

Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name		: Diploma In Medical Laboratory Technology																			
Programme Code		: ML										With Effect From Academic Year				: 2023-24					
Duration Of Programme		: 6 Semester										Duration				: 16 WEEKS					
Semester		: Fifth										NCrF Entry Level : 4.0				Scheme				: K	

Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme						Credits	Assessment Scheme											
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Paper Duration (hrs.)		Theory			Based on LL & TL		Based on Self Learning		Total Marks				
						CL	TL	LL					FA- TH	SA- TH	Total	Practical		SLA						
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min															

(All Compulsory)																							
1	MANAGEMENT	MAN	AEC	315301	1	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES	ETC	DSC	325320	-	4	-	2	2	8	4	1.5	30	70*#	100	40	25	10	-	-	25	10	150
3	DIAGNOSTIC PATHOLOGY IN PRACTICE	CLP	DSC	325321	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
4	PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY	MVM	DSC	325322	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
5	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	314014	-	1	-	2	1	4	2	-	-	-	-	50	20	25@	10	25	10	100	
Elective 1 (Any - One)																							
6	ADVANCED BIOCHEMISTRY	ADB	DSE	325323	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
	APPLIED MICROBIOLOGY IN MEDICAL LABORATORY TECHNOLOGY	AMM	DSE	325324	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
	CLINICAL IMMUNOLOGY - DIAGNOSTIC APPLICATIONS	IMM	DSE	325325	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
Total					1	17		16	7		20		150	350	500		150		100		150		900

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

Programme Name/s	: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Bamboo Technology/ Fashion & Clothing Technology/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg.
Programme Code	: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DBT/ DC/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SC/ SE/ TC/ TE
Semester	: Fifth / Sixth
Course Title	: MANAGEMENT
Course Code	: 315301

I. RATIONALE

Effective management is the cornerstone of success for both organizations and individuals. It empowers diploma engineers/ professionals to accomplish their tasks with finesse and efficiency through strategic planning and thoughtful execution, projects can optimize finances, enhance safety measures, facilitate sound decision-making, foster team collaboration and cultivate a harmonious work environment. The diploma engineers require leadership and management skills with technical knowledge of the core field to carry out various tasks smoothly. This course aims to instill fundamental management techniques, empowering diploma engineers/ professionals to enhance their effectiveness in the workplace.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply the relevant managerial skills for achieving optimal results at workplace.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use relevant management skills to handle work situation
- CO2 - Apply appropriate techniques of product, operations and project management
- CO3 - Use comprehensive tools of recent management practices
- CO4 - Plan suitable marketing strategy for a product / service
- CO5 - Utilize supply chain and human resource management techniques for effective management

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL			
															Practical							
				CL	TL	LL					FA-TH		SA-TH		Total		FA-PR		SA-PR		SLA	
							Max	Min			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
315301	MANAGEMENT	MAN	AEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125	

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

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3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the importance of management thoughts in Indian knowledge system. TLO 1.2 Describe the importance of management in day to day life. TLO 1.3 Explain Henry Fayol's principles of management. TLO 1.4 Describe the role of each level of management in its management hierarchy. TLO 1.5 Practice the self management skills for a given situation TLO 1.6 Apply the required managerial skills for a given situation	Unit - I Introduction to Management 1.1 Evolution of management thoughts from ancient/medieval to modern times in India (IKS) 1.2 Management: meaning, importance, characteristics, functions & challenges. 1.3 Introduction to scientific management- Taylor's & Fayol's principles of management 1.4 Levels & functions of management at supervisory level. 1.5 Self management skills: Self awareness, self discipline, self motivation, goal setting, time management, decision making, stress management, work life balance and multitasking 1.6 Overview of Managerial Skills: negotiation skills, team management, conflict resolution, feedback, leadership	Presentations Case Study Interactive session Quiz competition Mixed Picture Puzzle
2	TLO 2.1 Identify the appropriate creativity technique for new product development TLO 2.2 Describe the new product development process for a product / service TLO 2.3 Comprehend the importance of various strategic steps Product Management TLO 2.4 Elaborate Agile product management TLO 2.5 Explain the significance of the Project Management TLO 2.6 Describe the various tools of project management	Unit - II Product, Operations and Project Management 2.1 Creativity and innovation management: creativity techniques - brainstorming, checklist, reverse brainstorming, morphological analysis, six thinking hats. 2.2 New product development, change management 2.3 Product Management -meaning, strategic steps for sustainable design of a product 2.4 Agile product management- concept, benefits, principles and manifesto 2.5 Project Management: importance, areas within project management, 4Ps and phases 2.6 Tools of Project Management: PERT and CPM, GANTT & Chart Overview of Estimate and Budget	Presentations Case Study Video Demonstrations Presentations Role Play

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Understand the importance of quality management tools TLO 3.2 Explain the importance of various techniques for optimization and waste minimization TLO 3.3 State the importance of ISO quality standards TLO 3.4 Describe ERP TLO 3.5 State the importance of ISO TLO 3.6 Recognize the importance of customer satisfaction as a competitive advantage	Unit - III Management Practices 3.1 Quality circle, kaizen, Six Sigma, TQM 3.2 5S, Kanban card system, TPM, Lean Manufacturing: Meaning, Steps and Importance 3.3 Quality Standards and ISO: Meaning, ISO 9001:2016, ISO 14000, OSHA 2020 3.4 The overview of ERP along with example 3.5 Service quality and customer/client satisfaction, servicescape	Presentation Case study Interactive session Quiz Video Demonstration Lecture Using Chalk-Board
4	TLO 4.1 Explain the importance of marketing techniques TLO 4.2 Explain the importance of needs, wants and desires in marketing TLO 4.3 Interpret the traditional and digital marketing techniques TLO 4.4 Plan different aspects of an event management	Unit - IV Marketing Management 4.1 Marketing management: meaning, significance, Seven P's of Marketing 4.2 Needs, wants and demands in marketing. Customer relationship management 4.3 Types of marketing: traditional and digital marketing 4.4 Event management: types, different aspects of event management, crisis management	Case Study Interactive session based video Role Play Flipped Classroom Presentations
5	TLO 5.1 State the importance of supply chain and logistics management TLO 5.2 Explain the components of supply chain and logistics Management TLO 5.3 Describe the role of information technology in supply chain & logistics management TLO 5.4 State the significance of Human Resource Management TLO 5.5 Analyze the various methods of recruitment, selection and training for an organization TLO 5.6 List the qualities of a successful supervisor	Unit - V Supply Chain & Human Resource Management 5.1 The overview of Supply Chain and logistics Management 5.2 Components of Supply Chain and logistics Management 5.3 Role of information technology in supply chain & logistics management 5.4 Overview of Human Resource Management-Meaning,significance,scope and principles 5.5 Recruitment, selection and training of human resources. Chalk Circle 5.6 Qualities of a successful supervisor /team leader and types of leadership	Presentations Video Demonstrations Case Study Collaborative learning Video Demonstrations Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment / Article

- Make a one page note based on a book of management you read.
- Write a short article on inventory management exploring online learning resources.
- Prepare a report on ISO standards applicable to your field. a. IATF 16949-2016 / SLA-TS 16949-2016, - Automotive Industry b. ISO 22000 — Food safety management c. ISO 50001 — Energy management d. ISO/IEC 27001 - Cyber Security e. ISO/DIS 4931-1 - Buildings and civil engineering works
- Prepare a 4 quadrant matrix of time management for managing the tasks.
- Prepare a report on any one software used for Supply Chain and Logistics Management.
- Prepare a GANTT Chart for project management related to your field.

Note Taking

- Watch a Tedx Talk Video on managerial skills and take notes in the form of keywords.

Case Study

- Prepare a case study and discuss the same on following topics a. Self Management Skills b. Six Thinking Hats c. Kaizen d. Quality Circle e. Safety Measures in different organizations related to your field
- Study the recruitment and selection process of any organization related to your field.
- Prepare a case study on management lessons based on life of Chhatrapati Shivaji Maharaj
- Conduct outbound training on managerial skills. Make a video and upload on social media.

Quizzes

- Participate in online quizzes related to areas of management .

Assignment

- Workshops to be conducted for students on following topics a. creativity techniques b. time management c. stress management d. negotiation and conflict e. goal setting f. meditation new product development

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Management	CO1	13	8	6	4	18
2	II	Product, Operations and Project Management	CO2	8	2	4	6	12
3	III	Management Practices	CO3	8	4	4	6	14
4	IV	Marketing Management	CO4	8	2	4	6	12
5	V	Supply Chain & Human Resource Management	CO5	8	4	4	6	14
Grand Total				45	20	22	28	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- MCQ Based Class Test, Self Learning Activities / Assignment

Summative Assessment (Assessment of Learning)

- Summative Assessment (Assessment of Learning) MCQ based

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	1	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	A. K. Gupta	Engineering Management	S. Chand, ISBN: 81-219-2812-5, 2007, 2nd Edition
2	O. P. Khanna	Industrial Engineering & management	Dhanpat Rai Publication, ISBN: 978-8189928353, 2018
3	Harold Koontz and Heinz Weinrich	Essentials of Management	Tata McGraw Hill Education ISBN: 9789353168148, 2020, 12th edition
4	E. H. McGrath	Basic Managerial Skills for All	PHI ISBN: 978-8120343146, 2011, 9th Edition
5	Andrew DuBrin	Management Concepts and Cases	Cengage Learning, ISBN: 978-8131510537, 2009, 9th edition
6	K. Dennis Chambers	How Toyota Changed the World	Jaico Books ISBN: 978-81-8495-052-6, 2009
7	Jason D. O'Grandy	How Apple changed the Wolrd	Jaico Publishing House ISBN: 978-81-8495-052-0, 2009
8	Subhash Sharma	Indian Management	New Age International Private Limited ; ISBN-978-9389802412, 2020, 1st edition
9	Chitale, Dubey	Organizational Behaviour Text and Cases	PHI LEARNING PVT. LTD., ISBN: 978-9389347067, 2019, 2nd Edition

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.debonogroup.com/services/core-programs/six-thinking-hats/	Six Thinking Hats
2	https://hbr.org/1981/09/managing-human-resources	HR Management
3	https://theproductmanager.com/topics/agile-product-management/	Agile Product Management
4	https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management	Supply Chain Management
5	https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm	PERT, CPM, GANTT Chart
6	https://www.simplilearn.com/best-management-tools-article	Management Tools
7	https://www.psychometrica.in/free-online-psychometric-tests.html	Psychometric Tests
8	https://www.investopedia.com/terms/e/erp.asp	ERP
9	https://asq.org/quality-resources/quality-management-system	QMS
10	https://testlify.com/test-library/creative-thinking/	Psychometric Tests
11	https://www.mindtools.com/	Management Skills
12	https://www.investopedia.com/terms/d/digital-marketing.asp	Digital Marketing

