1	Clinical Centrifuge	Bench-top centrifuge with variable speed (3000–5000 rpm)	1
2	Blood Collection Set	Sterile syringes, vacutainers (plain, EDTA, fluoride)	1
3	Refrigerated Storage	Refrigerator (2–8 °C) for sample and reagent storage	1, 2, 4, 5
4	Semi-Auto Biochemistry Analyzer	Photometric analyzer with programmable assays	2, 4, 5, 6
5	Colorimeter	Filter-based photometer with cuvette holder	2, 4, 5

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
6	Water Bath	Temperature-controlled (37 °C–100 °C)	2, 4, 5
7	Micropipettes & Tips	Adjustable volume (10–1000 µL)	2, 4, 5, 6
8	Test Tubes & Racks	Glass / plastic tubes with racks	All Practicals
9	Glucose Estimation Kit (GOD-POD)	Enzymatic reagent kit for blood glucose estimation	2
10	Protein Estimation Kit	Biuret / Bromocresol Green (BCG) method	4
11	Lipid Profile Kit	Cholesterol / Triglyceride enzymatic kits	5
12	RFT Reagent Kit	Urea / Creatinine / Uric acid kits	6
13	LFT Reagent Kit	Bilirubin, ALT, AST reagents	7
14	Incubator	Temperature-controlled incubator (37 °C)	8, 9
15	Serology Rotator / Shaker	Motorized slide rotator for agglutination tests	8
16	Widal Test Kit	Antigen suspensions for slide/tube agglutination	8
17	Latex Agglutination Kits	CRP / RA / VDRL reagents	9
18	Rapid Card Test Kits	HIV / HBsAg rapid diagnostic kits	10
19	ELISA Reader (Demonstration)	Microplate reader (450 nm)	10 (Demo)
20	Personal Protective Equipment (PPE)	Lab coat, gloves, masks, goggles	All Practicals
21	Biohazard Waste Disposal System	Color-coded bins, sharps container	All Practicals
22	Computer with Data Recording Software	Result entry, reporting, and presentation	All Practicals

R) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher and Edition with ISBN
1	**Textbook of Clinical Biochemistry**	Ranjna Chawla	Jaypee Brothers Medical Publishers, 4th Edition, ISBN: 978-9352702991
2	**Clinical Biochemistry: Principles and Practice**	S. K. Singh	CBS Publishers & Distributors, 3rd Edition, ISBN: 978-8123926819

S. No.	Title	Author(s)	Publisher and Edition with ISBN
3	**Medical Biochemistry**	M. N. Chatterjea, Rana Shinde	Jaypee Brothers Medical Publishers, 9th Edition, ISBN: 978-9352704049
4	**Practical Clinical Biochemistry**	Varley (Indian Reprint)	CBS Publishers & Distributors, Latest Edition, ISBN: 978-8123926758
5	**Essentials of Immunology & Serology**	B. S. Nagoba	Paras Medical Publisher, 1st Edition, ISBN: 978-8181914762
6	**Textbook of Immunology**	Ananthanarayan & Paniker (Indian Edition)	Universities Press, Latest Edition, ISBN: 978-8173715635

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Practical / Module
1	National MOOC Platform	**NPTEL – Clinical Biochemistry & Immunology Modules**	NPTEL / SWAYAM (IITs, IISc)	Units I–III
2	National Digital Platform	**DIKSHA Portal** – Biochemistry & Immunology learning resources	Ministry of Education, Govt. of India	All Units
3	National Repository	**NROER** – Animations and diagrams on metabolism & immunity	CIET–NCERT (Govt. of India)	Units I, II, IV
4	Virtual Laboratory	**Virtual Labs – Biochemistry Experiments**	IIT Consortium / Ministry of Education	Practicals 2–7
5	Government e-Learning	**e-Pathshala** – Human Biology & Immunology content	NCERT, Govt. of India	Units I, IV
6	Educational TV Platform	**SWAYAM Prabha** – Health Sciences & Life Sciences Channels	Govt. of India	Self-learning & Revision
7	Online Simulation	**Amrita Virtual Labs – Serology & Biochemistry**	Amrita University (Govt. Supported)	Practicals 8–10

A) Course Code : 2476403(T2476403/P2476403/S2476403)

B) Course Title : Clinical Microbiology

C) Pre- requisite Course(s) : Fundamentals of Biology / Basic Life Sciences

D) Rationale

Clinical Microbiology deals with the study of microorganisms that cause diseases in humans and their laboratory diagnosis. The course provides fundamental knowledge of bacteria, viruses, fungi, and parasites, focusing on their identification, transmission, and prevention of infections. Emphasis is placed on laboratory techniques, safety practices, specimen handling, and basic interpretation of microbiological results. This subject builds a strong foundation for clinical diagnosis, infection control, and public health practices.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, the learners will be able to-

CO1: Explain the basic concepts, scope, and importance of microbiology in clinical diagnosis.

CO2: Describe the structure, growth, and identification of common pathogenic bacteria.

CO3: Apply basic microbiological techniques such as staining, culturing, and sterilization.

CO4: Understand specimen collection, transport, and laboratory diagnosis of infections**.**

CO5: Identify common viral, fungal, and parasitic infections and their preventive measures.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply fundamental microbiological knowledge to identify, analyze, and interpret clinical samples for diagnosis of infectious diseases.

PSO-2: Utilize basic laboratory skills, biosafety practices, and infection control principles in clinical microbiology laboratories and healthcare settings.

Course Outcomes (COs)	PO-1 Basic & Discipline Knowledge	PO-2 Problem Analysis	PO-3 Design / Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability & Environment	PO-6 Project Management	PO-7 Life-Long Learning	PSO-1	PSO-2
CO1: Explain basic concepts, scope and importance of microbiology	3	1	–	–	2	–	2	3	1
CO2: Describe structure, growth and identification of bacteria	3	2	–	1	1	–	2	3	2
CO3: Apply basic microbiological techniques and laboratory practices	3	2	2	2	2	–	2	2	3
CO4: Understand clinical specimen handling and diagnosis of infections	3	3	2	2	3	1	2	2	3
CO5: Identify viral, fungal and	3	2	1	1	3	–	3	3	2

Course Outcomes (COs)	PO-1 Basic & Discipline Knowledge	PO-2 Problem Analysis	PO-3 Design / Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability & Environment	PO-6 Project Management	PO-7 Life-Long Learning	PSO-1	PSO-2
parasitic infections and prevention									

Legend: High (3), Medium (2), Low (1) and No mapping (-)
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		L	T				
2476403	Clinical Microbiology	03	-	04	02	09	06

Legend:

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SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

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H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						
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2476403	Clinical Microbiology	30	70	20	30	20	30	200

Legend:

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TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

a. ETA & ELA are to be carried out at the end of the term/ semester.

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I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes

at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476403

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Explain the definition, scope, and importance of microbiology in healthcare. **TSO 1.2** Describe historical milestones and classification of microorganisms. **TSO 1.3** Identify bacterial morphology, microscope parts, and laboratory safety practices.	**Unit I – Introduction to Microbiology & Laboratory Practices** 1.1 Definition, scope and importance of microbiology 1.2 Historical milestones – Louis Pasteur and Robert Koch (brief) 1.3 Classification of microorganisms: bacteria, viruses, fungi, parasites (basic idea) 1.4 Structure and morphology of bacteria: cocci, bacilli, spiral 1.5 Microscope: parts, functions, care and maintenance 1.6 Sterilization & disinfection (introductory) 1.7 Laboratory safety: PPE, biosafety cabinets, biohazard symbols, waste disposal	**CO1**
TSO 2.1 Explain growth requirements of bacteria. **TSO 2.2** Describe culture media and inoculation techniques. **TSO 2.3** Understand staining techniques and common bacterial pathogens.	**Unit II – Bacteriology** 2.1 Growth requirements of bacteria: temperature, nutrients, oxygen 2.2 Culture media: nutrient, selective, differential (simple explanation) 2.3 Sample inoculation techniques: streak and lawn culture (concept only) 2.4 Staining techniques: simple stain and Gram stain 2.6 Common bacterial pathogens: *Staphylococcus*, *Streptococcus*, *E. coli*, *Salmonella*, *Mycobacterium*	**CO2, CO3**
TSO 3.1 Describe principles of clinical specimen collection, transport, and storage.	**Unit III – Clinical Diagnosis of Microbial Infections** 3.1 Clinical specimens: blood, urine, stool, sputum, pus, throat swab	**CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 3.2 Understand culture examination and colony interpretation. **TSO 3.3** Explain antibiotic susceptibility testing and infection control.	3.2 Principles of specimen collection and avoiding contamination 3.3 Transport and storage of clinical samples• Culture examination: observation of colonies (simple interpretation) 3.4 Antibiotic susceptibility testing: basic idea (Kirby–Bauer method) 3.5 Infection control and prevention: hand hygiene, universal precautions	
TSO 4.1 Explain properties of viruses and modes of infection. **TSO 4.2** Identify common viral diseases and preventive measures. **TSO 4.3** Understand vaccination and immunity concepts.	**Unit IV – Virology** 4.1 Properties of viruses 4.2 Modes of viral infection 4.3 Common viral diseases: hepatitis, HIV, influenza, dengue 4.4 Vaccination and immunity – basic concept 4.5 Role of virology in public health and infection prevention	**CO5**
TSO 5.1 Differentiate yeast and moulds and identify common fungal infections. **TSO 5.2** Describe protozoa and helminths of clinical importance. **TSO 5.3** Understand stool examination for parasitic infections.	**Unit V – Mycology & Parasitology** 5.1 Yeast and moulds – basic differences 5.2 Common fungal infections: ringworm, candidiasis 5.3 KOH mount – simple idea 5.4 Introduction to protozoa and helminths 5.5 Common parasites: *Entamoeba*, *Giardia*, *Plasmodium*, *Ascaris* 5.6 Stool examination: physical and microscopic features (introductory)	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2476403

