



# SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS01	Developmental Biology	4-0-1	120	04

### • Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

**CLO1:** Student will learn the process of fertilization and early embryonic development.

**CLO2:** Students will be able to explain different stages of development in invertebrates and vertebrates.

**CLO3:** Students will be able to understand body axis formation and patterning mechanisms.

**CLO4:** Student will be able to explain the role of hormones in development and metamorphosis.

**CLO5:** Students will be able to understand developmental disorders and environmental influences on development.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction to animal development: Fertilization: Structure of gametes, Egg sperm recognition, fertilization in sea urchins, Differential gene expression and cell-cell communication in development: Differential gene transcription, RNA processing, Control of gene expression at translation, Cell adhesion and cell signaling.	Classroom Lecture, Interactive Classroom Lecture, ICT-Enabled Learning, Concept Mapping, Self-Directed Learning	CO1
II	Early development in invertebrates and vertebrates: Cleavage and pattern of embryonic cleavage; Comparative account of gastrulation; Early development in the Sea urchin, <i>C. Elegans</i> ; <i>Drosophila</i> ; Amphibia; Birds; Mammals. Later embryonic development: Development of ectoderm, Neurulation, and Central nervous system, Neural crest cell; Development of mesoderm: Paraxial mesoderm, Intermediate mesoderm, Lateral plate mesoderm. Development of endoderm.	Interactive Classroom Lecture, Problem- Based Learning, ICT- Enabled Learning, Classroom Lecture, Collaborative Learning	CO2
III	Body Axes: Establishment of body axes in <i>C. Elegans</i> . Birds and Mammals, tetrapod limb development: Tetrapod limb development: Proximo –distal, Anterior-posterior, Dorsal-ventral; Cell death pathway <i>Drosophila</i> axis specification: Dorso- Ventral pattern, Segmentation and Anterior-Posterior body plan, Maternal gradient, Segmentation genes	Problem-Based Learning, Classroom Lecture, Collaborative Learning, Concept Mapping,	CO3
IV	Hormones as mediators of development: Amphibian metamorphosis: Morphological and biochemical changes, Hormonal control. Insect metamorphosis: Imaginal discs. Hormonal control, and Molecular mechanism of action of ecdysone. Birth defects,	Seminars, Research-Oriented Learning, Presentations, ICT-Enabled Learning, Simulation and Role-	CO4, CO5



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Endocrine disruptors, and cancer. Environmental as a normal agent in producing phenotype: Polyphenisms and Plasticity, Temperature and sex, Environmental induct. Medical Implications of Developmental biology – Teratogenesis, genetic errors. Environmental influences on development.	Play	
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### (\* Learning Pedagogies/Methods

#### Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Case-Based Learning (CBL)
- (e) Micro-Projects/Mini Research Tasks
- (f) Industrial Visit/Field Visit/Institutional Visit
- (g) Problem-Based Learning (PBL)
- (h) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (i) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (j) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (k) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (l) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (m) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (n) Inquiry-Based Learning
- (o) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

### • Assessment Methodologies

#### (A) Internal Assessment

##### a. Internal Formative assessment (20)

- (a) Mid-term tests
- (b) Assignment, Self-learning and Terms work
- (c) Seminar/Presentation
- (d) Quiz

##### b. Internal Summative Assessment (30)

- (a) End of Term Examination
- (b) Laboratory performance
- (c) Viva-voce



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## M.Sc. Biomedical Science SEM I

### (B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1	30	1	1	12	14
II	CO2	32	1	1	10	12
III	CO3	28	1	1	10	12
IV	CO4, CO5	30	1	1	12	14
		<b>120</b>	<b>04</b>	<b>04</b>	<b>34</b>	<b>50</b>

- Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

### (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	-	1	-	-	-	-	-
CLO2	3	2	1	-	2	1	-	-	-	-
CLO3	3	2	2	-	1	1	-	-	1	-
CLO4	2	2	-	2	1	2	1	1	-	-
CLO5	2	1	2	3	-	2	1	3	2	1

Values to CLO-PLO matrix are assigned by **judging the importance of the particular CLO** in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



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### M.Sc. Biomedical Science SEM I