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES**Course Code : 325320**

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES
Course Code : 325320

I. RATIONALE

The Emerging trend in Clinical laboratory processes increases efficiency, reduces human error, and enhances the throughput of sample processing to help for improved diagnostic accuracy and efficiency.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The students will be proficient in performing precise and accurate analyses of pathological samples using emerging technologies and techniques, ensuring reliable diagnostic outcomes.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Test the Susceptibility of Various antibiotics for given pathological sample
- CO2 - Analyze machine effectively to perform biochemical tests for a given sample of body fluid
- CO3 - Use cell counters effectively to differentiate cell count from a given sample of body fluid.
- CO4 - Use an automated analyzer for analysis of a given samples of semen and urine.
- CO5 - Collect samples effectively for conducting biopsy to diagnose liver diseases, including hepatitis, fatty liver, and liver cancer.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL	FA-TH	SA-TH			Total		FA-PR		SA-PR		SLA				
													Max	Min	Max	Min	Max	Min	Max	Min	
325320	EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES	ETC	DSC	4	-	2	2	8	4	1.5	30	70*#	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the Characteristic of Bacillus cereus. TLO 1.2 Describe the procedure of antibiotic susceptibility test Staphylococcus aureus. TLO 1.3 Describe the procedure of antibiotic susceptibility test E.Coli . TLO 1.4 Describe the procedure of antibiotic susceptibility test Salmonella typhi. TLO 1.5 Describe the procedure of antibiotic susceptibility test Pseudomonas aeruginosa.	Unit - I Microbiology 1.1 Study of principle and procedure of pure culture and antibiotic susceptibility test- Bacillus cereus. 1.2 Staphylococcus aureus. 1.3 E. coli. 1.4 Salmonella typhi. 1.5 Pseudomonas aeruginosa.	Video Demonstrations Flipped Classroom Hands-on Collaborative learning Site/Industry Visit
2	TLO 2.1 Identify different types of autoanalyzer and their significance. TLO 2.2 Describe the step by step procedure of chromatographic technique and its applications . TLO 2.3 Describe the step by step procedure of Nephelometry with suitable diagram. TLO 2.4 Illustrate specified PCR instruments with diagram. TLO 2.5 Use ELISA technique effectively for disease diagnosis	Unit - II Biochemistry 2.1 Type of Auto analyzer 2.2 Type of Chromatographic technique 2.3 Nephelometry. 2.4 Classification and diagrammatic representation of features of different PCR . 2.5 Principle , procedure and application of ELISA, RIA.	Video Demonstrations Flipped Classroom Model Demonstration Hands-on Collaborative learning

EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES**Course Code : 325320**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the principle and application of cell counter. TLO 3.2 Describe various types of cell counter. TLO 3.3 Describe the principle and application of Apheresis. TLO 3.4 Describe the procedure of automated blood grouping. TLO 3.5 Describe the significance of blotting technique as used in immunocytochemistry.	Unit - III Hematology 3.1 Principle and application of Cell counter. 3.2 Type of cell counter 3.3 Apheresis 3.4 Automated blood grouping 3.5 Types of blotting techniques - western blot assay, significance blotting technique in immunocytochemistry.	Model Demonstration Video Demonstrations Collaborative learning Role Play Hands-on
4	TLO 4.1 Describe the step by step procedure of Automated Semen analysis. TLO 4.2 Interpret the finding in automated urine analysis report. TLO 4.3 Describe the step by step procedure of Automated Mycobacterial culture. TLO 4.4 Describe features, functions of Electron Microscope with applications. TLO 4.5 Describe features, functions of Fluorescent Microscope with application.	Unit - IV Clinical Pathology 4.1 Procedure of Automated Semen analysis. 4.2 Reporting of findings of Automated urine chemistry. 4.3 Procedure of Automated Mycobacterial culture 4.4 Features, functions of Electron Microscope with applications 4.5 Features, functions of Fluorescent Microscope with application.	Model Demonstration Video Demonstrations Flipped Classroom Flipped Classroom Site/Industry Visit
5	TLO 5.1 Describe principle, procedure of Needle biopsy for specified sample. TLO 5.2 Describe principle, procedure of Surgical biopsy for specified sample. TLO 5.3 Describe principle, procedure of endoscopy biopsy for specified sample. TLO 5.4 Describe principle, procedure of Skin biopsy for specified sample. TLO 5.5 Describe principle, procedure of liquid biopsy for specified sample.	Unit - V Biopsy 5.1 Principle and Procedure of Needle biopsy 5.2 Principle and Procedure of Surgical biopsy. 5.3 Principle and Procedure of endoscopy biopsy 5.4 Principle and Procedure of Skin biopsy. 5.5 Principle and Procedure of bone marrow, liquid biopsy	Model Demonstration Video Demonstrations Hands-on Site/Industry Visit Collaborative learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Analyze glucose with glucometer	1	*Estimation of glucose with glucometer	2	CO1
LLO 2.1 Identify HIV by Tri Dot Method.	2	*Identification of HIV by Tri Dot Method	2	CO1
LLO 3.1 Examine Hepatitis B Virus by ELISA method.	3	*Detection of Hepatitis B Virus by ELISA.	2	CO1
LLO 4.1 Perform specified test using given type of autoanalyzer.	4	*Testing of specimens using Autoanalyzer.	2	CO2

EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES**Course Code : 325320**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Perform specified test using Cell counter.	5	*Testing of specimens using Cell Counter.	2	CO2
LLO 6.1 Separate Blood group by Cartridge method	6	*Automated blood grouping using gel cartridge method.	2	CO2
LLO 7.1 Perform Cholesterol test using given type of autoanalyzer	7	*Testing of Cholesterol using Autoanalyzer.	2	CO3
LLO 8.1 Measure zone of inhibition of Bacillus cereus accurately.	8	*Measurement of antibiotic susceptibility test of Bacillus cereus	2	CO3
LLO 9.1 Measure zone of inhibition of Staphylococcus aureus accurately.	9	*Measurement of antibiotic susceptibility test of Staphylococcus aureus.	2	CO3
LLO 10.1 Measure zone of inhibition accurately.	10	*Measurement of antibiotic susceptibility test of E. coli.	2	CO4
LLO 11.1 Measure zone of inhibition accurately Salmonella typhi	11	Measurement of antibiotic susceptibility test of Salmonella typhi	2	CO4
LLO 12.1 Measure zone of inhibition of Pseudomonas aeruginosa accurately.	12	Measurement of antibiotic susceptibility test of Pseudomonas aeruginosa	2	CO4
LLO 13.1 Analyze Cholesterol with Cholesterol Strip.	13	Estimation of cholesterol by using cholesterol strip	2	CO5
LLO 14.1 Handle biopsy equipment as per standard.	14	Sterilization of biopsy equipment	2	CO5
LLO 15.1 Identify cell or tissue under Microscope for cancer or other abnormalities.	15	Extraction of cell or tissue sample by Using Needle biopsy.	2	CO5
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare Model on Autoanalyzer.
- Draw Electron Microscope with labels.
- Prepare a Biopsy presentation.
- Prepare a chart on type Biopsy.
- Prepare chart in antibiotic susceptibility test.
- Prepare a presentation on antibiotic susceptibility test
- Draw ELISA with labels.
- Prepare a model on the cell counter.
- Prepare a model on Glucometer.

Micro project

- Assessment of Patients suffering from HIV.
- Assessment of glucose (pre and post meal) level in serum sample.
- Collection ,examination of biopsy sample.
- Assessment of Patients suffering from Hepatitis B.
- Conduct Antibiotic Susceptibility test.
- Assessment of Cholesterol level in serum sample.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Cell Counter, Autoanalyser, Glucometer	4,13,14,15
2	Water bath/Burner ,Calorimeter	All
3	Test tubes, flask, beaker, reagent bottle, analytical balance, dropper/micropipette	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Microbiology	CO1	12	4	5	5	14
2	II	Biochemistry	CO2	14	4	6	6	16
3	III	Hematology	CO3	12	2	6	6	14
4	IV	Clinical Pathology	CO4	12	2	8	4	14
5	V	Biopsy	CO5	10	2	6	4	12
Grand Total				60	14	31	25	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- 1) Two unit test each of 30 marks and average taken out of 30 marks. 2) formative assessment of 25 marks for laboratory learning.

Summative Assessment (Assessment of Learning)

- 1) End semester assessment of 70 marks for theory. 2) End semester assessment of 25 marks for practical.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	3		2	3	2	3			
CO2	3			3	3	2	3			
CO3	3	3		3	3	2	3			
CO4	3	3		3	3	2	3			
CO5	3	3		3	3	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	McPherson and Pincus	Henry's Clinical Diagnosis and Management	Elsevier, ISBN-10. 1437709745.
2	Munjial Shah	PJ Mehta's Practical Pathology	The National Book Depot, ISBN-10. 8195024947
3	Praful Godkar	Textbook of Medical Laboratory Technology	Bhalani, ISBN-10. 9789381496190
4	Kanai Mukherjee	Medical Laboratory Technology	McGraw Hill, ISBN-10. 9789352606818
5	Pankaja Naik	Essential of Biochemistry	Jaypee, ISBN NO-978-93-5025-491-2

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Net6oCxIBbc&t=47s	Estimation of glucose with glucometer
2	https://www.youtube.com/watch?v=iOyla5TZyS4	Identification of HIV by Tri Dot Method
3	https://www.youtube.com/watch?v=zR_xlV5v_f4	Detection of Hepatitis B Virus by ELISA
4	https://www.youtube.com/watch?v=zpL5xbZ_9wQ	Automated blood grouping using gel cartridge method.
5	https://www.youtube.com/watch?v=GRYtb8CqTvM	Testing of Cholesterol using Autoanalyzer.
6	https://www.youtube.com/watch?v=08Qm387wDx0	Estimation of cholesterol by using cholesterol strip
7	https://www.youtube.com/watch?v=p_52PvJVxG8	Sterilization of biopsy equipment
8	https://www.youtube.com/watch?v=QwvU0nqGxnU	Extraction of cell or tissue sample by Using Needle biopsy.

EMERGING TRENDS IN CLINICAL LABORATORY SCIENCES**Course Code : 325320**

Sr.No	Link / Portal	Description
9	https://www.youtube.com/watch?v=UDUiCMpqRvA	Measurement of antibiotic susceptibility test of Bacillus cereus
10	https://www.youtube.com/watch?v=aMD8DZGM8fw	Measurement of antibiotic susceptibility test of Salmonella typhi
Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : DIAGNOSTIC PATHOLOGY IN PRACTICE
Course Code : 325321

I. RATIONALE

The principles and techniques of pathology have a wide applications in many branches of medicine. Pathology is a basic subject which deals with examination of various body fluids for presence of multiple factors which affect human health and cause certain /related illness. This course provides necessary knowledge and skills to the students for performing pathological tests of various body fluids i.e. physical, chemical and microscopic examination in various pathological conditions.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

To determine the abnormalities in body function by performing relevant pathological test

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Conduct routine pathological investigation of urine in various disease conditions accurately using standard procedure
- CO2 - Conduct accurate clinical pathological tests of stool examinations in different diseases
- CO3 - Conduct pathological investigation of sputum accurately in various disease conditions
- CO4 - Investigate semen sample using standard procedure in case of infertility profile and advanced treatment
- CO5 - Examine various body fluids and their significance in specify pathological conditions