LSO No.	Laboratory Session Outcome	Practical / Experiment	Relevant CO
LSO 1.1	Identify microscope parts and perform focusing	1. Microscope: Parts, focusing & maintenance	CO1
LSO 1.2	Demonstrate sterilization and aseptic practices	2. Sterilization & aseptic technique	CO3
LSO 2.1	Perform and interpret basic staining	3. Simple staining & Gram staining	CO3
LSO 2.2	Observe bacterial colony characteristics	4. Observation of culture plates	CO2
LSO 2.3	Demonstrate bacterial isolation technique	5. Streak plate technique	CO3
LSO 3.1	Prepare wet mount and KOH mount	6. Wet mount / KOH mount	CO5
LSO 3.2	Perform basic biochemical identification	7. Catalase & oxidase tests	CO2
LSO 4.1	Identify parasite ova and cysts	8. Stool examination	CO5
LSO 4.2	Demonstrate clinical specimen processing	9. Sputum / throat swab Gram smear & culture	CO4
LSO 4.3	Understand antibiotic sensitivity testing	10. Kirby-Bauer test	CO4

L) Suggested Term Work and Self-Learning:S2476403 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Importance of Clinical Microbiology in healthcare	To understand the role of microbiology in diagnosis, treatment, and prevention of infectious diseases	CO1
2	Structure and morphology of bacteria with examples	To develop knowledge of bacterial forms and their clinical significance	CO2
3	Sterilization, disinfection, and biosafety practices	To gain awareness about infection control and laboratory safety	CO3

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
4	Common bacterial pathogens and diseases caused	To relate microorganisms with clinical infections	CO2, CO4
5	Vaccination and immunity in prevention of infectious diseases	To understand preventive strategies against infections	CO5

b. **Micro Projects**

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Preparation of charts/models on classification of microorganisms	To enhance visual learning and understanding of microbial diversity	CO1
2	Case study on bacterial infection and laboratory diagnosis	To apply theoretical knowledge to clinical scenarios	CO2, CO4
3	Study of antibiotic resistance and its impact on public health	To develop awareness of antimicrobial resistance	CO3, CO5
4	Model or poster on sterilization and disinfection methods	To understand infection control techniques in laboratories	CO3
5	Awareness presentation on common communicable diseases	To promote public health awareness and prevention strategies	CO5

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Role of clinical microbiology in disease diagnosis	To strengthen conceptual understanding of laboratory diagnostics	CO1, CO4
2	Antibiotic susceptibility testing and resistance	To understand rational use of antibiotics	CO3, CO5
3	Viral infections and vaccination strategies	To enhance awareness of viral diseases and prevention	CO5
4	Biosafety and infection control in microbiology laboratories	To develop safe laboratory practices	CO3

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
5	Emerging and re-emerging infectious diseases	To encourage continuous learning and awareness	CO5, CO7

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Awareness of hand hygiene practices among students	To assess infection control awareness	CO3, CO5
2	Knowledge of vaccination and immunization	To evaluate public awareness on disease prevention	CO5
3	Antibiotic usage pattern and misuse	To understand causes of antimicrobial resistance	CO3, CO5
4	Prevalence of common infectious diseases in community	To relate microbiology with public health	CO4
5	Awareness of biomedical waste management	To understand safe disposal and environmental protection	CO3, CO5

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Visit to a clinical microbiology laboratory	To observe diagnostic procedures and laboratory workflow	CO3, CO4
2	Visit to a hospital infection control unit	To understand infection prevention and control practices	CO3, CO5
3	Visit to a blood bank	To learn about screening of blood-borne infections	CO4
4	Visit to a public health laboratory	To understand disease surveillance and outbreak investigation	CO5
5	Visit to a biomedical waste treatment facility	To learn safe disposal of infectious waste	CO3, CO5

4. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Recent advances in clinical microbiology	To update knowledge and encourage life-long learning	CO7
2	Antimicrobial resistance and global health	To understand current challenges in infection control	CO3, CO5

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
3	Emerging viral infections and pandemics	To develop awareness of global infectious threats	CO5
4	Role of microbiology in public health and sanitation	To link microbiology with societal health	CO1, CO5
5	Online modules on laboratory biosafety	To reinforce safe laboratory practices	CO3

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Sessional Work Assessment (SWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities *		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%
CO-5	15%	15%	20%	20%	--	15%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

a. The percentage given are approximate

b. In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.

c. For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit I – Introduction to Microbiology & Laboratory Practices	10	CO1	14	14	6	6	2
Unit II – Bacteriology	12	CO2, CO3	18	18	4	8	6
Unit III – Clinical Diagnosis of Microbial Infections	10	CO3, CO4	16	16	3	6	7
Unit IV – Virology	8	CO5	11	11	3	5	3
Unit V – Mycology & Parasitology	8	CO5	11	11	3	5	3
Total	**48**	—	**70**	**70**	**19**	**30**	**21**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S.	Laboratory Practical Titles	Relevant COs	PLA/ELA	
			Performance	Viv

No.		Number(s)	PRA (%)	PDA (%)	a-Voce (%)
1	Microscope: Parts, focusing & maintenance	CO1	50	40	10
2	Sterilization & aseptic technique	CO3	50	40	10
3	Simple staining & Gram staining	CO3	50	40	10
4	Observation of culture plates	CO2	45	45	10
5	Streak plate technique	CO3	50	40	10
6	Wet mount / KOH mount	CO5	50	40	10
7	Catalase & oxidase tests	CO2	50	40	10
8	Stool examination	CO5	50	40	10
9	Sputum / throat swab Gram smear & culture	CO4	50	40	10
10	Kirby-Bauer test	CO4	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies:

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
1	Compound Microscope	Binocular/monocular microscope with 10×, 40× (oil immersion demo) objectives	1, 3, 6, 8, 9
2	Autoclave	Steam sterilizer with temperature and pressure control	2
3	Hot Air Oven	Dry heat sterilization unit	2
4	Biosafety Cabinet (Class I/II)	Enclosed cabinet with HEPA filtration for safe handling of samples	2, 9
5	Incubator	Temperature-controlled bacterial culture incubator (35–37°C)	4, 5, 9
6	Inoculating Loop / Needle	Nichrome / disposable sterile loops	2, 5
7	Culture Media Plates	Nutrient agar, selective and differential media plates	4, 5, 9
8	Staining Rack & Glassware	Slides, cover slips, staining trays	3, 6, 9
9	Gram Staining Kit	Crystal violet, iodine, decolorizer, safranin	3, 9
10	KOH Mount Reagents	10–20% potassium hydroxide solution	6
11	Biochemical Test Reagents	Catalase (H_2O_2), oxidase reagent	7
12	Antibiotic Discs & Disc Dispenser	Standard antibiotic discs for Kirby–Bauer method	10
13	Mueller–Hinton Agar Plates	Standard medium for antibiotic sensitivity testing	10
14	Measuring Scale / Vernier	For measuring zone of inhibition (mm)	10
15	Personal Protective Equipment (PPE)	Lab coat, gloves, masks, eye protection	All Practicals
16	Biohazard Disposal System	Color-coded bins, sharps container	All Practicals
17	Refrigerator	Storage of media, reagents, and specimens (2–8°C)	2, 4, 10
18	Computer with Multimedia Software	PPT, videos, virtual lab demonstrations	All Practicals (demo support)

R) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher and Edition with ISBN
1	Textbook of Microbiology	Ananthanarayan & Paniker	Universities Press, 10th Edition, ISBN: 978-9383315976
2	Textbook of Microbiology	C. P. Baveja	Arya Publications, 5th Edition, ISBN: 978-8189782127
3	Medical Microbiology	Jagdish Chander	Elsevier India, 9th Edition, ISBN: 978-8131268166
4	Essentials of Medical Microbiology	Apurba S. Sastry, Sandhya Bhat	Jaypee Brothers Medical Publishers, 2nd Edition, ISBN: 978-9386261713
5	Microbiology for Nurses and Allied Health Sciences	B. S. Nagoba	Paras Medical Publisher, 1st Edition, ISBN: 978-8181914663
6	Practical Microbiology	R. Ananthanarayan & C. K. Jayaram Paniker	Universities Press, Latest Edition, ISBN: 978-8173712948

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Practical / Module
1	National OER Platform	DIKSHA Portal – Microbiology concepts, videos, quizzes (Govt. of India)	DIKSHA – Ministry of Education, Govt. of India	All Units (Concept clarity)
2	MOOC / Video Lectures	NPTEL – Introduction to Microbiology by IIT faculty	NPTEL / SWAYAM	Units I–IV
3	National Digital Repository	e-Pathshala – NCERT Biology & Microbiology resources	CIET–NCERT	Unit I, IV, V
4	National OER Repository	NROER – Animations, diagrams on microbes and lab safety	National Repository of Open Educational Resources	Units I–III
5	Virtual Lab	Virtual Labs – Microbiology Experiments	IIT Consortium / MHRD	Practicals 1–7, 10
6	Government e-Learning	SWAYAM Prabha – Health & Biology lecture channels	Govt. of India	Revision & Self-Learning

A) Course Code **: 2476404(T2476404/P2476404/S2476404)**

B) Course Title **:** Biomedical Instrumentation

C) Pre- requisite Course(s) **:** Fundamentals of Biology

D) Rationale

Biomedical Instrumentation bridges the gap between engineering and medicine, playing a pivotal role in modern healthcare. This course provides students with fundamental knowledge of the operating principles, applications, and safety aspects of medical equipment used for diagnosis, monitoring, and therapy. It equips learners with the skills to operate, handle, and perform basic troubleshooting of essential hospital instruments. The course emphasizes electrical safety, accurate measurement of vital parameters, and the maintenance of equipment to ensure reliable patient care and effective clinical workflow.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, the learners will be able to-

CO1: Explain the scope of biomedical instrumentation, electrical safety standards, and the organizational structure of hospital departments.

CO2: Describe the working principle, operating procedures, and clinical applications of common diagnostic and monitoring instruments.

CO3: Explain the function and usage of essential life support, therapeutic, and physiotherapy equipment.

CO4: Identify and describe the components and applications of clinical laboratory instruments and medical imaging systems.

CO5: Apply basic maintenance procedures, calibration checks, and troubleshooting techniques to ensure equipment safety and longevity.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Demonstrate proficiency in the operation, handling, and basic maintenance of biomedical equipment used in clinical and laboratory settings.

PSO-2 : Ensure patient and operator safety by adhering to electrical safety protocols and accurately interpreting instrument readings for clinical support.

Course Outcomes (COs)	**PO-1** Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design / Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	-	-	1	-	-
CO-2	3	1	-	-	-	-	1	-	-
CO-3	3	2	3	2	1	1	2	-	-
CO-4	3	2	3	2	1	1	2	-	-
CO-5	3	2	3	2	1	1	2	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)
*****PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	**Course Title**	**Scheme of Studies (Hours/Week)**					
		Classroom Instruction (CI)		**Lab Instruction (LI)**	**Notional Hours (TW+SL)**	**Total Hours (CI+LI+TW+SL)**	**Total Credits(C)**
		L	**T**				
2476404	Biomedical Instrumentation	03	-	04	02	09	06

Legend:
CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T),

Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2476404	Biomedical Instrumentation	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

a. ETA & ELA are to be carried out at the end of the term/ semester.

b. Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476404

Major Theory Session Outcomes (TSOs)	**Units (with Expanded Title and Subtopics)**	**Relevant CO(s)**
TSO 1.1 Define biomedical instrumentation and explain its importance. **TSO 1.2** Describe basic electrical safety and equipment classification. **TSO 1.3** Outline the functions of various hospital departments.	**Unit I – Introduction to Biomedical Instrumentation & Healthcare Environment** 1.1 Meaning and scope of biomedical instrumentation. 1.2 Importance of instrumentation in modern healthcare. 1.3 Basic electrical safety in medical equipment (Shock hazards, grounding, safety standards). 1.4 Classification of instruments: Diagnostic, Monitoring, Therapeutic, Imaging.	**CO-1**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
	1.5 Overview of hospital departments: Functions of ICU, NICU, OT, Pathology, and Radiology.	
TSO 2.1 Explain the working of temperature and glucose measuring devices. **TSO 2.2** Describe the principle and operation of BP apparatus and Pulse Oximeter. **TSO 2.3** Explain ECG, EEG, and Spirometry basics.	**Unit II – Diagnostic & Monitoring Instruments** 2.1 Thermometer: Principle and types (Digital & Clinical). 2.2 Glucometer: Working principle and usage. 2.3 BP Apparatus: Sphygmomanometer (Mercury & Digital) – Principle and measurement technique. 2.4 Pulse Oximeter: Principle of SpO2 measurement and applications. 2.5 ECG Machine: Introduction, block diagram (basic), and lead placement. 2.6 EEG: Brief awareness of brain activity monitoring. 2.7 Spirometer: Concept of lung volume measurement. 2.8 Vital Signs Monitor: Overview of multi-parameter monitoring.	**CO-2**
TSO 3.1 Describe the operation of Nebulizers, Suction machines, and Pumps.	**Unit III – Therapeutic & Life Support Equipment** 3.1 Nebulizer: Types and operating procedure. 3.2 Suction Machine: Principle and clinical use.	**CO-3**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 3.2 Explain the basic concept of Defibrillators and Ventilators. **TSO 3.3** Overview of Dialysis and Physiotherapy devices.	3.3 Syringe Pump & Infusion Pump: Basic awareness and flow rate control. 3.4 Defibrillator: Simple introduction, types (AED), and safety precautions. 3.5 Ventilator: Basic concept of mechanical ventilation. 3.6 Dialysis Machine: Simple working idea of hemodialysis. 3.7 Physiotherapy Devices: Ultrasound (US) therapy and TENS (Transcutaneous Electrical Nerve Stimulation) – Basic concept.	
TSO 4.1 Explain the function of common laboratory equipment. **TSO 4.2** Describe hematology and biochemistry analyzers. **TSO 4.3** Outline the basic principles of medical imaging systems.	**Unit IV – Clinical Laboratory & Imaging Equipment** 4.1 Lab Instruments: Microscope, Centrifuge (principle/use), Hot air oven, Incubator, Water bath. 4.2 Automated Analyzers: Hematology cell counter and Biochemistry analyzer (Overview of workflow). 4.3 Imaging Equipment: X-ray (Simple generation concept). 4.4 Ultrasound Imaging: Basic idea of piezoelectric effect. 4.5 Advanced Imaging: CT Scan & MRI (One-line understanding of principle and difference).	**CO-4**
TSO 5.1 Explain routine maintenance and calibration importance.	**Unit V – Maintenance, Safety & Troubleshooting** 5.1 Routine maintenance procedures: Cleaning, preventive checks.	**CO-5**

Major Theory Session Outcomes (TSOs)	**Units (with Expanded Title and Subtopics)**	**Relevant CO(s)**
TSO 5.2 Describe basic troubleshooting and safety checks. **TSO 5.3** Maintain equipment records and logbooks.	5.2 Calibration awareness: Need for periodic calibration of devices. 5.3 Troubleshooting basics: Identifying common fuses, power issues, and sensor errors. 5.4 Record-keeping: Importance of logbooks, history cards, and service reports. 5.5 Safety protocols: Handling biomedical waste and equipment sterilization.	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2476404

LSO No.	**Laboratory Session Outcome (LSO)**	**Practical / Experiment Title**	**Relevant CO(s)**
LSO 1.1	Identify common biomedical instruments and demonstrate safe handling.	1. Identification & Handling of Common Biomedical Instruments (Stethoscope, BP cuff, Thermometer, etc.).	CO-1
LSO 2.1	Measure vital signs accurately using standard equipment.	2. Measurement of Vital Parameters (Body Temperature, Pulse, Respiration Rate, BP).	CO-2
LSO 2.2	Demonstrate the setup and electrode placement for ECG.	3. Demonstration of ECG Machine & Electrode Placement (Limb and Chest leads).	CO-2