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Developmental Biology	Scott F. Gilbert, Michael J. F. Barresi	12th Edition, 2020	Sinauer Associates / OUP
2	Essential Developmental Biology	Jonathan M. W. Slack	3rd Edition, 2013	Wiley-Blackwell
3	Developmental Biology: A Very Short Introduction	Lewis Wolpert	1st Edition, 2011	Oxford University Press
4	Regenerative Biology and Medicine	David L. Stocum	2nd Edition, 2012	Academic Press

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL – Developmental Biology Course	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	The Interactive Fly (Drosophila Development)	<a href="http://www.sdbonline.org/sites/fly/aimain/1aahome.htm">http://www.sdbonline.org/sites/fly/aimain/1aahome.htm</a>
3	UNSW Embryology Resources	<a href="https://embryology.med.unsw.edu.au">https://embryology.med.unsw.edu.au</a>
4	Khan Academy – Developmental Biology Basics	<a href="https://www.khanacademy.org">https://www.khanacademy.org</a>



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## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching- Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS02	Principles of Biomedical Instrumentation	4-0-1	120	04

### • Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

**CLO1:** Explain the principles and applications of microscopy and advanced visualization techniques in biomedical sciences.

**CLO2:** Apply separation and analytical techniques such as centrifugation, chromatography, and spectroscopy in biological analysis.

**CLO3:** Analyze the working principles and characteristics of biomedical sensors and measurement systems.

**CLO4:** Evaluate the role of transducers and bioelectric signals in biomedical instrumentation.

**CLO5:** Demonstrate the ability to select appropriate instruments for specific biomedical applications while ensuring accuracy and safety.

**CLO6:** Apply knowledge of instrumentation in clinical diagnostics and research with ethical and professional responsibility.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Visualization techniques: Principle of working and applications of bright field microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, scanning and transmission electron microscopy, scanning tunneling microscopy, and atomic force microscopy. Principle and applications of cytophotometry and flow cytometry.	Demonstration-based teaching, videos, lab exposure	CO1
II	Separation and analytical techniques: Basic principle and application of centrifugation, chromatography and electrophoreses Principle, instrumentation and applications of UV, Visible, IR including FTIR and ATR), AAS, NMR, fluorescence and CD spectroscopy.	Problem-solving sessions, experiments, ICT tools	CO2, CO3
III	Medical Sensors and their classification: Medically significant measure and, sensing methods for biological signals; Sensor characteristics: linearity, repeatability, hysteresis, drift; Sensor models in the time and frequency domains; Sensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and biopotentials. Sensors for measurement of chemicals: potentiometric sensors, ion selective electrodes, ISFETS; Amperometric sensors, Clark Electrode; Catalytic biosensors, immunosensors.	simulations, mini projects	CO3, CO4



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IV	Transducers for Biomedical Applications. Sources of Bioelectric potentials; Resting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials Electrodes, electrodes theory, Bio-potential Electrodes, Bio Chemical Transducers, Imaging techniques used to study Cardio vascular system.	Practical demonstrations, clinical case discussions, assignments	CO4, CO5, CO6
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### • (\*) Learning Pedagogies/Methods

#### Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

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- Interactive Classroom Lecture
- Classroom Lecture (CL)
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- Micro-Projects/Mini Research Tasks
- Industrial Visit/Field Visit/Institutional Visit
- Problem-Based Learning (PBL)
- Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- Inquiry-Based Learning
- Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

### • Assessment Methodologies

#### (A) Internal Assessment

##### a. Internal Formative assessment (20)

- Mid-term tests
- Assignment, Self-learning and Terms work
- Seminar/Presentation
- Quiz

##### b. Internal Summative Assessment (30)

- End of Term Examination
- Laboratory performance
- Viva-voce



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### (B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1	30	1	1	12	14
II	CO2, CO3	32	1	1	10	12
III	CO3, CO4	28	1	1	10	12
IV	CO4, CO5, CO6	30	1	1	12	14
		<b>120</b>	<b>04</b>	<b>04</b>	<b>34</b>	<b>50</b>

### • Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

### (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	-	2	1	-	-	-	1
CLO2	3	3	2	1	3	1	-	-	1	-
CLO3	2	3	3	1	2	2	-	-	1	1
CLO4	2	3	2	2	2	3	1	-	-	1
CLO5	2	3	2	2	3	2	-	2	1	-
CLO6	2	2	1	1	2	3	1	3	2	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