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week				Theory			Based on LL & TL				Based on SL						
											Practical										
											FA-TH	SA-TH	Total				FA-PR		SA-PR		
					CL	TL	LL				SLH	NLH	Max	Max	Max	Min	Max	Min	Max	Min	
325321	DIAGNOSTIC PATHOLOGY IN PRACTICE	CLP	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain clinical significance of urine analysis TLO 1.2 Select relevant method of sample collection TLO 1.3 Describe different parameters of physical examination of urine TLO 1.4 Conduct chemical examination of urine to determine various abnormal constituents. TLO 1.5 Explain the significance of specified microscopic examination of urine	Unit - I Urine Examination 1.1 Indication of urine examination 1.2 Sample collection, container, transportation, preservation of urine 1.3 Different parameters of Physical examination of urine 1.4 Different chemical examinations of urine and their significance 1.5 Microscopic examination of urine and its significance in urinary tract infections.	Video Demonstrations Demonstration Flipped Classroom Presentations Collaborative learning
2	TLO 2.1 Identify conditions in which stool examination is ordered TLO 2.2 State universal rules and precautions for stool examination sample collection TLO 2.3 Describe different parameters of physical examination of stool TLO 2.4 Explain chemical examination of stool and its significance TLO 2.5 Explain microscopic examination of stool and its significance	Unit - II Stool Examination 2.1 Indication or clinical significance of stool analysis 2.2 Sample collection, preservation and transportation of stool examination 2.3 Physical examination of stool and its significance 2.4 Chemical examination of stool and its significance 2.5 Microscopic examination of stool and its significance	PPT Video Demonstrations Flipped Classroom Lecture Using Chalk-Board Hands-on

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe procedure of collection, transportation, and preservation of sputum sample. TLO 3.2 Identify conditions in which sputum examination is ordered TLO 3.3 Describe physical characteristics of sputum. TLO 3.4 Analyze sputum by microscopic examination. TLO 3.5 Describe the steps of sputum AFB test	Unit - III Sputum Examination 3.1 Definition of sputum, sputum collection procedure, transportation and preservation of sputum 3.2 Indications or clinical significance of sputum examination 3.3 Physical examination of sputum 3.4 Microscopic examination of sputum and its significance 3.5 Gram staining and Zeihal-Neelsen staining procedure	Lecture Using Chalk-Board Video Demonstrations Presentations Flipped Classroom Case Study
4	TLO 4.1 Identify conditions in which semen examination is ordered TLO 4.2 Describe step by step procedure of collection, transportation and preservation of semen TLO 4.3 Interpret the condition of sample of semen after physical examination TLO 4.4 Perform chemical and microscopic examination of semen TLO 4.5 Interpret the result of chemical and microscopic examination of semen.	Unit - IV Semen Examination 4.1 Indication of semen analysis 4.2 Methods of collection, transportation and preservation of semen 4.3 Physical examination of semen analysis and its significance 4.4 Chemical and Microscopic examination of semen analysis and its significance 4.5 Interpretation of the report of semen analysis	Presentations Lecture Using Chalk-Board Flipped Classroom Video Demonstrations Collaborative learning
5	TLO 5.1 Describe Indication, collection, preservation, transportation and examination of C.S.F. TLO 5.2 Explain Indication, collection, preservation, transportation and examination of Pleural fluid TLO 5.3 Write Indication, collection, preservation, transportation and examination of peritoneal fluid TLO 5.4 Illustrate Indication, collection, preservation, transportation and examination of synovial fluid TLO 5.5 Describe Indication, collection, preservation, transportation and examination pericardial fluid	Unit - V Examination of other body fluids 5.1 Indication, collection, preservation, transportation and examination of C.S.F. 5.2 Indication, collection, preservation, transportation and examination of Pleural fluid. 5.3 Indication, collection, preservation, transportation and examination of peritoneal fluid 5.4 Indication, collection, preservation, transportation and examination of synovial fluid 5.5 Indication, collection, preservation, transportation and examination pericardial fluid	Video Demonstrations Presentations Case Study Collaborative learning Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Perform collection and physical examination of urine using standard procedure	1	*Sample collection and physical examination of urine	4	CO1

DIAGNOSTIC PATHOLOGY IN PRACTICE**Course Code : 325321**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Identify accurately abnormal components by Chemical examination of urine	2	*Chemical examination of urine	4	CO1
LLO 3.1 Perform microscopic examination and observe different fields using standard procedure	3	*Microscopic examination of urine	4	CO1
LLO 4.1 Perform sample collection and physical examination of stool using standard procedure	4	Sample collection and physical examination of stool	4	CO2
LLO 5.1 Perform accurately chemical examination of stool	5	Chemical examination of stool	4	CO2
LLO 6.1 Detect the bacteria and parasite by microscopic examination of stool	6	*Microscopic examination of stool	4	CO2
LLO 7.1 Perform sample collection and physical examination of sputum using standard procedure	7	*Sample collection and physical examination of sputum	4	CO3
LLO 8.1 Conduct accurate Chemical and microscopic examination of sputum	8	*Chemical and microscopic examination of sputum	4	CO3
LLO 9.1 Analyze semen sample by Physical examination	9	*Physical examination of semen	4	CO4
LLO 10.1 Conduct accurate Chemical and microscopic examination of semen	10	Chemical and microscopic examination of semen	4	CO4
LLO 11.1 Perform sample collection and physical examination of CSF using standard procedure	11	Sample collection and physical examination of CSF	4	CO5
LLO 12.1 Conduct accurate chemical and microscopic examination of CSF	12	*Chemical and microscopic examination of CSF	4	CO5
LLO 13.1 Perform sample collection and physical examination of ascitic fluid using standard procedure.	13	Sample collection and physical examination of ascitic fluid	4	CO5
LLO 14.1 Perform chemical and microscopic examination of ascitic fluid	14	Sample collection and Chemical and microscopic examination of ascitic fluid	4	CO5
LLO 15.1 Perform sample collection and physical, chemical and microscopic examination of synovial fluid	15	Sample collection and physical, chemical and microscopic examination of synovial fluid	4	CO5
LLO 16.1 Conduct accurate physical, chemical and microscopic examination of pericardial fluid	16	Physical, Chemical and microscopic examination of pericardial fluid	4	CO5
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING /

SKILLS DEVELOPMENT (SELF LEARNING)**Assignment**

- Prepare chart of microscopic examination of urine
- Draw a hand sketch of cyst, trophozoite and larva
- Prepare a chart on collection of other body fluids
- Prepare chart on semen analysis
- Prepare a chart on universal rules and precautions for stool examination
- Make a chart on disease (jaundices/diabetes militias/tuberculosis/crohn's disease/diarrhea etc.) and diagnostic related test

Survey

- survey on tuberculosis in particular 1000 population

Survey

- Survey of urinary tract infection in womens in particular area

Micro project

- Prepare model of lungs infected with tuberculosis
- Prepare a wooden model of pathological laboratory

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Urinometer (educational Model)	1
2	pH meter	1,2,3,4,5
3	centrifuge	3
4	compound microscope	3,6,8,10,12,14,15,16
5	Stain and Rack	3,6,8,10,12,14,15,16
6	Sample containers	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

DIAGNOSTIC PATHOLOGY IN PRACTICE**Course Code : 325321**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Urine Examination	CO1	11	4	8	4	16
2	II	Stool Examination	CO2	8	2	6	4	12
3	III	Sputum Examination	CO3	10	2	8	6	16
4	IV	Semen Examination	CO4	10	2	8	6	16
5	V	Examination of other body fluids	CO5	6	2	2	6	10
Grand Total				45	12	32	26	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks. •Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks. •Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks. •Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks. • End semester summative assessment is of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	3	2	2	1	-	3			
CO2	3	2	1	2	1	1	2			
CO3	3	3	2	2	1	-	3			
CO4	3	3	1	2	1	1	3			
CO5	3	2	1	2	1	-	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kanai L.Mukharjee Anuradha Chakravarthy	Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Test Vol 1, 2, 3	Mc Graw Hill Education : Third Edition ISBN - 9789352606818 - Vol - I 9789352606818 - Vol - II 9789352606815 - Vol - III
2	Shirish M Kawthlakat	Essential of Clinical Pathology	Jaypee Brothers Medical Publishers 978- 9380704197
3	J. Ochei A. Kolhatkar	Medical Laboratory Science Theory and practice	Mc Graw Hill Education ISBN ; 978 - 0074632239

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/K7cSO2cywZU?si=IJWBEQO5XLWZFYV	Urine examination
2	https://youtu.be/K7cSO2cywZU?si=IJWBEQO5XLWZFYV	Chemical examination of urine
3	https://youtu.be/-iI2PxmHxuo?si=Yyctz7Y3YlwHnKiI	Interpretation of stool examination
4	https://youtu.be/XMO-tj0mZyA?si=pZzik7w3yFuXIqNt	Routine parasite in stool microscopy
5	https://youtu.be/LJMJqrbWcI?si=rQkfZG2vUHE8AKQr	Sputum examination
6	https://youtu.be/kHgxDhRbQNU?si=mKJBrHN3bwauavfx	Semen Analysis
7	https://www.youtube.com/live/jY1DI4GVkAk?si=uYUL0cnYsjRq2b9	Examination of other body fluids

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY
Course Code : 325322

I. RATIONALE

The course in Medical Virology and Mycology is designed to address the pressing need for skilled professionals in the field of infectious diseases. By providing a comprehensive education that integrates theory with practical skills, the course prepares students to meet the challenges of diagnosing and managing viral and fungal infections, ultimately contributing to improved patient outcomes and public health.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Students of the Medical Virology and Mycology course should expertly perform and interpret diagnostic tests for viral and fungal infections, ensure high-quality results, and contribute effectively to infection management and research.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Illustrate properties of viruses with cultivation methods
- CO2 - Inspect Picorna, Rhabdo and Arboviruses
- CO3 - Compare and contrast Hepatitis, HIV and Influenza viruses
- CO4 - Examine properties, classification, collection and transportation of fungi
- CO5 - Assess morphology, pathogenesis and lab diagnosis of mycoses

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL			
				CL	TL	LL					Practical				SLA							
											FA-TH	SA-TH	Total		FA-PR		SA-PR					
													Max	Max	Max	Min	Max	Min	Max	Min	Max	
325322	PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY	MVM	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175	

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @\$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define viruses TLO 1.2 Describe properties of viruses TLO 1.3 Write methods of cultivation of viruses TLO 1.4 Explain Collection and Transportation of Viral specimen	Unit - I Fundamental and Diagnostic Virology 1.1 Definition of viruses 1.2 General Properties of Viruses – Size, Structure, Shape, Chemical properties 1.3 Methods of cultivation of Viruses - a. Animal inoculation b. Embryonated Eggs c. Cell Culture – Primary, Diploid, Continuous 1.4 Collection and transportation of Viral Specimen	Video Demonstrations Model Demonstration Flipped Classroom Hands-on Presentations
2	TLO 2.1 Write Morphology of polio, rabies, dengue virus and corona virus (SARS-CoV-2) TLO 2.2 Draw structure of polio, rabies, dengue virus and corona virus (SARS-CoV-2) TLO 2.3 Discuss Pathogenesis of polio, rabies, dengue virus and corona virus (SARS-CoV-2) TLO 2.4 Describe lab diagnosis of polio, rabies, dengue virus and corona virus (SARS-CoV-2)	Unit - II Study of Picorna, Rhabdo, Arboviruses and Corona virus (SARS-CoV-2) 2.1 Morphology, Pathogenesis and Lab diagnosis of Polio virus 2.2 Morphology, Pathogenesis and Lab diagnosis of Rabies virus 2.3 Morphology, Pathogenesis and Lab diagnosis of Dengue virus 2.4 Morphology, Pathogenesis and Lab diagnosis of corona virus (SARS-CoV-2)	Video Demonstrations Flipped Classroom Presentations Hands-on Role Play