LSO No.	Laboratory Session Outcome (LSO)	Practical / Experiment Title	Relevant CO(s)
LSO 2.3	Operate a glucometer and interpret the readings.	4. Glucometer: Operating Procedure & Interpretation of Random Blood Sugar.	CO-2
LSO 3.1	Demonstrate the assembly and operation of respiratory support devices.	5. Operating a Nebulizer & Suction Machine (Demonstration/Practice).	CO-3
LSO 4.1	Operate basic lab equipment for sample preparation.	6. Use of Centrifuge & Microscope (Observation / Practice of balancing and focusing).	CO-4
LSO 4.2	Identify components and workflow of automated analyzers.	7. Hematology/Clinical Analyzer: Components & Workflow (Demo/Visit).	CO-4
LSO 4.3	Set temperature controls for thermal lab equipment.	8. Hot Air Oven, Incubator & Water Bath: Operation and Temperature Setting.	CO-4
LSO 3.2	specific safety features of life-support devices.	9. Demonstration of Defibrillator (Dummy/Energy discharge check) & Syringe/Infusion Pump.	CO-3
LSO 5.1	Perform basic maintenance checks and document equipment status.	10. Biomedical Equipment Maintenance & Logbook Entry (Mock maintenance schedule).	CO-5

L) Suggested Term Work and Self-Learning: S2476404 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Explain the importance of anatomy and physiology in understanding human health.	To develop conceptual understanding of the relevance of anatomy and physiology in maintaining health, diagnosing diseases, and promoting wellness.	CO-1

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
2	Describe the structure and functions of the skeletal and muscular systems.	To enhance understanding of support, movement, and protection systems and their coordinated functioning in the human body.	CO-2
3	Write short notes on blood groups and respiratory disorders.	To develop knowledge of circulatory and respiratory systems and create awareness about common health conditions and their implications.	CO-3
4	Explain the role of nervous and endocrine systems in coordination.	To identify control and coordination mechanisms in the human body and their role in maintaining internal balance.	CO-4
5	Discuss the importance of balanced nutrition and human reproductive health.	To promote awareness of nutrition, reproductive health, and their role in overall well-being and sustainable human health.	CO-5

b. Micro Projects

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Prepare charts/models showing levels of organization of the human body.	To develop clear understanding of structural organization from cellular to system level and enhance visual learning and presentation skills.	CO-1
2	Case study on common lifestyle disorders related to the circulatory system.	To analyze the causes, symptoms, and preventive measures of circulatory disorders and relate theoretical knowledge to real-life health issues.	CO-3
3	Survey on dietary habits and nutritional deficiencies.	To understand the relationship between diet, nutrition, and health and to develop data collection and interpretation skills.	CO-5
4	Model preparation of human heart or nephron.	To enhance practical understanding of circulatory or excretory system structures and improve hands-on and creative skills.	CO-3, CO-5
5	Awareness presentation on reproductive health and hygiene.	To promote health awareness, responsible behaviour, and understanding of reproductive health and hygiene practices.	CO-5

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Importance of anatomy and physiology in healthcare and life sciences	To enhance conceptual understanding of the role of anatomy and physiology in health maintenance, disease prevention, and healthcare practices.	CO-1
2	Lifestyle disorders and their impact on the circulatory system	To develop awareness about lifestyle-related diseases, their causes, and preventive measures related to the circulatory system.	CO-3
3	Role of nutrition in maintaining physiological balance and immunity	To understand the importance of balanced nutrition in supporting body functions, immunity, and overall health.	CO-5
4	Nervous and endocrine coordination in stress management	To analyze how nervous and endocrine systems regulate stress and maintain homeostasis.	CO-4
5	Reproductive health, hygiene, and awareness	To promote responsible attitudes, health awareness, and understanding of reproductive health and hygiene.	CO-5

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Survey on lifestyle habits affecting cardiovascular health	To understand the impact of lifestyle factors such as diet, physical activity, and stress on circulatory health and promote preventive healthcare awareness.	CO-3
2	Survey on dietary patterns and nutritional deficiencies among students	To analyze common dietary habits and identify nutritional gaps, enhancing awareness of balanced nutrition and healthy eating practices.	CO-5
3	Survey on respiratory health and exposure to environmental pollutants	To study the effect of environmental factors on respiratory health and develop awareness about pollution-related disorders.	CO-3
4	Survey on stress levels and their effects on nervous and endocrine health	To assess the role of stress on control and coordination systems and understand stress management strategies.	CO-4
5	Survey on awareness of reproductive health and hygiene practices	To promote understanding of reproductive health, hygiene, and responsible behavior among individuals.	CO-5

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Visit to a hospital / diagnostic laboratory	To observe basic clinical practices, understand human body systems in health and disease, and relate theoretical concepts to real-life medical applications.	CO-3, CO-4
2	Visit to a blood bank	To understand blood grouping, blood storage, transfusion practices, and the importance of blood donation in healthcare.	CO-3
3	Visit to a public health center / wellness center	To gain awareness about preventive healthcare, nutrition, hygiene, and reproductive health services provided at community level.	CO-5

4. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Recent advances in learning of in human anatomy and physiology	To update learners with modern developments in understanding of human body systems and encourage continuous academic enrichment.	CO-1
2	Role of yoga, exercise, and lifestyle modification in physiological health	To understand how physical activity and healthy lifestyle choices influence circulatory, respiratory, and metabolic functions.	CO-3, CO-5
3	Impact of stress on nervous and endocrine systems	To analyze physiological stress responses and understand mechanisms of control and coordination.	CO-4
4	Nutrition, immunity, and disease prevention	To explore the relationship between balanced nutrition and immune system functioning for maintaining health.	CO-5
5	Use of digital health tools for monitoring physiological parameters	To develop awareness of basic digital tools used for monitoring heart rate, blood pressure, and respiratory parameters.	CO-3

M. Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

	Course Evaluation Matrix		
	Theory Assessment (TA)**	**Sessional Work Assessment (SWA)**	**Lab Assessment (LA)#**

COs	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities *		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%
CO-5	15%	15%	20%	20%	--	15%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

a. The percentage given are approximate

b. In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.

c. For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N. Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA – Remember (R)	ETA – Understanding (U)	ETA – Application & Above (A)
Unit I – Intro to Biomedical Inst. & Environment	8	CO1	10	4	4	2

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA – Remember (R)	ETA – Understanding (U)	ETA – Application & Above (A)
Unit II – Diagnostic & Monitoring Instruments	12	CO2	20	4	8	8
Unit III – Therapeutic & Life Support Equipment	12	CO3	18	4	8	6
Unit IV – Clinical Laboratory & Imaging Equipment	10	CO4	12	4	6	2
Unit V – Maintenance, Safety & Troubleshooting	6	CO5	10	2	4	4
Total	**48**	**-**	**70**	**18**	**30**	**22**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O. Suggested Assessment Table for Laboratory (Practical):

			PLA/ELA

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	Performance		Viva-Voce (%)
			PRA (%)	PDA (%)	
1	Study of human body anatomical terms, body planes, and body cavities using charts/models	CO-1	50	40	10
2	Identification of major bones and joints of the human skeleton using skeletal model	CO-2	50	40	10
3	Identification of human tissues (epithelial, connective, muscular, nervous) under microscope	CO-1	50	40	10
4	Study of structure of heart and circulatory system; identification of major blood vessels	CO-3	45	45	10
5	Determination of blood group (ABO and Rh typing)	CO-3	50	40	10
6	Measurement of pulse rate and blood pressure in resting and post-activity condition	CO-3	50	40	10
7	Demonstration of respiratory system and measurement of lung capacity	CO-3	50	40	10
8	Study of digestive system: identification of major digestive organs	CO-5	50	40	10
9	Urine physical examination (color, appearance, pH, specific gravity)	CO-5	50	40	10
10	Study of male and female reproductive systems using models/charts	CO-5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P. Suggested Instructional/Implementation Strategies:

Q. List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
1.	**Standard Diagnostic Set** (Stethoscope, Sphygmomanometer, Clinical Thermometer)	**Stethoscope:** Dual-head acoustic (Bell & Diaphragm). **BP Apparatus:** Mercury-free (LCD/LED) or Standard Aneroid gauge (0-300 mmHg). **Thermometer:** Digital clinical probe type (Range: 32°C–42°C).	Exp. 1 & 2
2.	**Vital Signs Monitor** (Optional but recommended)	Multi-para monitor (ECG, SpO2, NIBP, Temp, Resp); 10-12 inch color display.	Exp. 2
3.	**ECG Machine**	3-Channel or 12-Channel digital ECG; Thermal printer; Standard 12-lead acquisition; Filters (AC, EMG, Drift).	Exp. 3
4.	**Glucometer Kit**	Handheld Amperometric Biosensor type; Digital LCD; Test strips compatibility; Lancet device.	Exp. 4
5.	**Respiratory Therapy Kit** (Nebulizer & Suction Machine)	**Nebulizer:** Piston compressor type; Max pressure ~2.5 bar. **Suction:** Portable electric; Vacuum range 0-600 mmHg; 1L collection jar.	Exp. 5