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## M.Sc. Biomedical Science SEM I

### • Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Instrumental Methods of Analysis	Douglas A. Skoog, F. James Holler, Stanley R. Crouch; B. Krishna	6 <sup>th</sup> Edition, 2007	Cengage Learning / Thomson
2	Instrumentation Methods of Chemical Analysis	Gurdeep R. Chatwal, Sham K. Anand	5 <sup>th</sup> Edition, 2007	Himalaya Publishing House
3	Biomedical Instrumentation and Measurements	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer	2 <sup>nd</sup> Edition, 1980	Prentice Hall
4	Modern Experimental Biochemistry	Rodney F. Boyer	3 <sup>rd</sup> Edition, 2000	Benjamin Cummings

### • Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	MIT Open Course Ware – Biomedical Instrumentation (Covers microscopy, sensors, transducers, and bioelectric signals)	<a href="https://ocw.mit.edu">https://ocw.mit.edu</a>
2	NPTEL Biomedical Instrumentation (Lectures on spectroscopy, sensors, imaging techniques, and analytical methods)	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
3	OpenStax / Libre Texts – Analytical Techniques (Covers spectroscopy, chromatography, centrifugation, and electrophoresis)	<a href="https://chem.libretexts.org">https://chem.libretexts.org</a>
4	Khan Academy – Biology & Physics (Basics of microscopy, bioelectric potentials, and instrumentation concepts)	<a href="https://www.khanacademy.org">https://www.khanacademy.org</a>



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## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching- Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS03	Microbial Pathogenesis	4-0-1	120	04

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

**CLO1.** Explain traditional concepts of health, hygiene, and disease prevention, including indigenous sanitation practices.

**CLO2.** Describe the traditional understanding of microorganisms (Krimi) and host resistance in relation to disease causation.

**CLO3.** Identify and discuss plant-based and natural antimicrobial agents used in traditional systems for infection control.

**CLO4.** Analyze the role of traditional practices in the management of infections such as dental, gastrointestinal, skin, wound, respiratory, and related diseases.

**CLO5.** Evaluate the scientific relevance and limitations of traditional antimicrobial practices in the context of modern microbiology and antimicrobial therapy.

**CLO6.** Integrate traditional knowledge with modern microbiological concepts to understand disease mechanisms, prevention strategies, and management approaches in human and veterinary health.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Molecular microbial pathogenicity: Molecular Koch's postulates, virulence determinants and their regulation, two-component signal transduction systems, antigenic variation, clonal and panmictic nature of pathogens, type III secretion system (T3SS), role of biofilms and quorum sensing. <b>Bhartiya Chikitsa and microbial practices: Traditional concepts of health, hygiene, and disease prevention; plant-based antimicrobials for dental, gastrointestinal, skin, wound, respiratory, neurological, and veterinary diseases.</b>	Classroom Lecture (CL), Interactive Classroom Lecture, Collaborative Learning, ICT Enabled Learning, Reflective Practices	CLO1, CLO2, CLO3, CLO4
II	Concepts of pathogenicity and virulence; quantitative measures (MLD, LD <sub>50</sub> , ID <sub>50</sub> , TCID <sub>50</sub> ). Virulence determinants: colonization, invasiveness, toxins, and enzymes. Intracellular pathogens. Pathogenesis of viral and bacterial diseases: transmission, entry, replication, spread, host interaction, and exit. Pathogenicity islands and regulation of virulence. Toxigenicity: Exotoxins (AB toxins, membrane-disrupting toxins, superantigens) and endotoxins.	(Classroom Lecture (CL), Seminars (Student-led and Faculty-moderated), Inquiry-Based Learning, ICT-Enabled Learning, Self-Directed Learning	CLO6