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Write Morphology of Hepatitis A virus, Hepatitis B virus, HIV, Influenza virus TLO 3.2 Draw structure of Hepatitis A virus, Hepatitis B virus, HIV, Influenza virus TLO 3.3 Discuss Pathogenesis of Hepatitis A virus, Hepatitis B virus, HIV, Influenza virus TLO 3.4 Describe lab diagnosis of Hepatitis A virus, Hepatitis B virus, HIV, Influenza virus	Unit - III Study of Hepatitis, HIV and Influenza viruses 3.1 Morphology, Pathogenesis and Lab diagnosis of Hepatitis A virus 3.2 Morphology, Pathogenesis and Lab diagnosis of Hepatitis B virus 3.3 Morphology, Pathogenesis and Lab diagnosis of HIV virus 3.4 Morphology, Pathogenesis and Lab diagnosis of Influenza virus	Video Demonstrations Flipped Classroom Presentations Hands-on Site/Industry Visit
4	TLO 4.1 Define mycology, fungi, hyphae, mycelium TLO 4.2 Classify fungi TLO 4.3 Explain collection and transportation of fungal specimen TLO 4.4 Describe processing of clinical specimen	Unit - IV Introduction to Mycology 4.1 Mycology – Definition, Fungi – Morphology of fungi, Hyphae, Mycelium 4.2 Classification based on cell morphology and systemic 4.3 Laboratory Techniques: Collection & Transportation of specimens, Direct Examination (KOH Preparation), Negative Staining with India Ink & 10% Nigrosin, Common fungal media-Sabouraud's Dextrose Agar (SDA), Brain Heart Infusion Agar (BHIA), Corn meal 4.4 Processing of Clinical specimen – Wet Mount, Slide Culture, Germ Tube test	Video Demonstrations Flipped Classroom Presentations Hands-on Site/Industry Visit
5	TLO 5.1 Explain morphology of fungi causing surface, cutaneous, subcutaneous, systemic, opportunistic mycoses TLO 5.2 Explain Pathogenesis of fungi causing surface, cutaneous, subcutaneous, systemic, opportunistic mycoses TLO 5.3 Explain lab diagnosis of fungi causing surface, cutaneous, subcutaneous, systemic, opportunistic mycoses	Unit - V Mycoses 5.1 Superficial Mycoses – Morphology, pathogenesis and lab diagnosis of Surface infection – Tinea Versicolor, Piedra – White Cutaneous Infections – Trichophyton, Microsporum 5.2 Subcutaneous Mycoses – Morphology, pathogenesis and lab diagnosis of Mycetoma 5.3 Systemic Mycoses – Morphology, pathogenesis and lab diagnosis of Cryptococcus 5.4 Opportunistic Mycoses – Morphology, pathogenesis and lab diagnosis of Aspergillosis, Candidiasis	Video Demonstrations Flipped Classroom Presentations Hands-on Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Demonstrate cultivation of virus by Egg inoculation method	1	Isolate virus from given clinical specimen using egg inoculation technique	4	CO1 CO2 CO3
LLO 2.1 Perform Collection and Transportation of virological specimens following standard procedure	2	Conduct Collection and Transportation of virological specimens from suspected patients in hospital	4	CO1 CO2 CO3
LLO 3.1 Prepare Giemsa stain and detection of inclusion body by it	3	Prepare Giemsa stain and detect inclusion body from clinical specimen	4	CO1 CO2 CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Demonstrate negri bodies in brain smear	4	Detection presence of negri bodies in given specimen	4	CO1 CO2 CO3
LLO 5.1 Detect Dengue antibody by chromatographic immunoassay	5	*Determination Dengue antibody by chromatographic immunoassay	4	CO1 CO2
LLO 6.1 Identify sample infected with HIV LLO 6.2 Quantitative assay of HIV antibody	6	Detection of HIV antibody in given serum/plasma sample by ELISA method	4	CO1 CO3
LLO 7.1 Identify person suffering from HIV LLO 7.2 Qualitative assay of HIV antibody	7	*Detection of HIV antibody by Tridot/ immunoassay method	4	CO1 CO3
LLO 8.1 Identify person suffering from hepatitis B infection LLO 8.2 Qualitative assay of Hepatitis antigen	8	*Detection of Australia antigen by chromatographic immunoassay method	4	CO1 CO3
LLO 9.1 Perform Collection and Transportation of virological specimens using standard procedure	9	*Collection and transportation of fungal specimens	4	CO4 CO5
LLO 10.1 Prepare fungal media – PDA, SDA and Corn Meal Agar	10	*Preparation of fungal media – PDA, SDA and Corn Meal Agar	4	CO4 CO5
LLO 11.1 Identify fungi by slide culture	11	*Examination of fungal specimen	4	CO4 CO5
LLO 12.1 Identify type of fungi	12	*Preparation of Wet Mount of fungal specimen in 10% KOH solution	4	CO4 CO5
LLO 13.1 Identify type of fungi	13	*Prepare Slide of fungal specimen in lactophenol cotton blue	4	CO4 CO5
LLO 14.1 Identify Cryptococcus neoformans	14	Perform negative staining of Cryptococcus neoformans using 10% nigrosin/ India ink	4	CO4 CO5
LLO 15.1 Differentiate Candida albicans and non candida albicans	15	Identification of Candida by germ tube assay	4	CO4 CO5
LLO 16.1 Identify Aspergillus spp	16	Perform Isolation of Aspergillus Spp from clinical specimen	4	CO4 CO5

Note : Out of above suggestive LLOs -

- '* Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Design a set of posters or slides that showcase the morphology of fungi (hyphae, mycelium) alongside the morphology of selected viruses. Highlight similarities and differences in structure.
- Collect fungal and/or viral specimens from nearby hospital and illustrate the workflow from specimen collection to diagnosis.
- Create detailed diagrams or flowcharts illustrating the pathogenesis of any two to three virus listed in. Include stages of infection, immune response, and clinical manifestations.
- Develop a guide or educational video detailing the best practices for collecting and transporting specimens for viruses like Polio, Rabies, Dengue, and SARS-CoV-2. Include specific requirements and challenges for each virus. You can use free

apps and mobile phone for video development

- Design a detailed guide on the preparation and use of different fungal media (SDA, BHIA) and their role in the cultivation and identification of various fungi. Include instructions for processing clinical specimens like wet mounts and slide cultures.
- Visit to virology laboratory and prepare a report with pictures
- Participate in AIDS rallies and prepare a report with pictures
- Develop a report and / or powerpoint presentation on the epidemiology and prevention strategies for selected viral (e.g., Polio, Dengue) and fungal diseases (e.g., Mycetoma, Cryptococcus). Include information on vaccines, public health measures, and effective treatments.
- Create a comparative study or infographic that illustrates the relationship between virus structure (e.g., size, shape) and the methods used for their cultivation (animal inoculation, embryonated eggs, cell culture). Highlight how different structural features might affect the choice of cultivation method.
- Create a comprehensive diagnostic methods chart or flowchart on paper sheet (Full size / half size drawing sheet covering techniques for viruses studied in Units II and III, including PCR, serology, and microscopy. Include comparisons and typical diagnostic scenarios.
- Develop a lab instruction sheet or video tutorial on common mycology laboratory techniques such as KOH preparation, slide culture, and germ tube test, including how these techniques apply to diagnosing different types of mycoses. Use of mobile phone and free software is recommended.
- Create a comparative report or presentation that examines similarities and differences in the morphology, pathogenesis, and lab diagnosis of selected viral infections (e.g., Polio, Rabies) and fungal infections (e.g., Tinea Versicolor, Aspergillosis).

Assignment

- Prepare a chart on any one viral disease including selected key aspects i.e. Pathogenesis and laboratory diagnosis
- Write a report comparing diagnostic techniques for viruses and fungi.
- Prepare a chart on any one fungal diseases including selected key aspects i.e. Pathogenesis and laboratory diagnosis.
- Search software/ freeware/ apps for the course content / and write the detailed features , applications.
- Write a report comparing and contrasting the definition, size, structure, shape, and chemical properties of different viruses.
- Explains various methods of virus cultivation.
- Discuss how understanding pathogenesis informs diagnostic approaches and treatment strategies.
- Develop a worksheet that includes diagrams and descriptions of fungal morphology.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Microcentrifuge maximum speed of at least 10,000 rpm.	1
2	Egg Incubator	1
3	Class II Biosafety Cabinet	1,2

PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY**Course Code : 325322**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	Sterile Swabs (e.g., calcium alginate-free)	1,2,3,4,9,11,16
5	Light Microscope	3,4,11,12,13,14,15,16
6	Chromatographic Immunoassay Kits	5,7,8
7	Portable Refrigerators	All
8	Horizontal Laminar Flow Hood	All
9	Adjustable micropipettes (0.1-10 μ L, 1-100 μ L, 10-1000 μ L)	All
10	Sterile needles and syringes	All
11	Laboratory Autoclave	All
12	Sterile Containers (e.g., tubes with viral transport media)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamental and Diagnostic Virology	CO1	4	4	0	4	8
2	II	Study of Picorna, Rhabdo, Arboviruses and Corona virus (SARS-CoV-2)	CO1,CO2	9	0	8	6	14
3	III	Study of Hepatitis, HIV and Influenza viruses	CO1,CO3	9	2	4	8	14
4	IV	Introduction to Mycology	CO4	9	2	0	12	14
5	V	Mycoses	CO4,CO5	14	2	8	10	20
Grand Total				45	10	20	40	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- 2 Progressive assessment theory/ Class test each 30 marks
- Record 25 Marks

Summative Assessment (Assessment of Learning)

- End Semester Examination 25 Marks
- Self learning - Assignments 10 Marks
- Self learning - Microproject 10 Marks
- Self learning - Presentation 05 Marks

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	2	3	3	1	-	3			

PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY**Course Code : 325322**

CO2	3	2	1	3	3	-	-			
CO3	3	3	1	3	3	-	-			
CO4	3	2	3	3	1	-	3			
CO5	3	2	1	3	2	-	-			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jagdish Chandar	Text Book of Medical Mycology	Jaypee Brothers Medical Publishers (P) Ltd ISBN Number:9789386261830
2	Baijayantimala Mishra	Text Book Virology	CBS Publishers & Distributors 9789386478320
3	Dr. Reba Kanungo	Ananthnarayan and Panikar's Text Book of Microbiology	The Orient Blackswan 9789386235251
4	Praful B Godkar Darshan P Godkar	Text Book of Medical Laboratory Technology	Bhalani Publication House Third Edition Vol. I and II, 2018 ISBN Number : 978818557853
5	Praful B Godkar Darshan P Godkar	Text Book of Medical Laboratory Technology	Bhalani Publication House Third Edition Vol. I and II, 2018 ISBN Number: 978818557853
6	J.Ochei A. Kolhatkar	Medical Laboratory Science Theory and practice	Mc Graw Hill Education, ISBN: 978-0074632239
7	Satish Gupte	The short Text Book of Medical Laboratory for Technician	JYPEE Publication, Second Edition, ISBN: 9789350908518
8	Ramnik Sood	Medical Laboratory Methods & Interpretation Vol 1 & Vol 2	JPB, Sixth Edition ISBN:978-8184484496-Vol-2
9	Kanai L. Mukharjee Anuradha Chakravarthy	Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests Vol 1, 2, 3	Mc Graw Hill Education: Third Edition ISBN:9789352606801- Vol-I 9789352606818- Vol-II 9789352606815-Vol-III
10	C.P.Baveja V. Baveja	Textbook of Microbiology for MLT	Arya Publication, 2nd Edition (2019) ISBN:978-8178556987

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.cdc.gov/respiratory-viruses/index.html	Respiratory Illnesses
2	https://ncdc.mohfw.gov.in/	The institute was established to function as a national centre of excellence for control of communicable diseases. The function of the institute also included various areas of training and research using multi-disciplinary integrated approach.
3	https://www.who.int/health-topics/hepatitis?gad_source=1&gclid=Cj0KCQjwIIG2BhC4ARIsADBgpVR2YGEkYulLynodiDn00KCIlv92XisyL1igGHRWW9H3WOL9nUrFNhUaAsIqEALw_wcB#tab=tab_1	Hepatitis
4	https://www.ncbi.nlm.nih.gov/labs/virus/vssi/	is a community portal for viral sequence data from RefSeq, GenBank and other NCBI repositories.