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
6.	**Clinical Centrifuge**	Benchtop model; Rotor capacity: 8 to 12 tubes (15ml); Speed: 3000–5000 RPM; Timer control.	Exp. 6
7.	**Compound Light Microscope**	Binocular; LED illumination; Objectives: 4x, 10x, 40x, 100x (Oil immersion); Mechanical stage.	Exp. 6
8.	**Hematology / Biochemistry Analyzer** (Demonstration Unit)	**Hematology:** 3-part differential automated counter. **Biochemistry:** Semi-auto analyzer; Flow cell system; Absorbance range 0-3.0 OD.	Exp. 7
9.	**Biomedical Heating Equipment** (Hot Air Oven, Incubator, Water Bath)	**Oven:** Digital temp control (up to 250°C). **Incubator:** Bacteriological (Ambient to 80°C). **Water Bath:** Serological, precision ±0.5°C.	Exp. 8
10.	**Defibrillator** (Training/Demo Unit)	Biphasic or Monophasic; Paddle set (Adult/Pediatric); Energy selection (2J–200J/360J); Test load facility.	Exp. 9
11.	**Infusion & Syringe Pumps**	**Syringe Pump:** Compatible with 5ml-50ml syringes.	Exp. 9

S. No.	Name of Equipment / Tools / Software	Broad Specifications	Relevant Experiment / Practical No.
		Infusion Pump: Volumetric; Drop sensor; Flow rate 1-1000 ml/hr.	
12.	**Biomedical Maintenance Toolkit**	Digital Multimeter (True RMS); Electrical Safety Analyzer (Optional); Precision screwdriver set; Soldering station; Contact cleaner.	Exp. 10
13.	**Simulation Software** (Virtual Lab)	MATLAB / LabVIEW (with Biomedical toolkit) **OR** Online Virtual Labs (vlab.co.in) for ECG/Signal simulation.	Exp. 3 & 10

R. Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher and Edition with ISBN
1.	**Handbook of Biomedical Instrumentation**	Dr. R.S. Khandpur	**McGraw Hill Education** 3rd Edition (2014/2024 Reprint) ISBN: 978-9355328021

S. No.	Title	Author(s)	Publisher and Edition with ISBN
2.	**Biomedical Instrumentation**	Dr. M. Arumugam	**Anuradha Publications** 10th Edition (Reprint 2016) ISBN: 978-8187721123
3.	**Introduction to Biomedical Instrumentation**	Mandeep Singh	**PHI Learning** 2nd Edition (2014) ISBN: 978-8120350236
4.	**Biomedical Electronics and Instrumentation**	S.K. Venkata Ram	**Galgotia Publications** Revised Edition ISBN: 978-8175156012

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title/ Description	Link /Reference	Relevant Practical / Module
1.	Video Course (NPTEL)	**Biomedical Instrumentation** *(Prof. D. Mishra, IIT Roorkee)* Comprehensive video lectures covering sensors, bio-potentials, and imaging physics found in the syllabus.	**https://nptel.ac.in/courses/108105101** *(Course ID: 108105101)*	**Unit 1 & 2:** Transducers, ECG, EEG, EMG **Unit 4:** X-Ray and Imaging Physics
2.	Interactive Lab (Virtual)	**Biomedical and Signal Processing Virtual Lab** *(Ministry of Education, Govt. of India)* Simulations allowing students to virtually place ECG leads and operate patient monitors.	**https://bmv-iitr.vlabs.ac.in/**	**Unit 2:** ECG basic lead placement, Pulse Oximeter principle, Blood Pressure measurement
3.	Technical Manual (PDF)	**Maintenance Manual for Medical Equipment** *(MoHFW, Govt. of India)*	**https://nhm.gov.in/** *(Search: "Maintenance Manual for Medical Equipment")*	**Unit 5:** Routine maintenance procedures, Calibration awareness, Troubleshooting basics

S. No.	Resource Type	Title/ Description	Link /Reference	Relevant Practical / Module
		A practical handbook for technicians covering repair and maintenance checklists.		
4.	Technical Guidelines	**WHO Medical Device Technical Series** *(World Health Organization)* Global safety standards and operational guides for critical care equipment.	**https://www.who.int/health-topics/medical-devices**	**Unit 3:** Ventilator (basic concept), Defibrillator safety, Oxygen delivery systems
5.	Open Textbook	**Biomedical Engineering Theory** *(Wikibooks)* Community-maintained open textbook chapters on medical imaging and bio-electricity.	**https://en.wikibooks.org/wiki/Biomedical_Engineering_Theory**	**Unit 4:** CT & MRI (Simple understanding), Ultrasound basics

A) Course Code **: 2476405(T2476405/P2476405/S2476405)**

B) Course Title **:** Environmental Toxicology

C) Pre- requisite Course(s) **:** Fundamentals of Environmental Science

D) Rationale

Environmental Toxicology deals with the study of toxic substances, environmental pollutants, and their effects on human health and ecosystems. With increasing industrialization, urbanization, chemical usage, and lifestyle changes, exposure to toxic agents through air, water, soil, and food has become a major public health concern.

This course provides learners with basic knowledge of environmental toxins, pollution-related health effects, safety measures, poisoning management, environmental regulations, and eco-friendly practices. The course emphasizes awareness, prevention, personal safety, and responsible environmental behavior essential for sustainable living and occupational safety.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, learners will be able to:

CO1: Explain the definition, sources, types of toxic substances, and routes of entry into the human body.

CO2: Describe environmental pollutants and their short-term and long-term health effects.

CO3: Explain the effects of pollutants and heavy metals on different human body systems.

CO4: Apply personal safety measures, safe chemical handling, and first aid for poisoning.

CO5: Describe environmental laws, regulatory agencies, waste disposal practices, and eco-friendly measures.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply environmental health knowledge to identify toxic hazards and pollution-related health risks.

PSO-2: Demonstrate safe practices, preventive measures, and awareness of environmental regulations.

Course Outcomes (COs)	PO-1Basic & Discipline Knowledge	PO-2Problem Analysis	PO-3Design / Development of Solutions	PO-4Engineering Tools	PO-5Engineering Practices for Society, Sustainability & Environment	PO-6Project Management	PO-7Life-Long Learning	PSO-1	PSO-2
CO1 Explain definition, sources, types of toxic substances, and routes of entry	3	2	–	–	2	–	2	1	1
CO2 Describe environmental pollutants and their short- and long-term health effects	3	3	–	–	3	–	2	1	1
CO3 Explain effects of pollutants	3	3	–	–	2	–	2	1	1

Course Outcomes (COs)	PO-1Basic & Discipline Knowledge	PO-2Problem Analysis	PO-3Design / Development of Solutions	PO-4Engineering Tools	PO-5Engineering Practices for Society, Sustainability & Environment	PO-6Project Management	PO-7Life-Long Learning	PSO-1	PSO-2
and heavy metals on human body systems									
CO4 Apply personal safety measures, safe chemical handling, and first aid	2	2	2	1	3	–	2	–	3
CO5 Describe environmental laws, waste disposal practices, and eco-friendly measures	2	2	2	–	3	1	2	–	2

Legend: Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Titl	Scheme of Studies (Hours/Week)				
		Classroom Instructio	Lab Instructio	Notional Hours	Total Hou	Total Credits(C)

	e	n (CI)		n (LI)	(TW+ SL)	rs (CI+LI+TW+ SL)	
		L	T				
2476405	**Environmental Toxicology**	03	-	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)				
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment	Internal	External	
2476405	Environmental Toxicolo	30	70	20	30	100

	gy					

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA:Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **Course Curriculum Detailing**: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: P2476405