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III	Host defense mechanisms: primary and secondary defenses, factors influencing immunity, and microbial evasion strategies. Antimicrobial chemotherapy: characteristics of antimicrobial agents, therapeutic index, spectrum, and cidal/static action. Susceptibility testing methods (dilution, disc diffusion, Kirby–Bauer, E-test). Antimicrobial drugs: inhibitors of cell wall, protein, metabolic pathways, and nucleic acids. Drug resistance: mechanisms, origin, and transmission. Overview of antifungal, antiviral, and antiprotozoal drugs.	Problem-based learning, assignments, Literature review assignments, Practical exposure	CLO5, CLO6
IV	Pathogenesis, clinical features, laboratory diagnosis, epidemiology, chemotherapy, and prevention of infectious diseases. <u>Bacteria</u> : <i>Staphylococcus</i> , <i>Streptococcus</i> , <i>Pneumococcus</i> , <i>E. coli</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Neisseria</i> , <i>Vibrio</i> , <i>Clostridium</i> , <i>Haemophilus</i> , <i>Brucella</i> , <i>Mycobacterium</i> , <i>Mycoplasma</i> . <u>Viruses</u> : <i>Measles</i> , <i>Mumps</i> , <i>Influenza</i> , <i>HIV</i> , <i>Rabies</i> , <i>Hepatitis</i> , <i>Poliomyelitis</i> , <i>Dengue</i> , <i>Coronavirus</i> , Prions, Viroids. <u>Protozoa</u> : Amoebiasis, Giardiasis, Malaria, Leishmaniasis, Trypanosomiasis. Fungal infections: Classification and overview of superficial, cutaneous, subcutaneous, systemic, and opportunistic mycoses.	Lectures, case studies, demonstrations, group discussions, field-based learning	CLO4, CLO6

• (\*) **Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

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- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
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- (k) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (l) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (m) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (n) Inquiry-Based Learning
- (o) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)



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## M.Sc. Biomedical Science SEM I

- Assessment Methodologies

- (A) Internal Assessment

- a. Internal Formative assessment (30)

- (a) Quiz
    - (b) Assignment
    - (c) Seminar/Presentation
    - (d) Group Task
    - (e) Attendance

- b. Internal Summative Assessment (20)

- (a) Mid-Term
  - (B) External Assessment (50)
  - (a) End-Term

- (B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/Analyse & above (A)	
I	CLO1, CLO2, CLO3, CLO4	30	1	1	12	14
II	CLO6	32	1	1	10	12
III	CLO5, CLO6	28	1	1	10	12
IV	CLO4, CLO6	30	1	1	12	14
		<b>120</b>	<b>04</b>	<b>04</b>	<b>34</b>	<b>50</b>

- Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

- (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	2	-	2	3	-	-	-
CLO2	3	2	2	2	1	2	3	-	1	1
CLO3	2	2	2	2	1	2	3	-	1	1
CLO4	3	2	1	3	1	3	3	1	1	-
CLO5	2	1	2	3	-	3	3	2	1	-
CLO6	1	2	-	1	1	2	2	3	1	-



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## M.Sc. Biomedical Science SEM I

Values to **CLO-PLO** matrix are assigned by **judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Text book of Microbiology	Ananthanarayan, R and Paniker,	8 <sup>th</sup> Edition, 2009.	Universities press Private Limited, Hyderabad, India.
2	Microbiology Principles and Applications	Black, J.G.	3 <sup>rd</sup> edition, 1996	Prentice Hall Publications, USA.
3	Immunology (A short course)	Coiw, R and Sunshine	6 <sup>th</sup> edition	Wiley Blackwell
4	Diagnostic Microbiology	Forbes, B., Sahn, D.F and Weissfeld, A.S.	11 <sup>th</sup> edition, 1998	Mosby, Inc. Missouri
5	Immunobiology (The immuno system in health and diseases)	Janeway, Travers, Walport and Shlomchik	6 <sup>th</sup> edition, 2005	Garland Science Publishers, New York
6	Kuby Immunology	Kindt, T.J., Goldsby, R.A and Osborne, B.A.	6 <sup>th</sup> edition, 2007	W.H. Freeman & Company, New York.
7	Roitt Immunology	Male, D., Brostoff, J., Roth, D.B and Roitt, I.	7 <sup>th</sup> edition, 2006	Mosby Elsevier Publishers.
8	Medical Microbiology	Mims, C., Dockrell, H.M., Goering, R.V., Roitt, I., Wakelin, D. and Zucker, M. 2004.	3 <sup>rd</sup> edition, 2004	Elsevier Mosby, New York.
9	Microbiology	Prescott, Harley, and Kleins	7 <sup>th</sup> Edition	McGraw Hill Publication
10	Caraka Samhita: Text with English Translation	P. V. Sharma	2014	Chaukhambha Orientalia
11	The Sushruta Samhita: English Translation	K. Bhisagratna	1911	The Asiatic Society
12	Aṣṭāṅga Hṛdayam of Vagbhāṭa	K. R. Srikantha Murthy	2001	Chaukhambha Orientalia