PRACTICAL APPROACHES TO MEDICAL VIROLOGY AND MYCOLOGY**Course Code : 325322**

Sr.No	Link / Portal	Description
5	https://www.cdc.gov/fungal/index.html	Fact sheets and images of information related to fungal diseases.
6	https://en.fungaleducation.org/factsheets/	Information about emerging fungal diseases
7	https://www.youtube.com/watch?v=O1TetEto1Is	Viral Structure and Functions
8	https://www.youtube.com/watch?v=JJbQz-4Tz2Q	Introduction to Virology
9	https://www.youtube.com/watch?v=-7dhZou0KRM	Virus in hindi What is a virus? Introduction to viruses structure and symmetry of virus
10	https://www.youtube.com/watch?v=3tRJ1JcnuhM	Picornavirus microbiology // overview// picornavirus in Hindi
11	https://www.youtube.com/watch?v=CWDxxgvgzGw	Rabies virus microbiology / Morphology, pathogenesis, Treatment, prevention of rabies virus
12	https://www.youtube.com/watch?v=V9ppWprZP1c	Arbovirus
13	https://www.youtube.com/watch?v=tmjwd2bHaOs	COVID-19: Corona Virus (Pathophysiology)
14	https://www.youtube.com/watch?v=K4MldnSoW9o	Hepatitis virus microbiology // hepatitis virus (A,B,C,D,E) / Hepatitis B virus
15	https://www.youtube.com/watch?v=RRvn1CpjFeg	Human immunodeficiency virus // HIV Virus microbiology
16	https://www.youtube.com/watch?v=GyNyFqWtFyk	Influenza Virus Microbiology Animation
17	https://www.youtube.com/watch?v=iIViTamopBY	Lab diagnosis of fungal infection Microbiology
18	https://www.youtube.com/watch?v=pDBDu8tnIZY	Lab diagnosis of fungus
19	https://www.youtube.com/watch?v=B76w6u_hl6U	Superficial Mycoses
20	https://www.youtube.com/watch?v=DcZf7KhxJts	Subcutaneous mycoses
21	https://www.youtube.com/watch?v=dQjufVrD7M4	Systemic mycoses
22	https://www.youtube.com/watch?v=F5kE1lkYnOI	Opportunistic mycoses

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Agricultural Engineering/ Architecture/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Food Technology/ Instrumentation & Control/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Surface Coating Technology/ Textile Technology/ Travel and Tourism/ Textile Manufactures/
Programme Code	: AA/ AD/ AE/ AL/ AT/ DC/ DD/ FC/ IC/ IS/ IX/ IZ/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ SC/ TC/ TR/ TX
Semester	: Fourth / Fifth / Sixth
Course Title	: ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS
Course Code	: 314014

I. RATIONALE

Entrepreneurship and Startup is introduced in this curriculum to develop the entrepreneurship traits among the students before they enter into the professional life. By exposing and interacting with entrepreneurship and startup eco-system, student will develop the entrepreneurial mind set. The innovative thinking with risk taking ability along with other traits are to be inculcated in the students through micro projects and training. This exposure will be instrumental in orienting the students in transforming them to be job generators after completion of Diploma in Engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

- Develop project proposals for launching small scale enterprises and starts up.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify one's entrepreneurial traits.
- CO2 - Use information collected from stakeholder for establishing/setting up/founding starts up
- CO3 - Use support systems available for Starts up
- CO4 - Prepare project plans to manage the enterprise effectively

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL				
				CL	TL	LL					Practical				SLA								
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA				
													Max	Max	Max	Min	Max	Min	Max	Min	Max		Min
314014	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	1	-	2	1	4	2	-	-	-	-	-	50	20	25@	10	25	10	100		

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare advantages and disadvantages of Entrepreneurship TLO 1.2 Identify entrepreneurial traits through self-analysis TLO 1.3 Compare risk associated with different type of enterprise	Unit - I Introduction to Entrepreneurship Development 1.1 Entrepreneurship as a career – charms, advantages, disadvantages , scope- local and global 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking, learning from failure 1.3 Types of enterprises and their features : manufacturing, service and trading	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Explain Important factors essential for selection of product/service and selection of process TLO 2.2 Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. TLO 2.3 Suggest steps for the selection process of an enterprise for the specified product or service with justification. TLO 2.4 Plan a market study /survey for the specified enterprise	Unit - II Startup Selection Process 2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Industries Commission[KVIC]	Presentations Lecture Using Chalk-Board

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain categorization of MSME on the basis of turnover and investment TLO 3.2 Describe support system provided by central and state government agencies TLO 3.3 State various schemes of government agencies for promotion of entrepreneurship TLO 3.4 Describe help provided by the non-governmental agencies for the specified product/service TLO 3.5 Compute breakeven point, ROI and ROS for the specified business enterprise, stating the assumptions made	Unit - III Support System for Startup 3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP, DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment (ROI) and return on sales (ROS).	Presentations Lecture Using Chalk-Board
4	TLO 4.1 Explain key elements for the given business plan with respect to their purpose/size TLO 4.2 Justify USP of the given product/ service from marketing point of view. TLO 4.3 Formulate business policy for the given product/service. TLO 4.4 Choose relevant negotiation techniques for the given product/ service with justification TLO 4.5 Identify risks that you may encounter for the given type of business/enterprise with justification. TLO 4.6 Describe role of the incubation centre and accelerators for the given product/service.	Unit - IV Managing Enterprise 4.1 Techno commercial Feasibility study, feasibility report preparation and evaluation criteria 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, definition of startup cycle, ecosystem, angel investors, venture capitalist 4.6 Incubation centers and accelerators : Role and procedure	Presentations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Collect information of successful entrepreneurial traits	1	*Preparation of report on entrepreneurship as a career	2	CO1
LLO 2.1 Identify different traits as an entrepreneur from various field LLO 2.2 Suggest different traits from identified problem	2	Case study on 'Traits of Entrepreneur'	2	CO1

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 314014**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Explore probable risks for identified enterprise.	3	*Case study on 'Risks associated with enterprise	2	CO1
LLO 4.1 Identify new product for development LLO 4.2 Prepare a newly developed product	4	*Preparation of report on 'Development of new Product'	2	CO1 CO2
LLO 5.1 Identify Process for development of product for new startup	5	Preparation of Report on ' Process selection ' for new startup	2	CO1 CO2 CO3
LLO 6.1 Develop questioner for market survey	6	*Market survey for setting up new Start up	2	CO2 CO3
LLO 7.1 Interpret the use of Technology Life Cycle	7	A Case study on ' Technology life cycle' of any successful entrepreneur.	2	CO3
LLO 8.1 Use information related to support of startups from Government and non-government agencies' LLO 8.2 Prepare report for setting up startup	8	*Preparation of report on 'Information for setting up new startup' from MCED/MSME/KVIC etc	2	CO3 CO4
LLO 9.1 Compute ROI of successful enterprise.	9	Case study on 'Return on Investment (ROI)' of any successful startup	2	CO3
LLO 10.1 Calculate of ROS of any successful enterprise	10	Case study on 'Return on sales (ROS)' of any successful startup	2	CO3
LLO 11.1 Calculate Brake even point of any enterprise	11	Preparation of report on 'Brake even point calculation' of any enterprise.	2	CO3 CO4
LLO 12.1 Prepare feasibility report of given business	12	*Preparation of report on 'feasibility of any Techno-commercial business"	2	CO4
LLO 13.1 Plan a USP of any enterprise.	13	*A case study based on 'Unique selling Proposition (USP) of any successful enterprise	2	CO4
LLO 14.1 Prepare a project report using facilities of Atal Incubation center.	14	*Prepare project report for starting new startup using 'Atal incubation center (AIC)	2	CO1 CO2 CO3 CO4

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Prepare a ' Women entrepreneurship business plan ' Choose relevant government scheme for the product/service
- Prepare a 'Pitch- desk' for your start up
- Prepare a business plan for a. Market research b. Advertisement agency c. Placement Agency d. Repair and Maintenance agency e. Tour and Travel agency

- Prepare a 'Social entrepreneurship business plan, plan for CSR funding.
- Prepare a business plan for identified projects by using entrepreneurial eco system for the same (Schemes, incentives, incubators etc.)

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computers with internet and printer facility	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Entrepreneurship Development	CO1	5	0	0	0	0
2	II	Startup Selection Process	CO2	4	0	0	0	0
3	III	Support System for Startup	CO3	3	0	0	0	0
4	IV	Managing Enterprise	CO4	3	0	0	0	0
Grand Total				15	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)****Summative Assessment (Assessment of Learning)**

- End of Term Examination - Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	2	2	2	-	-	3	2			
CO2	2	2	2	2	-	3	2			
CO3	2	2	2	2	-	3	2			
CO4	2	2	2	2	-	3	2			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dr. Nishith Dubey, Aditya Vyas , Annu Soman , Anupam Singh	Un- boxing Entrepreneurship your self help guide to setup a successful business	Indira Publishing House ISBN-2023,978-93-93577-70-2
2	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad
3	Chitale, A K	Product Design and Manufacturing	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
4	Charantimath, Poornima	Entrepreneurship Development Small Business Entrepreneurship	Pearson Education India, New Delhi; ISBN: 9788131762264
5	Khanka, S.S.	Entrepreneurship and Small Business Management	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mced.nic.in/allproduct.aspx	MCED Product and Plan Details
2	http://niesbud.nic.in/Publication.html	The National Institute for Entrepreneurship and Small Business Development Publications
3	http://niesbud.nic.in/docs/1standardized.pdf	Courses : The National Institute for Entrepreneurship and Small Business Development
4	https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530	Government Schemes
5	https://www.nabard.org/Tenders.aspx?cid=501andid=24	NABARD - Information Centre
6	http://www.startupindia.gov.in/pdf/file.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdf&content_type=Actionandsubmenupoint=action	Start Up India

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 314014**

Sr.No	Link / Portal	Description
7	http://www.ediindia.org/institute.html	About - Entrepreneurship Development Institute of India (EDII)
8	http://www.nstedb.com/training/training.htm	NSTEDB - Training