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Define toxicology and environmental health. **TSO 1.2** Explain the importance of studying environmental toxicology.	**Unit I – Basics of Environmental Toxicology** • Definition and importance of environmental health • Types of toxic substances	**CO1**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.3 Classify toxic substances based on origin and use. **TSO 1.4** Identify major sources of environmental toxins. **TSO 1.5** Explain routes of entry and basic dose–response concept.	• Sources of toxins: industrial, agricultural, medical, household, radiation • Routes of entry: inhalation, ingestion, skin absorption • Dose–response relationship (simple understanding)	
TSO 2.1 Identify major air pollutants and their sources. **TSO 2.2** Describe water pollutants and contamination sources. **TSO 2.3** Explain soil pollution and solid waste contamination. **TSO 2.4** Describe food contaminants and adulterants. **TSO 2.5** Differentiate between acute and chronic health effects.	**Unit II – Environmental Pollutants & Health Effects** • Air pollutants: smog, smoke, CO, SO_2, NOx, particulate matter • Water pollutants: sewage, heavy metals, pesticides • Soil pollutants: plastics, fertilizers, industrial waste • Food contaminants and adulterants • Acute and chronic health effects	**CO2**
TSO 3.1 Explain effects of pollutants on the respiratory system. **TSO 3.2** Describe neurological effects of toxic exposure. **TSO 3.3** Explain digestive and reproductive system effects. **TSO 3.4** Describe skin allergies and dermal effects. **TSO 3.5** Explain toxicity of heavy metals with examples.	**Unit III – Effects of Environmental Pollutants on Human Body Systems** • Respiratory system: asthma, bronchitis, COPD • Nervous system: headache, memory loss, neurotoxicity • Digestive system: nausea, vomiting, ulcers • Reproductive and developmental effects • Skin allergies and irritation • Heavy metal toxicity: lead, mercury, arsenic, cadmium	**CO3**
TSO 4.1 Explain the importance of personal protective equipment (PPE). **TSO 4.2** Describe safe handling, storage, and labeling of chemicals. **TSO 4.3** Explain ventilation and hygiene practices. **TSO 4.4** Apply first aid measures for poisoning cases. **TSO 4.5** Explain safe disposal of toxic and household waste.	**Unit IV – Personal Safety & Poisoning Management** • Personal protective equipment and hygiene practices • Laboratory and workplace ventilation • Safe chemical storage and labelling • First aid measures for poisoning • Household chemical safety • Safe waste disposal practices	**CO4**
TSO 5.1 Identify major environmental laws and regulations. **TSO 5.2** Explain the role of pollution control boards. **TSO 5.3** Describe functions of regulatory and government agencies.	**Unit V – Environmental Laws & Sustainable Practices** • Environmental laws and regulations (basic overview) • Pollution Control Boards – role and functions	**CO5**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 5.4 Explain waste management rules and practices. **TSO 5.5** Promote eco-friendly and sustainable practices.	• Environmental Protection Act (EPA) – basic idea • Role of government and regulatory agencies • Eco-friendly practices, sustainability, and public awareness	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Term Work and Self-Learning:S2476405 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Sources and routes of toxin exposure	Understand exposure pathways	CO1
2	Air, water & soil pollution effects	Pollution impact analysis	CO2
3	Heavy metal toxicity effects	Health risk awareness	CO3
4	First aid for poisoning cases	Emergency preparedness	CO4
5	Role of pollution control agencies	Regulatory awareness	CO5

b. **Micro Projects**

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Chart showing routes of toxin entry	Concept clarity	CO1
2	Case study on pollution-related disease	Real-life application	CO2
3	Poster on heavy metal toxicity	Health awareness	CO3
4	Demonstration of PPE & safety labels	Practical safety skills	CO4
5	Eco-friendly practices campaign	Sustainability awareness	CO5

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Environmental toxicology basics	Concept understanding	CO1
2	Pollution and chronic diseases	Health impact awareness	CO2
3	Heavy metals and human health	Risk understanding	CO3
4	Chemical safety and poisoning control	Safety awareness	CO4
5	Environmental laws and sustainability	Legal awareness	CO5

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Household chemical usage	Exposure assessment	CO1
2	Local air & water pollution sources	Environmental awareness	CO2
3	Health complaints due to pollution	Data collection skills	CO3
4	Awareness about first aid for poisoning	Safety evaluation	CO4
5	Awareness of eco-friendly practices	Sustainability learning	CO5

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Pollution control laboratory / SPCB	Observe monitoring practices	CO2, CO5
2	Hospital toxicology / emergency unit	Poisoning management exposure	CO4
3	Waste treatment / recycling facility	Safe disposal learning	CO4, CO5

4. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Environmental toxicology basics	Knowledge enrichment	CO1
2	Health impacts of air pollution	Preventive awareness	CO2
3	Heavy metal contamination cases	Applied learning	CO3
4	Household chemical safety	Risk reduction	CO4
5	Sustainable lifestyle practices	Environmental responsibility	CO5

L) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each

student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix				
	Theory Assessment (TA)**		Sessional Work Assessment (SWA)		
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment		
			Assignments	Micro Projects	Other Activities*
CO-1	15%	15%	20%	20%	33%
CO-2	20%	25%	20%	20%	33%
CO-3	25%	25%	20%	20%	34%
CO-4	25%	20%	20%	20%	--
CO-5	15%	15%	20%	20%	--
Total Marks	30	70	20	20	10
			50		

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

M) Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit I – Basics of Environmental Toxicology	9	CO1	12	12	5	5	2
Unit II – Environmental Pollutants	10	CO2	15	15	4	7	4

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
& Health Effects							
Unit III – Effects of Pollutants on Human Body Systems	10	CO3	16	16	3	7	6
Unit IV – Personal Safety & Poisoning Management	9	CO4	14	14	3	5	6
Unit V – Environmental Laws & Sustainable Practices	10	CO5	13	13	4	6	3
Total	**48**	—	**70**	**70**	**19**	**30**	**21**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

N) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher & Edition (ISBN)
1	Environmental Studies	Dr. Erach Bharucha	Universities Press, ISBN: 978-8173715400
2	Environmental Pollution & Control	Dr. C. S. Rao	New Age International
3	Occupational Health & Safety	Dr. R. K. Rajput	Katson Publishers
4	Toxicology for Environmental Health	Dr. A. K. De	New Central Book Agency

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Module
1	Govt. Portal	CPCB pollution guidelines	CPCB, Govt. of India	Unit II & V
2	MOOC	Environmental Studies	SWAYAM / NPTEL	Unit I–III
3	OER	Health & environmental safety modules	DIKSHA Portal	Unit I–IV
4	Guidelines	Chemical safety & waste disposal	MoEFCC India	Unit IV
5	Awareness Videos	Pollution & health effects	MoHFW India	Unit II–III

A) Course Code : 2476405(T2476405/P2476405/S2476405)

B) Course Title : Biomedical Waste Management

C) Pre- requisite Course(s) : Fundamentals of Environmental Science

D) Rationale

Biomedical Waste Management (BMWM) is a critical component of healthcare and environmental safety. This course provides learners with fundamental knowledge of biomedical waste generation, segregation, treatment, disposal, safety practices, legal provisions, and documentation. Emphasis is placed on compliance with Biomedical Waste Management Rules (2016 and amendments), safe handling practices, and sustainable waste management in healthcare settings.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, learners will be able to:

CO1: Explain the concept, sources, categories, and hazards of biomedical waste.

CO2: Apply proper segregation, color coding, collection, and storage practices for biomedical waste.

CO3: Describe biomedical waste transportation, treatment technologies, and final disposal methods.

CO4: Demonstrate safe handling practices, PPE usage, and spill/sharps management procedures.

CO5: Interpret biomedical waste management rules, documentation, roles, responsibilities, and accident reporting mechanisms.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply basic environmental and biomedical engineering knowledge to manage biomedical waste safely and sustainably.

PSO-2: Demonstrate compliance with biomedical waste regulations, safety protocols, and documentation practices in healthcare settings.

Course Outcomes (COs)	**PO-1** Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design / Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	-	-	1	-	-
CO-2	3	1	-	-	-	-	1	-	-
CO-3	3	2	3	2	1	1	2	-	-
CO-4	3	2	3	2	1	1	2	-	-
CO-5	3	2	3	2	1	1	2	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)
*****PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	**Course Title**	**Scheme of Studies (Hours/Week)**					
		Classroom Instruction (CI)		**Lab Instruction (LI)**	**Notional Hours (TW+SL)**	**Total Hours (CI+LI+TW+SL)**	**Total Credits(C)**
		L	**T**				
2476405	**Biomedical Waste Management**	03	-	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

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SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	**Course Title**	**Assessment Scheme (Marks)**				
		Theory Assessment (TA)		**Term Work & Self-Learning Assessment (TWA)**		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	
2476405	Biomedical Waste Management	30	70	20	30	100

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal

faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **Course Curriculum Detailing**: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476405