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13	A Historical Dictionary of Indian Food	K. T. Achaya	1998	Oxford University Press
14	Traditional Indian Foods: A Comprehensive Study	P. N. K. Thampi	2005	APH Publishing

• **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Medical Microbiology (Open resource covering pathogenicity, virulence, and host–pathogen interactions)	<a href="https://www.ncbi.nlm.nih.gov/books">https://www.ncbi.nlm.nih.gov/books</a>
2	OpenStax Microbiology (Free textbook covering microbial diseases and virulence factors)	<a href="https://openstax.org/details/books/microbiology">https://openstax.org/details/books/microbiology</a>
3	Nature Scitable (Concepts of molecular pathogenesis, gene regulation, and virulence mechanisms)	<a href="https://www.nature.com/scitable">https://www.nature.com/scitable</a>
4	PubMed Central (Research articles on biofilms, quorum sensing, and T3SS)	<a href="https://www.ncbi.nlm.nih.gov/pmc">https://www.ncbi.nlm.nih.gov/pmc</a>
5	Kuhad, U., Goel, G., Maurya, P. K., & Kuhad, R. C. (2021). Sukshmjeevanu in Vedas: The forgotten past of microbiology in Indian Vedic knowledge. Indian Journal of Microbiology, 61(1), 108–110.	<a href="https://doi.org/10.1007/s12088-020-00911-5">https://doi.org/10.1007/s12088-020-00911-5</a>



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## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS04	Practical's Based on Developmental Biology and Principles of Biomedical Instrumentation	0-8-0	120	04

### • Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

**CLO1:** Explain the principles of developmental biology including gametogenesis, fertilization, cleavage, gastrulation, neurulation, and organogenesis in model organisms.

**CLO2:** Demonstrate identification and comparative study of developmental stages of frog, chick, and Drosophila using permanent slides and specimens.

**CLO3:** Apply laboratory techniques such as microscopy, centrifugation, buffer preparation, pH calibration, chromatography, and electrophoresis in biological analysis.

**CLO4:** Analyze biomolecules using chromatographic, electrophoretic, and instrumental techniques such as GC, HPLC, GPC, and particle size analysis.

**CLO5:** Evaluate reproductive and cellular processes through sperm viability testing, mitosis, meiosis, and placental histology studies.

**CLO6:** Develop experimental skills, scientific reporting, teamwork, project execution, and ethical laboratory practices in developmental biology and analytical techniques.

Practical Content	Learning Pedagogies*	CLO(s)
1. Study of developmental stages of frog through permanent slides 2. Study of Cleavage stages blastula glastula neurula and tail bud stage 3. Study of developmental stages of chick through permanent slide 4. Study of devel stages and lifecycle of drosophila 5. Study of different sections of placenta 6. Study of mitosis and meiosis through permanent slide 7. Study of sperm Viability test 8. Project work on drosophila culture/chick embryo development 9. Microscopy: demonstration of bright field, fluorescence and phase contrast microscopy 10. Density gradient separation of yeast cells by centrifugation 11. Preparation of different buffers and calibration of pH meter 12. pI value of amino acid 13. Paper Chromatography for separation of chlorophyll pigments 14. TLC for separation of amino acids 15. SDS PAGE 16. Demonstration of: GC and HPLC 17. Demonstration of GPC 18. Demonstration of Particle size analyzer	Demonstration - based Laborator y Teaching, Hands-on Practical / Experimental Learning	<b>CO1,            to CO6</b>



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### • (\*) Learning Pedagogies/Methods

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Case-Based Learning (CBL)
- (e) Micro-Projects/Mini Research Tasks
- (f) Industrial Visit/Field Visit/Institutional Visit
- (g) Problem-Based Learning (PBL)
- (h) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (i) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (j) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (k) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (l) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (m) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (n) Inquiry-Based Learning
- (o) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