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024**Semester - 4 / 5 / 6, K Scheme**

ADVANCED BIOCHEMISTRY**Course Code : 325323**

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : ADVANCED BIOCHEMISTRY
Course Code : 325323

I. RATIONALE

Advanced biochemistry provides a comprehensive understanding of the molecular underpinnings of life, which in turn drives innovation in medicine, industry, and environmental sustainability. It combines fundamental research with practical applications, ultimately aiming to improve human health, enhance quality of life, and contribute to the scientific and technological advancement of society.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The students will be able to perform analysis of given pathological samples using advanced techniques.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the Molecular process in a cell from given sample
- CO2 - Analyze enzyme in given sample of body fluid.
- CO3 - Correlate observed biochemical pathway with metabolic disorder.
- CO4 - Interpret biochemical process of Cancer cell in given sample
- CO5 - Diagnose the given sample using advanced biochemistry techniques.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL				
															Practical								
				CL	TL	LL					FA-TH		SA-TH		Total		FA-PR		SA-PR		SLA		
											Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min
325323	ADVANCED BIOCHEMISTRY	ADB	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175		

Total IKS Hrs for Sem. : Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain DNA Replication detail. TLO 1.2 Describe the RNA transcription. TLO 1.3 Explain process of translation. TLO 1.4 Classify Mutation TLO 1.5 Explain application of molecular genetic in disease diagnosis.	Unit - I Molecular Genetics and Biochemistry 1.1 DNA Replication. 1.2 RNA Transcription. 1.3 Translation process. 1.4 Mutation and type of Mutation 1.5 Application of Molecular Genetics in disease diagnosis.	Model Demonstration Video Demonstrations Flipped Classroom Hands-on Site/Industry Visit
2	TLO 2.1 Describe enzyme kinetics and their significance. TLO 2.2 Explain type of enzyme inhibition TLO 2.3 Describe the clinical marker with example. TLO 2.4 Explain the Clinical Significance of enzyme assay. TLO 2.5 Explain role of enzyme in disease diagnosis.	Unit - II Clinical Enzymology and biomarker. 2.1 Enzyme kinetics and their significance 2.2 Enzyme inhibition and classification. 2.3 Enzyme as Clinical Marker. 2.4 Clinical Significance of Enzyme assay. 2.5 Role of Enzyme in disease diagnosis.	Video Demonstrations Hands-on Flipped Classroom Role Play Collaborative learning

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 . Describe the different biochemical pathways of inborn error of metabolism. TLO 3.2 Explain the metabolic pathway in diabetes mellitus. TLO 3.3 Describe the different integrated metabolic pathways. TLO 3.4 Describe the effect of starvation on the metabolic process. TLO 3.5 Write the diagnostic procedure and clinical interpretation of metabolic disorder.	Unit - III Metabolic disorders and biochemical pathway 3.1 Different biochemical Pathways of Inborn error of Metabolism. 3.2 Metabolic pathway in diabetes mellitus, hyperlipidemia 3.3 Integration of metabolic pathways 3.4 Metabolic process in Starvation 3.5 Diagnostic test for metabolic disorder and clinical interpretation	Video Demonstrations Model Demonstration Collaborative learning Flipped Classroom Lecture Using Chalk-Board
4	TLO 4.1 Describe the characteristic of cancer cell. TLO 4.2 Explain process of carcinogenesis. TLO 4.3 Describe th proto-oncogene and oncogenes. TLO 4.4 Describe structure of tumor suppressor gene. TLO 4.5 Describe diagnostic tumor marker.	Unit - IV Biochemical basis of disease 4.1 Characteristic of cancer cells. 4.2 Carcinogenesis and carcinogens 4.3 Proto-Oncogene and Oncogenes 4.4 Tumor Suppressor gene 4.5 Diagnostic tumor marker	Video Demonstrations Flipped Classroom Lecture Using Chalk-Board Site/Industry Visit Collaborative learning
5	TLO 5.1 Justify the procedure of the TLC in detail for specified sample TLO 5.2 Justify the procedure of the HPLC in detail for specified samples. TLO 5.3 Explain immunoassay techniques. TLO 5.4 Justify the procedure of electrophoresis for specified sample. TLO 5.5 Describe principle, procedure of Mass Spectroscopy for specified sample	Unit - V Advanced techniques in Biochemistry 5.1 Thin Layer Chromatography 5.2 High performance liquid Chromatography 5.3 Immunoassay and their application 5.4 Electrophoresis 5.5 Mass Spectroscopy	Video Demonstrations Hands-on Flipped Classroom Site/Industry Visit Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Examine DNA from Liver cell.	1	*Isolation of DNA from liver cell	4	CO1
LLO 2.1 Identify DNA by Diphenylamine reagent.	2	*Identification of DNA by Diphenylamine reagent.	4	CO1
LLO 3.1 Estimate DNA by Calorimetric method	3	Estimation of DNA Calorimetric method.	4	CO1
LLO 4.1 Examine RNA by Yeast cell.	4	Isolation of RNA by Yeast Cell.	4	CO1
LLO 5.1 Identify RNA by Trizol method.	5	*Detection of RNA from Trizol reagent.	4	CO1
LLO 6.1 Separate RNA from protein by Phenol extraction method	6	Separation of RNA from protein by Phenol extraction method	4	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Estimate RNA by Orcinol method.	7	Estimation of RNA by Orcinol method.	4	CO2
LLO 8.1 Measure of alkaline phosphatase in serum	8	*Measurment of alkaline phosphatase in serum	4	CO3
LLO 9.1 Measure Acid phosphatase enzyme activity	9	*Measurment of Acid phosphatase enzyme activity	4	CO3
LLO 10.1 Measure of SGPT ,SGOT activity	10	*Measurment of SGPT,SGOT activity	4	CO3
LLO 11.1 Measure Amylase enzyme activity	11	*Measurement amylase enzyme activity	4	CO4
LLO 12.1 Identify amylase enzyme from saliva.	12	*Isolation of amylase enzyme form saliva	4	CO4
LLO 13.1 Measure Creatine kinase activity	13	*Measurment of Creatine kinase activity	4	CO4
LLO 14.1 Separate amino acid by TLC	14	*Separation of amino acid by TLC.	4	CO5
LLO 15.1 Separate drugs by TLC	15	*Separation of Drugs by Thin Layer Chromatography	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Analyze DNA from various biological sources (e.g., blood, saliva, plant tissues).
- Extract RNA from different biological sources for molecular diagnostic purposes.
- Perform liver function tests (LFTs).
- Collect and analyze blood/urine samples for amylase levels.
- Collect 10 patient samples and analyze clinical markers (e.g., ALT, AST, ALP, bilirubin)
- Case study on role of amylase in digestion and its deficiency-related diseases (e.g., pancreatitis, cystic fibrosis).
- Compare normal and deficient levels of amylase.
- Identification of specific markers for different liver diseases like hepatitis, cirrhosis, and fatty liver.

Assignment

- Diagrammatic representation of TLC on paper sheet.
- Diagrammatic representation of HPLC on paper sheet
- Diagrammatic representation of enzyme-inhibitor complex Formation on paper sheet.
- Prepare presentation on integration of metabolic pathway.
- Prepare presentation on starvation
- Prepare chart for enzyme marker.
- Prepare chart for tumor Marker.
- Prepare model of Electrophoresis.

- Prepare chart for metabolic disorder.
- Prepare model of DNA
- Prepare chart enzyme inhibition.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and may be considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Water bath/Burner ,Calorimeter, TLC plate	3,7,15
2	Autoanalyzer	8,9,10,11,13,14
3	Test tubes, flask, beaker, reagent bottle, analytical balance, dropper/micropipette	All
4	Centrifuge	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Molecular Genetics and Biochemistry	CO1	13	4	6	6	16
2	II	Clinical Enzymology and biomarker.	CO2	10	4	5	5	14
3	III	Metabolic disorders and biochemical pathway	CO3	8	2	6	6	14
4	IV	Biochemical basis of disease	CO4	8	2	8	4	14
5	V	Advanced techniques in Biochemistry	CO5	6	2	6	4	12
Grand Total				45	14	31	25	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- 1. Two unit test each of 30 marks and average taken out of 30 marks
- formative assessment of 25 marks for laboratory learning.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks for theory.
- End semester assessment of 70 marks for theory.
- End semester assessment of 25 marks for practical

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	3	1	3	2	1	3			
CO2	3	3	2	3	2	1	3			
CO3	3	3	2	3	2	1	3			
CO4	3	3	2	3	2	1	3			
CO5	3	3	2	3	2	1	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Deb & Deb	Fundamental of Biochemistry	New Central Agency. Kolkata, ISBN 13:9788173811449
2	Ramkrishna, Prasanna and Rajan	Text Book of Biochemistry	Orient Longman Ltd, ISBN 978825020714
3	Rama Rao	Text Book of Biochemistry	UBS Publication ISBN 10:817476660X
4	P.B Godkar and D.P Godkar	Text Book of Medical Laboratory Technology	Bhalani Publishing House, Mumbai-12 ISBN: 9789381496190
5	J.L Jain	Fundamental of Biochemistry	S.Chand &CO ISBN: 9788121924535

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=CB7CbV1Cnh0	Isolation of DNA from liver sample
2	https://www.youtube.com/watch?v=keRjffSWaaY	Identification of DNA by Diphenylamine reagent.
3	https://www.youtube.com/watch?v=18bFdY7_Dno	Isolation of RNA by Yeast Cell.
4	https://www.youtube.com/watch?v=RmPsLoIPRwc	Detection of RNA from Trizol reagent.
5	https://www.youtube.com/watch?v=JNl1kpw9ZDQ	Separation of RNA from protein by Phenol extraction method
6	https://www.youtube.com/watch?v=3dbQIr0q9sc	Estimation of RNA by Orcinol method.
7	https://www.youtube.com/watch?v=D_NCevZ76UI&t=45s	Measurement of alkaline phosphatase in serum
8	https://www.youtube.com/watch?v=dbDMgKyTeNM&t=29s	Measurement of SGPT activity

ADVANCED BIOCHEMISTRY**Course Code : 325323**

Sr.No	Link / Portal	Description
9	https://www.youtube.com/watch?v=9jOMvA-jdDk	Measurement of SGOT activity
10	https://www.youtube.com/watch?v=jL56wDIzpmE	Isolation of amylase enzyme from saliva
Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : APPLIED MICROBIOLOGY IN MEDICAL LABORATORY TECHNOLOGY
Course Code : 325324