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Define toxicology and environmental health. **TSO 1.2** Explain the importance of environmental toxicology in public health. **TSO 1.3** Classify toxic substances based on source and nature. **TSO 1.4** Identify major sources of environmental toxins. **TSO 1.5** Explain routes of entry and the basic dose–response concept.	**Unit I – Basics of Environmental Toxicology** • Definition and importance of environmental health • Types of toxic substances • Sources of toxins: industrial, agricultural, medical, household, radiation • Routes of entry: inhalation, ingestion, skin absorption • Dose–response concept (simple understanding)	**CO1**
TSO 2.1 Identify major air pollutants and their sources.	**Unit II – Environmental Pollutants & Health Effects**	**CO2**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 2.2 Describe water pollutants and modes of contamination. **TSO 2.3** Explain soil pollution due to solid and industrial waste. **TSO 2.4** Describe food contaminants and adulterants. **TSO 2.5** Differentiate between acute and chronic health effects of pollutants.	• Air pollutants: smog, smoke, CO, SO_2, NOx, particulate matter • Water pollutants: sewage, heavy metals, pesticides • Soil pollutants: plastics, fertilizers, industrial waste • Food contaminants and adulterants • Acute and chronic health effects	
TSO 3.1 Explain effects of pollutants on the respiratory system. **TSO 3.2** Describe neurotoxic effects of environmental pollutants. **TSO 3.3** Explain digestive and gastrointestinal effects of toxins. **TSO 3.4** Describe reproductive and developmental toxicity. **TSO 3.5** Explain heavy metal toxicity with suitable examples.	**Unit III – Effects on Human Body Systems** • Respiratory system: asthma, COPD • Nervous system: headache, memory loss, neurotoxicity • Digestive system: vomiting, ulcers • Reproductive and developmental effects • Skin allergies and irritation • Heavy metal toxicity: lead, mercury, arsenic, cadmium	**CO3**
TSO 4.1 Explain the importance of personal protective equipment (PPE). **TSO 4.2** Describe safe handling, storage, and labeling of chemicals. **TSO 4.3** Explain the role of ventilation and hygiene practices. **TSO 4.4** Apply first aid measures for poisoning cases. **TSO 4.5** Explain safe disposal practices for toxic and household waste.	**Unit IV – Personal Safety & Poisoning Management** • PPE and hygiene practices • Ventilation in laboratories and workplaces • Safe chemical storage and labelling • First aid for poisoning • Household chemical safety • Safe waste disposal practices	**CO4**
TSO 5.1 Identify major environmental laws and regulations. **TSO 5.2** Explain the role of Pollution Control Boards. **TSO 5.3** Describe functions of environmental regulatory agencies. **TSO 5.4** Explain environmental protection and waste management rules. **TSO 5.5** Promote eco-friendly practices and environmental awareness.	**Unit V – Environmental Laws & Sustainable Practices** • Pollution Control Boards – roles and functions • Environmental Protection Act (EPA) – basic idea • Role of government and regulatory agencies • Waste management rules (overview) • Eco-friendly practices and public awareness	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Term Work and Self-Learning: S2476405 Some sample suggested

assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Types and hazards of biomedical waste	Understand risks of improper BMW handling	CO1
2	Color coding and segregation of BMW	Apply segregation principles	CO2
3	Treatment methods of BMW	Understand treatment technologies	CO3
4	PPE and sharps management	Improve safety awareness	CO4
5	Overview of BMW Rules 2016	Understand legal compliance	CO5

b. **Micro Projects**

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Model/chart of BMW color coding	Visual understanding of segregation	CO2
2	Case study on BMW accident	Analyze safety failures	CO4, CO5
3	Survey of BMW practices in a hospital	Real-world exposure	CO2, CO5
4	Flowchart of BMW treatment & disposal	Understand waste pathway	CO3
5	Awareness poster on BMW safety	Promote safe practices	CO4

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Hazards of biomedical waste	Risk awareness	CO1
2	Importance of segregation at source	Waste minimization	CO2
3	CBWTF and its role	Infrastructure understanding	CO3
4	Occupational safety in healthcare	Worker safety	CO4
5	Legal compliance in BMWM	Regulatory knowledge	CO5

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	BMW segregation practices in hospitals	Practical exposure	CO2
2	PPE usage among healthcare workers	Safety assessment	CO4
3	Awareness of BMW rules	Legal awareness	CO5
4	Sharps disposal practices	Injury prevention	CO4
5	Role of CBWTF in waste management	System understanding	CO3

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Visit to a hospital / diagnostic laboratory	To observe basic clinical practices, understand human body systems in health and disease, and relate theoretical concepts to real-life medical applications.	CO-3, CO-4
2	Visit to a blood bank	To understand blood grouping, blood storage, transfusion practices, and the importance of blood donation in healthcare.	CO-3
3	Visit to a public health center / wellness center	To gain awareness about preventive healthcare, nutrition, hygiene, and reproductive health services provided at community level.	CO-5

4. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Latest amendments in BMW rules	Regulatory update	CO5
2	Green & sustainable BMW practices	Environmental awareness	CO3
3	Occupational health hazards	Safety improvement	CO4
4	Digital tracking of BMW	Modern practices	CO5
5	Role of nurses in BMWM	Role clarity	CO2, CO4

L) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

	Course Evaluation Matrix		
	Theory Assessment (TA)**	**Sessional Work Assessment (SWA)**	

COs	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment		
			Assignments	Micro Projects	Other Activities*
CO-1	15%	15%	20%	20%	33%
CO-2	20%	25%	20%	20%	33%
CO-3	25%	25%	20%	20%	34%
CO-4	25%	20%	20%	20%	--
CO-5	15%	15%	20%	20%	--
Total Marks	30	70	20	20	10
			50		

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

M) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit I – Introduction to Biomedical Waste	9	CO1	10	10	5	5	2
Unit II – Segregation, Collection & Storage	10	CO2	14	14	4	7	4
Unit III – Transportatio	10	CO3	18	18	3	7	6

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
n & Treatment Methods							
Unit IV – Safety Practices in BMWM	9	CO4	14	14	3	5	6
Unit V – Laws, Rules & Record Keeping	10	CO5	14	14	4	6	3
Total	**48**	–	**70**	**70**	**19**	**30**	**21**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

N) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher & Edition (ISBN)
1	Biomedical Waste Management	Dr. S. S. Kadam	CBS Publishers, ISBN: 978-9387964699
2	Hospital Waste Management	Dr. A. K. Gupta	Jaypee Brothers, ISBN: 978-8180612140
3	Solid & Biomedical Waste Management	Dr. R. C. Gaur	Khanna Publishers

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Module
1	Govt. Portal	BMW Rules 2016	MoEFCC, Govt. of India	Unit V
2	MOOC	Biomedical Waste Management	SWAYAM / NPTEL	All Units
3	OER	Infection Control & BMW	DIKSHA Portal	Unit II–IV
4	Video	CBWTF operations	CPCB Training Modules	Unit III
5	Guidelines	CPCB BMW Guidelines	CPCB India	Unit III & V

A) Course Code : 2476405(T2476405/P2476405/S2476405)

B) Course Title : Environmental Health and Safety

C) Pre- requisite Course(s) : Fundamentals of Environmental Science

D) Rationale

Environmental Health and Safety focuses on protecting human health and the environment from hazards arising due to pollution, unsafe workplace practices, poor sanitation, and emergencies. This course equips learners with basic knowledge of environmental pollution, public health and sanitation, workplace safety, emergency preparedness, and personal protection practices. The course emphasizes awareness, preventive measures, safety culture, and responsible behaviour essential for sustainable development and community well-being.

E) Course Outcomes (COs): Upon successful completion of the course, learners are expected to achieve the prescribed course outcomes through active participation in learning activities encompassing the cognitive, psychomotor, and affective domains in classroom and experiential learning environments.

After completion of the course, learners will be able to:

CO1: Explain environmental health concepts, pollution types, and their harmful effects on humans and surroundings.

CO2: Describe public health, sanitation practices, safe water supply, and hygiene measures.

CO3: Identify occupational hazards, safety symbols, PPE, and safe work practices.

CO4: Explain emergency situations, fire safety, first aid, and disaster preparedness measures.

CO5: Apply safety awareness and preventive measures during pandemics and community emergencies.

F) Suggested Course Articulation Matrix (CAM):

PSO-1: Apply basic environmental and health science knowledge to identify and prevent health and safety hazards.

PSO-2: Demonstrate safe practices, emergency response skills, and community health awareness.