### • Assessment Methodologies

#### (A) Internal Assessment

##### a. Internal Formative assessment (30)

- (a) Journal Evaluation
- (b) Method of working
- (c) Attendance

##### b. Internal Summative Assessment (20)

- (a) Mid-Term
- (b) Viva-Voce
- (B) External Assessment (50)
- (a) End-Term

#### (B) Weightage of Learning Efforts for External Assessment

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R)	Understanding (U)	Application/ Analyze & above (A)	
CO1, to CO6	120	04	04	34	50



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### (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	2	-	2	3	-	-	-
CLO2	3	2	2	2	1	2	3	-	1	1
CLO3	2	2	2	2	1	2	3	-	1	1
CLO4	3	2	1	3	1	3	3	1	1	-
CLO5	2	1	2	3	-	3	3	2	1	-
CLO6	1	2	-	1	1	2	2	3	1	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

### • Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Developmental Biology	Scott F. Gilbert & Michael J. F. Barresi	12th Ed., 2020	Oxford University Press
2	Essential Developmental Biology	Jonathan M. W. Slack	3rd Ed., 2013	Wiley-Blackwell
3	Human Embryology and Developmental Biology	Bruce M. Carlson	6th Ed., 2018	Elsevier
4	Langman's Medical Embryology	T. W. Sadler	14th Ed., 2019	Wolters Kluwer
5	Practical Zoology	G. S. Shukla & P. S. Upadhyay	Latest Ed.	Rastogi Publications
6	Biophysical Chemistry	Upadhyay, Upadhyay & Nath	Latest Ed.	Himalaya Publishing
7	Principles and Techniques of Biochemistry and Molecular Biology	Wilson & Walker	8th Ed., 2018	Cambridge University Press
8	Lehninger Principles of Biochemistry	Nelson & Cox	8th Ed., 2021	W.H. Freeman
9	Introduction to Practical Biochemistry	David T. Plummer	6th Ed.	McGraw Hill
10	Chromatography Concepts and Contrasts	James M. Miller	2nd Ed.	Wiley



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• **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Courses – Developmental Biology / Biochemistry / Instrumentation	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	UNSW Embryology Learning Resources	<a href="https://embryology.med.unsw.edu.au">https://embryology.med.unsw.edu.au</a>
3	The Interactive Fly – Drosophila Development	<a href="http://www.sdbonline.org/sites/fly/aimain/1aahome.htm">http://www.sdbonline.org/sites/fly/aimain/1aahome.htm</a>
4	Khan Academy – Cell Division, Reproduction, Biology Basics	<a href="https://www.khanacademy.org">https://www.khanacademy.org</a>
5	MIT OpenCourseWare – Biology and Analytical Techniques	<a href="https://ocw.mit.edu">https://ocw.mit.edu</a>



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## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS05	Practical's Based on Microbial Pathogenesis and Toxicology	0-8-0	120	04

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

**CLO1:** Explain the principles of medical microbiology, normal human microflora, pathogenic microorganisms, and host–microbe interactions.

**CLO2:** Demonstrate laboratory techniques for isolation, identification, staining, culturing, and antimicrobial sensitivity testing of clinically important microorganisms.

**CLO3:** Analyze clinical specimens such as urine, sputum, blood, and stool for diagnosis of infectious diseases and parasitic infections.

**CLO4:** Apply hematological and serological techniques for detection of diseases and interpretation of clinical parameters.

**CLO5:** Evaluate principles of toxicology through cytotoxicity assays, toxicant analysis, bioaccumulation studies, and environmental toxicity testing.

**CLO6:** Develop practical competence, biosafety awareness, scientific reporting, teamwork, and ethical practices in microbiology and toxicology laboratories.