I. RATIONALE

The curriculum is designed to equip students with essential knowledge and practical skills in microbiology that are crucial for diagnosing and managing infectious diseases. It combines theoretical concepts with hands-on laboratory experiences, encouraging critical thinking and analytical skills necessary for the healthcare industry. This approach ensures that graduates are well-prepared to meet the challenges of modern medical laboratory practices.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Demonstrate competence in microbiological techniques, critical analysis of lab results, and effective communication in clinical settings.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify and explain fundamental concepts of microbiology
- CO2 - Assess the role of microorganisms in human health and disease.
- CO3 - Demonstrate laboratory techniques for microbial analysis.
- CO4 - Analyze and interpret laboratory results for clinical applications.
- CO5 - Investigate current trends and advancements in microbiology.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH			Theory	Based on LL & TL				Based on SL					
				CL	TL	LL						Practical				SLA					
												FA-TH	SA-TH	Total		FA-PR		SA-PR			
														Max	Max	Max	Min	Max	Min	Max	
325324	APPLIED MICROBIOLOGY IN MEDICAL LABORATORY TECHNOLOGY	AMM	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define microbiology and its importance in health TLO 1.2 Describe the structure and functions of microorganisms TLO 1.3 Analyze microbial metabolism and growth TLO 1.4 Classify major groups of microorganisms.	Unit - I Introduction to Microbiology 1.1 Definition and scope of microbiology 1.2 Structure of bacteria, viruses, fungi, protozoa 1.3 Metabolism (aerobic vs. anaerobic) 1.4 Growth phases of microorganisms 1.5 Classification methods	Lectures Interactive discussions Concept mapping Video presentations Group activities
2	TLO 2.1 Identify common pathogens and related diseases TLO 2.2 Explain mechanisms of microbial pathogenesis TLO 2.3 Discuss host-microbe interactions. TLO 2.4 Evaluate the significance of virulence factors	Unit - II Microbial Pathogenesis 2.1 Overview of pathogenic microorganisms 2.2 Mechanisms of disease causation 2.3 Host defenses (innate and adaptive immunity) 2.4 Role of virulence factors 2.5 Epidemiology of infectious diseases	Case studies Group discussions Role Play Presentations Collaborative learning
3	TLO 3.1 Describe safety protocols and lab standards TLO 3.2 Perform microbial culturing techniques TLO 3.3 Identify microorganisms using staining methods TLO 3.4 Conduct antimicrobial susceptibility tests	Unit - III Laboratory Techniques in Microbiology 3.1 Laboratory safety protocols 3.2 Culturing techniques for bacteria and fungi 3.3 Staining techniques (Gram stain, acid-fast stain) 3.4 Antimicrobial susceptibility testing (disk diffusion, MIC) 3.5 Quality control in microbiological testing	Hands-on lab sessions Demonstrations Presentations Collaborative learning Site/Industry Visit

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Analyze microbiological test results TLO 4.2 Correlate lab findings with clinical symptoms TLO 4.3 Assess trends in antimicrobial resistance TLO 4.4 Communicate findings effectively.	Unit - IV Clinical Microbiology and Interpretation 4.1 Interpreting culture and sensitivity results 4.2 Correlating lab findings with clinical conditions 4.3 Understanding antimicrobial resistance mechanisms 4.4 Effective reporting techniques 4.5 Ethical considerations in microbiology	Case analyses Presentations Site/Industry Visit Collaborative learning Flipped Classroom
5	TLO 5.1 Discuss emerging infectious diseases TLO 5.2 Explain advancements in microbiological diagnostics TLO 5.3 Evaluate the role of biotechnology in microbiology TLO 5.4 Analyze public health strategies for infection control	Unit - V Advancements in Microbiology 5.1 Overview of emerging infectious diseases 5.2 Innovations in diagnostic technologies (PCR, next-gen sequencing) 5.3 Role of biotechnology in microbiology 5.4 Public health measures for infection control 5.5 Global health challenges	Site/Industry Visit Flipped Classroom Presentations Video Demonstrations Collaborative learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare microbial growth media	1	Prepare microbial growth media*	4	CO1 CO2 CO3
LLO 2.1 Provide pure bacterial cultures critical for identification and treatment.	2	Isolation of Bacteria from Clinical Samples*	4	CO1 CO2 CO3
LLO 3.1 Differentiate between gram positive and gram negative bacteria	3	Gram Staining of Bacterial Samples*	4	CO1 CO2 CO3 CO4 CO5
LLO 4.1 Detect acid-fast bacteria like Mycobacterium tuberculosis, aiding in TB diagnosis.	4	Perform Acid-Fast Staining*	4	CO2 CO3 CO4
LLO 5.1 Differentiate motile from non-motile bacteria, useful for species identification.	5	Perform motility testing of bacteria*	4	CO1 CO2 CO3 CO4
LLO 6.1 Determine microbial resistance to antibiotics, guiding appropriate therapy.	6	Perform Antibiotic Susceptibility Testing (Disk Diffusion)*	4	CO1 CO2 CO3 CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Quantify viable microorganisms, aiding in infection control and research.	7	Perform Serial Dilution and Viable Count*	4	CO1 CO2 CO3 CO4
LLO 8.1 Evaluate bacterial biofilm potential, which impacts chronic infections and resistance.	8	Perform Biofilm Formation Assessment	4	CO2 CO3 CO4 CO5
LLO 9.1 Diagnose fungal infections, enabling targeted antifungal treatment.	9	Perform Identification of Yeast and Fungi*	4	CO2 CO3 CO4
LLO 10.1 Offer precise identification of pathogens at the molecular level.	10	PCR Amplification of Microbial DNA	4	CO2 CO3 CO4 CO5
LLO 11.1 Enable the isolation of anaerobes, often implicated in wound infections.	11	Perform Culture of Anaerobic Bacteria	4	CO3 CO4 CO5
LLO 12.1 Detect microbial antigens or antibodies with high specificity for diagnosis.	12	Perform Serological Testing for Microbial Antigens*	4	CO3 CO4 CO5
LLO 13.1 Monitor environmental microbial load, essential for infection control.	13	Environmental Sampling for Microbial Analysis	4	CO4 CO5
LLO 14.1 Visualize DNA/RNA, aiding genetic analysis and pathogen detection.	14	Molecular Techniques in Microbiology (Gel Electrophoresis)	4	CO3 CO4 CO5
LLO 15.1 Detect infectious agents in biological samples.	15	Detection of Pathogens using ELISA	4	CO3 CO4 CO5
LLO 16.1 Interpret and communicate lab findings for clinical use.	16	Reporting and Interpreting Microbial Laboratory Results	4	CO1 CO2 CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Design a Microbial Cell Model
- Microbial Growth Simulation Project

- Choose a specific infectious disease and document the pathogen, symptoms, transmission, and treatment strategies.
- Create a poster explaining how virulence factors (toxins, adhesion, immune evasion) enable pathogens to cause disease.
- Develop a concise safety guide for students working in a microbiology lab, focusing on protocols and PPE.
- Create a step-by-step video or presentation demonstrating how to culture bacteria and fungi on different media.
- Interpret given lab reports and propose suitable antibiotic treatment based on the results.
- Create a template for reporting microbiological results effectively, with sections for interpretation and recommendations.
- Choose an emerging infectious disease (e.g., COVID-19) and present its challenges, prevention, and control measures.
- Prepare a project demonstrating the use of PCR or CRISPR technology in diagnostics or treatment.

Assignment

- Write a Essay: Importance of Microbiology in Health Sciences
- Prepare a chart comparing bacteria, viruses, fungi, and protozoa based on their structure, reproduction, and examples.
- Describe the interactions between normal microbiota and the immune system
- Choose an infectious disease outbreak and analyze its spread
- Write an assignment explaining the principle of Gram staining, its procedure, and clinical applications.
- Compare different antimicrobial susceptibility tests (disk diffusion, MIC) and explain their relevance in clinical practice.
- Discuss how antimicrobial resistance affects patient outcomes and strategies for combating it.
- Write about ethical considerations in reporting sensitive lab results, including privacy and public health concerns.
- Write about recent innovations in diagnostic tools, such as PCR, MALDI-TOF, or next-gen sequencing.
- Prepare a report on how public health measures like vaccination and surveillance control infectious diseases.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	PCR Machine (Thermocycler)	10
2	Anaerobic Jar and Gas Packs	11
3	Centrifuge	12
4	Swabs and Agar Plates	13
5	Gel Electrophoresis Apparatus	14
6	ELISA Reader	15
7	Computer and Reporting Software	16

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
8	Light Microscope	3
9	Heating Block/Water Bath	4
10	Microtiter Plates	8
11	Autoclave	All
12	Laminar Air Flow Cabinet	All
13	Pipettes and Microtubes	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Microbiology	CO1	8	8	4	0	12
2	II	Microbial Pathogenesis	CO2	8	0	12	0	12
3	III	Laboratory Techniques in Microbiology	CO3	12	0	0	18	18
4	IV	Clinical Microbiology and Interpretation	CO4	10	0	0	14	14
5	V	Advancements in Microbiology	CO5	10	0	8	6	14
Grand Total				48	8	24	38	70

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two class tests of 30 marks each conducted during the semester.
- Practical record book/journals
- Self learning micro project (10 Mark) / assignment (10 Mark) / Presentations (05 Mark)

Summative Assessment (Assessment of Learning)

- End Semester Examination of Theory
- End Semester Examination of practical and viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	1	1	1	1	0	2			

APPLIED MICROBIOLOGY IN MEDICAL LABORATORY TECHNOLOGY**Course Code : 325324**

CO2	2	3	2	1	2	1	2			
CO3	3	2	3	3	2	1	2			
CO4	2	3	3	3	3	2	3			
CO5	2	2	2	2	3	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Ananthanarayan & Paniker	Textbook of Microbiology	Universities Press 978-8173717815
2	Chakraborty P.	A Textbook of Microbiology	New Central Book Agency 978-8173815078
3	Baveja CP	Textbook of Microbiology for Nurses	Arya Publications 978-9350250161
4	Jawetz, Melnick & Adelberg	Medical Microbiology	McGraw-Hill Education 978-0071818216
5	D.R. Arora	Textbook of Microbiology	CBS Publishers 978-8123922624

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=Mo-VT2OGzt4	Culture Media In hindi Culture Media Microbiology Culture Media Classification Use of Media
2	https://www.youtube.com/watch?v=CMfEZ4b-xY8	Culture media Microbiology Classification of Culture media
3	https://www.youtube.com/watch?v=2jcrReCqQpY	Next Generation Sequencing Method
4	https://www.youtube.com/watch?v=nI5AWEIvHJg	Polymerase Chain Reaction / PCR in Microbiology
5	https://www.youtube.com/watch?v=85KBu1RLRxQ	Types of staining Common Staining techniques
6	https://www.youtube.com/watch?v=IPuSuuAbHMg	Microbiology lectures Pathogenesis of bacterial infections Bacteriology
7	https://www.youtube.com/watch?v=ZcL67RjIGI8	Laboratory Methods for Identification of bacteria explain in Hindi
8	https://www.youtube.com/watch?v=4H0RC_5HUDU	What is Microbiology With Full Information? – [Hindi]
9	https://www.youtube.com/watch?v=gJgWRSOH8_g	Pathogen Kya Hai Pathogen Kya Hota Hai Pathogens in Hindi
10	https://www.youtube.com/watch?v=vfq9vdgqsII	Introduction of Microbiology Branches of Microbiology Microbiology Lecture in hindi

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : Medical Laboratory Technology
Programme Code : ML
Semester : Fifth
Course Title : CLINICAL IMMUNOLOGY - DIAGNOSTIC APPLICATIONS
Course Code : 325325