Legend: Legend: High (3), Medium (2), Low (1) and No mapping (-)
*****PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

Course Outcomes (COs)	PO-1Basic & Discipline Knowledge	PO-2Problem Analysis	PO-3Design / Development of Solutions	PO-4Engineering Tools	PO-5Engineering Practices for Society, Sustainability & Environment	PO-6Project Management	PO-7Life-Long Learning	PSO-1	PSO-2
CO1: Explain environmental health concepts, pollution types, and their harmful	3	2	–	–	2	–	2	1	1

Course Outcomes (COs)	PO-1Basic & Discipline Knowledge	PO-2Problem Analysis	PO-3Design / Development of Solutions	PO-4Engineering Tools	PO-5Engineering Practices for Society, Sustainability & Environment	PO-6Project Management	PO-7Life-Long Learning	PSO-1	PSO-2
effects on humans and surroundings									
CO2 Describe public health, sanitation practices, safe water supply, and hygiene measures	3	3	–	–	3	–	2	1	1
CO3 Identify occupational hazards, safety symbols, PPE, and safe work practices.	3	3	–	–	2	–	2	1	1
CO4 Explain emergency situations, fire safety, first aid, and disaster preparedness measures.	2	2	2	1	3	–	2	–	3

Course Outcomes (COs)	PO-1Basic & Discipline Knowledge	PO-2Problem Analysis	PO-3Design / Development of Solutions	PO-4Engineering Tools	PO-5Engineering Practices for Society, Sustainability & Environment	PO-6Project Management	PO-7Life-Long Learning	PSO-1	PSO-2
CO5: Apply safety awareness and preventive measures during pandemics and community emergencies.	2	2	2	–	3	1	2	–	2

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Studies (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+ SL)	Total Credits(C)
		L	T				
2476405	**Environmental Health and Safety**	03	-	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, open educational resources (OERs)

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	**Course Title**	**Assessment Scheme (Marks)**				
		Theory Assessment (TA)		**Term Work & Self-Learning Assessment (TWA)**		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	
2476405	Environmental Health and Safety	30	70	20	30	100

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/

presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **Course Curriculum Detailing**: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2476405

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 1.1 Explain the meaning of environment and environmental health. **TSO 1.2** Identify different types of environmental pollution. **TSO 1.3** Describe major sources of environmental pollution. **TSO 1.4** Explain harmful effects of pollution on health and environment. **TSO 1.5** Justify the importance of a clean and healthy environment.	**Unit I – Introduction to Environmental Health** • Meaning of environment and environmental health • Types of pollution: air, water, soil, noise • Sources of pollution • Harmful effects of pollution • Importance of clean environment	**CO1**
TSO 2.1 Explain the concept of sanitation and hygiene. **TSO 2.2** Describe sources and importance of clean water supply. **TSO 2.3** Explain wastewater and sewage-related problems. **TSO 2.4** Identify common waterborne diseases. **TSO 2.5** Explain personal and community sanitation practices.	**Unit II – Public Health & Sanitation** • Sanitation and hygiene concepts • Clean water supply and hygiene practices • Wastewater and sewage problems • Waterborne diseases: cholera, typhoid (basic idea) • Handwashing, personal and community sanitation	**CO2**
TSO 3.1 Identify common occupational and workplace hazards.	**Unit III – Occupational Health & Workplace Safety**	**CO3**

Major Theory Session Outcomes (TSOs)	Units (with Expanded Title and Subtopics)	Relevant CO(s)
TSO 3.2 Classify physical, chemical, and biological hazards. **TSO 3.3** Explain workplace hazards in hospitals and laboratories. **TSO 3.4** Interpret safety signs and symbols. **TSO 3.5** Apply PPE and safe work practices.	• Occupational hazards • Physical, chemical, and biological hazards • Hazards in hospitals and laboratories • Safety signs and symbols • Personal Protective Equipment (PPE) and safe work practices	
TSO 4.1 Explain the concepts of emergency, accident, and disaster. **TSO 4.2** Identify different types of fire and fire extinguishers. **TSO 4.3** Explain basic first aid measures. **TSO 4.4** Identify important emergency contact numbers. **TSO 4.5** Explain evacuation plans and safety drills.	**Unit IV – Disaster Preparedness & Emergency Response** • Emergency, accident, and disaster concepts • Fire types and fire extinguishers • First aid basics and emergency numbers • Evacuation plans • Safety drills and preparedness	**CO4**
TSO 5.1 Explain the concept of pandemics with examples. **TSO 5.2** Describe infection prevention and control measures. **TSO 5.3** Explain the role of community responsibility during pandemics. **TSO 5.4** Identify mental health challenges during pandemics. **TSO 5.5** Explain the importance of social health awareness.	**Unit V – Pandemic Safety & Community Health Awareness** • Pandemic awareness (COVID-like pandemics – basic idea) • Infection prevention measures • Community responsibility • Mental health awareness • Social health and wellbeing	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Term Work and Self-Learning:S2476405 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
1	Types of pollution and health effects	Understand pollution impact	CO1
2	Importance of sanitation & hygiene	Promote healthy habits	CO2
3	Workplace hazards and PPE	Safety awareness	CO3
4	Fire safety and first aid basics	Emergency preparedness	CO4

S. No.	Assignment Topic	Purpose / Expected Learning	Relevant CO(s)
5	Lessons learned from COVID-19	Community health awareness	CO5

b. Micro Projects

S. No.	Micro-Project Topic	Purpose / Expected Learning	Relevant CO(s)
1	Chart on pollution types	Visual understanding	CO1
2	Handwashing & hygiene awareness poster	Promote public health	CO2
3	PPE usage demonstration	Practical safety skills	CO3
4	Emergency evacuation plan model	Disaster preparedness	CO4
5	Pandemic safety awareness campaign	Social responsibility	CO5

c. Other Activities

1. Seminar Topics:

S. No.	Seminar Topic	Purpose / Expected Learning	Relevant CO(s)
1	Environmental pollution & health	Awareness creation	CO1
2	Role of sanitation in disease prevention	Public health understanding	CO2
3	Occupational safety in labs & hospitals	Worker safety	CO3
4	Disaster management & preparedness	Emergency readiness	CO4
5	Pandemic preparedness & safety culture	Community resilience	CO5

2. Surveys:

S. No.	Survey Topic	Purpose / Expected Learning	Relevant CO(s)
1	Pollution sources in local area	Environmental awareness	CO1
2	Hygiene practices among students	Health assessment	CO2
3	PPE usage awareness	Safety evaluation	CO3
4	Fire safety awareness	Emergency preparedness	CO4
5	COVID safety awareness	Pandemic learning	CO5

3. Visit:

S. No.	Visit Place / Activity	Purpose / Expected Learning	Relevant CO(s)
1	Water treatment plant / sanitation facility	Public health exposure	CO2
2	Hospital / laboratory	Occupational safety learning	CO3
3	Fire station / disaster management cell	Emergency response skills	CO4

c. Self-Learning Topics

S. No.	Self-Learning Topic	Purpose / Expected Learning	Relevant CO(s)
1	Environmental protection laws	Awareness of regulations	CO1
2	Water conservation & hygiene	Sustainable practices	CO2
3	Workplace safety guidelines	Accident prevention	CO3
4	Disaster management strategies	Emergency planning	CO4
5	Pandemic preparedness & mental health	Holistic safety	CO5

L) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix				
	Theory Assessment (TA)**		Sessional Work Assessment (SWA)		
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment		
			Assignments	Micro Projects	Other Activities*
CO-1	15%	15%	20%	20%	33%
CO-2	20%	25%	20%	20%	33%
CO-3	25%	25%	20%	20%	34%
CO-4	25%	20%	20%	20%	--
CO-5	15%	15%	20%	20%	--
Total Marks	30	70	20	20	10
			50		

Legend:

***:** Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

******: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
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Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)	Remember (R)	Understanding (U)	Application & Above (A)
Unit I – Introduction to Environmental Health	9	CO1	12	12	5	5	2
Unit II – Public Health & Sanitation	10	CO2	15	15	4	7	4
Unit III – Occupational Health & Workplace Safety	10	CO3	16	16	3	7	6
Unit IV – Disaster Preparedness & Emergency Response	9	CO4	14	14	3	5	6
Unit V – Pandemic Safety & Community Health Awareness	10	CO5	13	13	4	6	3
Total	**48**	—	**70**	**70**	**19**	**30**	**21**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

N) Suggested Learning Resources:

(a) Books:

S. No.	Title	Author(s)	Publisher & Edition (ISBN)
1	Environmental Studies	Dr. Erach Bharucha	Universities Press, ISBN: 978-8173715400
2	Environmental Health & Safety	Dr. B. K. Sharma	Laxmi Publications
3	Occupational Health & Safety	Dr. R. K. Rajput	Katson Publishers
4	Disaster Management	Dr. Vinod Sharma	IIPA Publications

(b) Open Educational Resources (OER):

S. No.	Resource Type	Title / Description	Link / Reference	Relevant Module
1	Govt. Portal	National Health Mission resources	MoHFW, Govt. of India	Unit II
2	MOOC	Environmental Studies	SWAYAM / NPTEL	Unit I–III
3	OER	Health & Hygiene modules	DIKSHA Portal	Unit II
4	Guidelines	Disaster Management Guidelines	NDMA India	Unit IV
5	Awareness Videos	COVID-19 safety & prevention	MoHFW India	Unit V