Practical Content	Learning Pedagogies*	CLO(s)
1. Determination of antibiotic sensitivity of bacteria: Kirby-Bauer method 2. Determination of Phenol-coefficient of antimicrobial compounds 3. Estimation of Hemoglobin content in blood 4. Total RBC count 16 Total WBC count 5. Differential WBC count 18 Determination of Erythrocyte sedimentation rate (ESR) 6. Syphilis detection by VDRL Test 20 Detection of Salmonella by WIDAL test 7. Preparation of standard solutions and serial dilutions of toxicants 8. Determination of LC <sub>50</sub> /EC <sub>50</sub> 9. In vitro cytotoxicity assay 10. Hemolysis assay using erythrocytes to evaluate membrane toxicity 11. Enzyme inhibition assay (e.g., catalase or acetylcholinesterase activity under toxic exposure) 12. Qualitative detection of heavy metals in samples 13. Chromatographic separation of toxic compounds (paper/TLC chromatography) 14. Spectrophotometric analysis of a toxicant	Demonstration-based Laboratory Teaching, Hands-on Practical / Experimental Learning	<b>CO1, to CO6</b>



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15. Study of pesticide residue detection (basic qualitative methods)		
16. Study of bioaccumulation using yeast/algal model systems		
17. Microbial toxicity assay (effect of toxicants on bacterial growth – zone of inhibition/turbidity)		

- (\*) Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline- specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Case-Based Learning (CBL)
- (e) Micro-Projects/Mini Research Tasks
- (f) Industrial Visit/Field Visit/Institutional Visit
- (g) Problem-Based Learning (PBL)
- (h) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (i) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (j) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (k) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (l) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (m) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (n) Inquiry-Based Learning
- (o) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- Assessment Methodologies**

- (A) Internal Assessment**

- a. Internal Formative assessment (30)**

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance

- b. Internal Summative Assessment (20)**

- (a) Mid-Term
- (B) External Assessment (50)
- (a) End-Term

- (B) Weightage of Learning Efforts for External Assessment**

Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
		Remember (R)	Understanding (U)	Application/ Analyze &	



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					above (A)	
CO1 to CO6	120	04	04	04	34	50

### (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	1	2	-	2	3	-	-	-
CLO2	3	2	2	2	1	2	3	-	1	1
CLO3	2	2	2	2	1	2	3	-	1	1
CLO4	3	2	1	3	1	3	3	1	1	-
CLO5	2	1	2	3	-	3	3	2	1	-
CLO6	1	2	-	1	1	2	2	3	1	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

### • Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Medical Microbiology	Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller	9th Ed., 2020	Elsevier
2	Prescott's Microbiology	Joanne Willey, Linda Sherwood, Christopher Woolverton	11th Ed., 2019	McGraw-Hill
3	Jawetz, Melnick & Adelberg's Medical Microbiology	Geo. Brooks et al.	28th Ed., 2019	McGraw-Hill
4	Textbook of Microbiology	Ananthanarayan & Paniker	11th Ed., 2021	Universities Press
5	Practical Medical Microbiology	Mackie & McCartney	14th Ed.	Elsevier
6	Casarett and Doull's Toxicology	Curtis D. Klaassen	9th Ed., 2019	McGraw-Hill
7	Principles and Methods of Toxicology	A. Wallace Hayes	6th Ed., 2014	CRC Press
8	Clinical Hematology Atlas	Jacqueline Carr	5th Ed., 2015	Elsevier



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9	Diagnostic Microbiology	Connie R. Mahon et al.	6th Ed., 2018	Elsevier
10	Fundamentals of Clinical Chemistry	Carl A. Burtis et al.	7th Ed., 2015	Elsevier

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	CDC Laboratory Training and Biosafety Resources	<a href="https://www.cdc.gov">https://www.cdc.gov</a>
2	WHO Laboratory Biosafety Manual and Diagnostic Resources	<a href="https://www.who.int">https://www.who.int</a>
3	NCBI Bookshelf – Medical Microbiology and Toxicology References	<a href="https://www.ncbi.nlm.nih.gov/books">https://www.ncbi.nlm.nih.gov/books</a>



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## M.Sc. Biomedical Science SEM I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCBMS06	Toxicology	2-0-1	60	02

• **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

**CLO1:** Explain the foundations of toxicology including history, scope, subdivisions, classification of toxins/toxicants, dose–response relationship, and types of toxic effects.

**CLO2:** Describe the factors affecting toxicity such as species, age, sex, nutritional status, hormones, circadian rhythms, and environmental influences.

**CLO3:** Discuss toxicokinetic and toxicodynamic principles including portals of entry, ADME processes, bioaccumulation, and biomagnification.