I. RATIONALE

A course in Clinical Immunology - Diagnostic Applications focuses on applying immunological principles to diagnose and manage diseases through advanced diagnostic techniques. It provides in-depth knowledge of how to interpret immunological tests, understand disease mechanisms, and utilize diagnostic tools to identify and monitor immune-related conditions. This specialization is crucial for developing precise diagnostic strategies, improving patient outcomes, and advancing personalized medicine, equipping students with the skills needed to excel in clinical settings and contribute effectively to healthcare and research.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply immunological principles to clinical diagnostics, interpret tests accurately, and develop strategies for diagnosing immune-related conditions. Contribute to patient care, integrate new diagnostic technologies, and support research and innovation in immunology.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Demonstrate basic principle of immunology
- CO2 - Design model of antigen and antibody
- CO3 - Apply techniques for identifying antigen antibody interactions
- CO4 - Describe organs and cell of immune system
- CO5 - Exemplify the adverse effect of immune system including allergy, hypersensitivity and elucidate the reasons for immunization

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL			Total Marks
				CL	TL	LL					Practical											
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
				Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min			
325325	CLINICAL IMMUNOLOGY - DIAGNOSTIC APPLICATIONS	IMM	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175	

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define immunology immunity TLO 1.2 Describe mechanisms of innate immunity TLO 1.3 Explain acquired immunity TLO 1.4 Define local immunity, herd immunity	Unit - I Introduction to Immunology 1.1 Definition of immunology, immunity, Classification of immunity with examples 1.2 Mechanisms of innate immunity 1.3 Acquired immunity 1.4 Measurement of immunity, local immunity, Herd immunity	Video Demonstrations Flipped Classroom Demonstration Role Play Collaborative learning
2	TLO 2.1 Explain properties of antigen TLO 2.2 Define hapten, epitope and paratope TLO 2.3 Draw a neat sketch of antibody TLO 2.4 Explain properties of immunoglobulins	Unit - II Antigen and antibody 2.1 Antigen - Definition, Types, properties, antigenic specificity. 2.2 Hapten – Definition, Types, Autoantigen-Definition, Epitope and paratope, Adjuvants 2.3 Antibody – Definition, Structure 2.4 Types of Immunoglobulins -IgA, IgM, IgD, IgE, IgG, properties, biological function	Model Demonstration Video Demonstrations Flipped Classroom Collaborative learning Cooperative Learning

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Enlist general features of antigen antibody reactions. TLO 3.2 Describe precipitation reaction. TLO 3.3 Explain agglutination reaction TLO 3.4 Write procedure for complement fixation test	Unit - III Diagnostic immunology (Serology) 3.1 General features of antigen antibody reactions, Definitions of Affinity and avidity. 3.2 Principles, Requirements, Procedure and application of Precipitation –Immunoelectrophoresis, Counterimmunoelectrophoresis, One-dimensional single electroimmunodiffusion, VDRL 3.3 Principles, Requirements, Procedure and application of - Agglutination – Slide agglutination – Blood grouping, Rh factor determination, Tube agglutination – Widal test, Coombs test, and passive agglutination test 3.4 Principles, Requirements, Procedure and application of - Immunofluorescence – Direct and indirect, a. ELISA – Enzymes used in ELISA, Sandwich, Indirect, Competitive b. Immunochromatographic test – HbsAg, Dengue -IgG, IgM	Video Demonstrations Flipped Classroom Hands-on Site/Industry Visit Collaborative learning
4	TLO 4.1 Explain the functions of primary lymphoid organs TLO 4.2 Describes cell of immune system TLO 4.3 State role of MHC in immune recognition TLO 4.4 Explain immune response	Unit - IV Immune system- Structure and Function 4.1 Central (Primary) Lymphoid organs – Thymus, Bursa of Fabricus, Peripheral (Secondary) Lymphoid organs – Lymph nodes, Spleen, MALT 4.2 Cells of Lymphreticular system – Lymphocytes – T cells, B cells, Null cells, Phagocytic cells, Dendritic cells. 4.3 MHC – Types, Role in immune recognition 4.4 Immune response – Humoral immune response - primary and secondary responses, production of antibodies, monoclonal antibodies, Cell mediated immunity-Scope, Induction.	Video Demonstrations Flipped Classroom Presentations Role Play Collaborative learning
5	TLO 5.1 Describe hypersensitivity reactions TLO 5.2 Explain mechanisms of autoimmunity TLO 5.3 Define vaccine, antisera and antitoxins TLO 5.4 Give national immunization schedule followed in India	Unit - V Hypersensitivity, Autoimmunity and Immunization 5.1 Hypersensitivity – Definition, classification of hypersensitivity (Coombs and Gel), a. Type I reactions – Anaphylaxis – types and mechanisms, Atopy – mechanism and detection. b. Type II reactions – hemolytic diseases of new born – mechanism. c. Type III reactions – Arthus reaction, serum sickness – Mechanism. d. Type IV reactions – Tuberculin, contact dermatitis – Mechanism. 5.2 Autoimmunity – Definition, Mechanism, Classification, Hemocytolytic autoimmune diseases – Autoimmune hemolytic anemias - mechanism, Localized autoimmune diseases – Hashimoto disease, Myasthenia gravis – mechanism, Systemic autoimmune diseases – Systemic lupus erythematosus, Rheumatoid arthritis – mechanism. 5.3 Vaccine – Definition, types, antisera/antitoxins 5.4 Hazards of immunization, National immunization schedule followed in India	Video Demonstrations Flipped Classroom Presentations Role Play Collaborative learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

CLINICAL IMMUNOLOGY - DIAGNOSTIC APPLICATIONS**Course Code : 325325**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Differentiate between different blood groups	1	Perform blood grouping*	4	CO1 CO2 CO3
LLO 2.1 Identify presence of Rh factor in blood	2	Perform Rh typing*	4	CO1 CO2 CO3
LLO 3.1 Analyze salmonella antibody in blood sample	3	Perform widal test*	4	CO1 CO2 CO3
LLO 4.1 Analyze ASO in blood sample	4	Perform ASO test*	4	CO1 CO2 CO3
LLO 5.1 Analyze CRP in blood sample	5	Perform CRP test*	4	CO1 CO2 CO3
LLO 6.1 Analyze RA factor in blood sample	6	Perform RA test*	4	CO1 CO2 CO3 CO5
LLO 7.1 Detect HIV antibody in blood sample	7	HIV tridot test*	4	CO1 CO2 CO3
LLO 8.1 Detect HCG hormone in urine sample	8	Perform hCG test*	4	CO1 CO2 CO3
LLO 9.1 Detect HBsAg antigen in blood sample	9	HBsAg test*	4	CO1 CO3 CO4
LLO 10.1 Detect dengue IgG and IgM antibody in blood/plasma	10	Perform Dengue IgG and IgM test	4	CO3 CO4 CO5
LLO 11.1 Detect syphilis antibody	11	Perform RPR test*	4	CO3 CO4 CO5
LLO 12.1 Detect malaria antigen in blood	12	Perform Malaria Antigen Test	4	CO3 CO4 CO5
LLO 13.1 Demonstrate steps of ELISA test	13	Demonstration of ELISA	4	CO3 CO4 CO5
LLO 14.1 Demonstrate different stages of Immunofluorescence	14	Demonstration of Immunofluorescence	4	CO3 CO4 CO5
LLO 15.1 Demonstrate different stages of electrophoresis	15	Demonstration of Electrophoresis	4	CO3 CO4 CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Identify recent infection of tuberculosis	16	Demonstration of Mantoux test	4	CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Create an Immunity Classification Chart
- Explore Phagocytosis and Inflammation using models or charts
- Create a presentation on the physical and chemical barriers of the innate immune system
- Design an study experiment to measure an individual's immune response
- Create a Visual Representation of Antigen Types
- Create a model or flowchart showing the hapten-carrier relationship
- Create a 3D Model or Diagram of Antibody Structure
- Create a visual or digital simulation demonstrating the steps in antigen-antibody reactions

Assignment

- Compare Natural vs. Artificial Immunity
- Case Study on Vaccines and Herd Immunity
- Write a report or create a presentation explaining how antigenic specificity is determined, including factors like antigenic determinants (epitopes) and cross-reactivity.
- Write a comparative report on epitopes and paratopes
- Role of Adjuvants in Immunology
- Comparative Study on Types of Immunoglobulins
- Affinity vs. Avidity: Comparative Study

Presentation

- Prepare presentation on the clinical uses of antibodies, such as in monoclonal antibody therapies, diagnostic tests (e.g., ELISA, western blot), and passive immunity

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Glass slide	1,2
2	Microscope	2,4,5,6,11
3	Containers for Blood, serum (plain bulb and EDTA)	All
4	Centrifuge (with 3000 rpm)	All
5	Refrigerator	All
6	Syringe	All
7	Dropper	All
8	Micropipette	All
9	Tornicate	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Immunology	CO1	8	8	4	0	12
2	II	Antigen and antibody	CO2	8	0	12	0	12
3	III	Diagnostic immunology (Serology)	CO3	11	2	0	18	20
4	IV	Immune system- Structure and Function	CO4	8	0	0	12	12
5	V	Hypersensitivity, Autoimmunity and Immunization	CO5	10	0	8	6	14
Grand Total				45	10	24	36	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two class tests of 30 marks each conducted during the semester.
- Practical record book/journals
- Self learning micro project (10 Mark) / assignment (10 Mark) / Presentations (05 Mark)

Summative Assessment (Assessment of Learning)

- End Semester Examination of Theory
- End Semester Examination of practical and viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	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	PSO-3
CO1	3	2	1	0	2	0	1			
CO2	2	2	3	1	1	0	0			
CO3	2	3	2	2	1	0	1			
CO4	3	1	0	0	2	0	1			
CO5	2	2	1	0	3	0	1			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R Ananthanarayan and CK Jayaram Paniker (Author) Reba Kanungo (Editor)	Ananthanarayan and Paniker's Text Book of Microbiology	Universities Press (India) Pvt.,Ltd, Eleventh edition ISBN-13: 978-9389211436
2	Dr. C. P. Bavaja	Textbook of Microbiology	Arya Publication, 6th Edition, 2021 ISBN-13: 978-8178556406
3	P Chakraborty	A Text Book of Microbiology	New Central Book Agency, Third Edition, ISBN-13: 978-8173818769
4	K. Park	Parks Text Book of Preventive and Social Medicine	Banarsidas Bhanot Publishers ISBN-13: 978-9382219156
5	Seamus J Martin, Dennis R. Burton, Ivan M Roitt, Peter J Delves	Roitt's Essential Immunology (Essentials)	Wiley-Blackwell, 13th Edition ISBN-978-1118415771

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.nature.com/nri/	A leading journal providing reviews and articles on various immunology topics.
2	https://www.youtube.com/c/MedCram	Medical education channel with clear explanations of immunological concepts and current events.
3	https://www.coursera.org/learn/immunology	Online course on immunology offered by universities, including videos and readings.

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Sr.No	Link / Portal	Description
4	https://www.youtube.com/user/DoctorNajeeb	Comprehensive medical lecture series, including detailed explanations of immunology.
5	https://www.youtube.com/c/ProfessorDaveExplains	Educational channel with videos that simplify complex immunology concepts.
6	https://www.youtube.com/@shomusbiologyofficial	Medical and immunology lectures in Hindi
7	https://www.youtube.com/@TEACHINGPATHSHALA	Medical and immunology lectures in Hindi
8	https://www.youtube.com/@IndianMedicalLecture	Medical lecture in hindi
9	https://www.youtube.com/@MLTeducationpoint	Medical and immunology lectures in Hindi
10	https://www.khanacademy.org/science/biology/human-biology/immunology	Comprehensive educational resources covering basic immunology concepts.

Note :

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MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**