**CLO4:** Interpret concepts of human health risk assessment, laboratory practices, quality control, and regulatory considerations in toxicology.

**CLO5:** Explain the Ayurvedic concept of Visha, chemistry of toxic plants and alkaloids, their toxic effects, and principles of detoxification (Shodhana) and detection methods.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	<b>Foundation of Toxicology:</b> Introduction, definition, brief history, scope and subdivisions of toxicology. Classification of toxins/toxicants: natural toxins, animal toxins, plant toxins, food toxins, genetic poisons, chemical toxicants. Basic concepts: dose and dose-response relationship. Types of toxic effects: allergic reactions, idiosyncratic reactions, reversible and irreversible effects, acute toxicity, sub-acute toxicity, sub-chronic toxicity, chronic toxicity. Factors affecting toxicity: species and strain, age, sex, nutritional status, hormones, circadian rhythms, environmental factors.	Lectures, case studies, discussions, real-life examples	CO1, CO2
II	<b>Toxicokinetic and Toxicodynamic:</b> Absorption and distribution of toxins. Portals of entry: skin, gastrointestinal tract, gills, respiratory system. Concepts of toxicokinetic and toxicodynamic. ADME (Absorption, Distribution, Metabolism, Excretion). Bioaccumulation and biomagnification. Human health risk assessment. Basics of laboratory practices, quality control and regulatory considerations in toxicology. <b>Toxic Plants in Ayurveda – Chemistry and Safety: Concept of Visha, major toxic alkaloids, and their effects. Includes detoxification (Shodhana) and detection methods.</b>	Lectures, diagram-based learning, group discussions, assignments	CO3, CO4



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### (\* Learning Pedagogies/Methods

Notes:

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(2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
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- (f) Industrial Visit/Field Visit/Institutional Visit
- (g) Problem-Based Learning (PBL)
- (h) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (i) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (j) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (k) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (l) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (m) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (n) Inquiry-Based Learning
- (o) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

### • Assessment Methodologies

#### (A) Internal Assessment

##### a. Internal Formative assessment (20)

- (a) Mid-term tests
- (b) Assignment, Self-learning and Terms work
- (c) Seminar/Presentation
- (d) Quiz

##### b. Internal Summative Assessment (30)

- (a) End of Term Examination
- (b) Laboratory performance
- (c) Viva-voce

#### (B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CO1	30	1	3	8	12
II	CO2, CO3	30	1	4	8	13
		<b>60</b>	<b>02</b>	<b>07</b>	<b>22</b>	<b>25</b>



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### • Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

### (C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	1	1	3	-	2	1	-	-	-
CLO2	3	2	2	3	1	2	-	-	1	-
CLO3	2	2	2	3	1	3	1	2	1	-
CLO4	2	3	1	2	3	2	-	3	1	-
CLO5	2	3	2	2	3	2	-	3	3	-
CLO6	2	1	1	3	-	3	2	3	1	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

### • Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Casarett and Doull's Toxicology: The Basic Science of Poisons	Curtis D. Klaassen (Ed.)	8th Edition, 2013	McGraw-Hill Education
2	Essentials of Toxicology	Curtis D. Klaassen	3rd Edition, 2015	McGraw-Hill
3	Microbial Toxins	P. Gopalakrishnakone, Brad Stiles, Alberto Alape-Girón, J. Daniel Dubreuil, Manas Mandal	1st Edition, 2016	Springer



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- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	WHO Chemical Safety (Covers toxicants, exposure routes, and human health risk assessment)	<a href="https://www.who.int/health-topics/chemical-safety">https://www.who.int/health-topics/chemical-safety</a>
2	ATSDR Toxicological Profiles (Detailed toxicant information and exposure characterization)	<a href="https://www.atsdr.cdc.gov/toxprofiledocs/index.html">https://www.atsdr.cdc.gov/toxprofiledocs/index.html</a>
3	US EPA Risk Assessment (Environmental toxicology and exposure analysis resources)	<a href="https://www.epa.gov/risk">https://www.epa.gov/risk</a>
4	NCBI Bookshelf Toxicology Resources (Fundamentals of toxicology and dose-response concepts)	<a href="https://www.ncbi.nlm.nih.gov/books">https://www.ncbi.nlm.nih.gov/books</a>