

	Swarnim Startup & Innovation University	
	Swarnim Science College	
	Problem-solving	

The Bachelor of Science program offers five different specializations, each designed to enhance students' problem-solving abilities through structured practical sessions and theoretical assignments across all semesters.

❖ Practical Courses

Each semester includes a dedicated practical course for every specialization, where students are actively engaged in problem-solving activities. These practicals are designed to help students apply theoretical concepts to real-world problems. For instance, through laboratory experiments and simulations, students are tasked with troubleshooting issues, interpreting experimental data, and finding solutions to scientific problems.

Activity Design: In each practical session, students are provided with problems that require critical thinking and application of scientific principles. For example, physics students might work on experiments related to waveguides or IC circuits, where they solve problems involving measurement, accuracy, and performance.

Learning Outcome: These practical aim to build skills such as analytical thinking, data interpretation, and experimental design. Students are trained to approach problems systematically, testing hypotheses, analyzing results, and making necessary adjustments based on observations.

❖ Theoretical Assignments

In addition to practical courses, problem-solving activities are embedded in the theoretical components of the curriculum. Students are regularly given assignments that require them to apply theoretical knowledge to solve problems independently. These assignments are carefully curated to cover key topics from the syllabus, ensuring that students grasp both fundamental concepts and advanced applications.

Example of Assignment Design: For a chemistry specialization, students might be given assignments on reaction mechanisms or molecular interactions, which involve identifying solutions to complex chemical reactions or predicting outcomes based on theory.

Autonomous Learning: These assignments encourage students to work independently, enhancing their ability to research, analyze, and solve complex problems. This method also promotes the development of self-directed learning habits and critical thinking skills.

❖ **Continuous Evaluation and Feedback**

The problem-solving activities are continuously evaluated through lab reports, viva voce, and assignment submissions. Feedback is provided to help students improve their problem-solving approaches, refine their methodologies, and enhance their understanding of core concepts.

❖ **Outcome-Oriented Approach**

By integrating problem-solving activities into both the curriculum's practical and theoretical components, students are equipped with technical knowledge and develop critical competencies such as analytical thinking, logical reasoning, and creativity, which are essential for scientific problem-solving.

Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Biotechnology

Masters- Teaching syllabus & examination pattern

	Semester 1															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256010101	Gene Structure and Function	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256010102	Bioinstrumentation	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256010103	Microbial Diversity	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256010104	Biogeohydrotechnology and Biofuels	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256010105	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000007	INTRODUCTION TO ENTREPRENEUSHIP	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

Semester 2																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256010201	Microbial Genetics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256010202	Immunology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256010203	Bioprocess Technology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256010204	Tools and techniques in synthetic microbiology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256010205	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000013	Preparing Wider Horizon for Entrepreneurship	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Biotechnology

Masters- Teaching syllabus & examination pattern

	Semester 3															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256010301	Microbial Biotechnology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256010302	Enzymology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256010303	r-DNA Technology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256010304	Animal Tissue culture & pharmaceutical Biotechnology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256010305	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000014	ENTREPRENEURIAL MOTIVATION	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

	Semester 4															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256010401	Plant Biotechnology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256010402	Environmental Biotechnology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256010403	Practicals	4	-	-	6	6	-	-	100	40	-	-	-	-	100
4	256010404	Dissertation	12	-	-	12	12	-	-	300	120	-	-	-	-	300
5	23000017	PROJECT FEASIBILITY & MARKETING SKILLS	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	24	8	-	18	26	60	-	400	-	140	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Chemistry

Masters- Teaching syllabus & examination pattern

	Semester 1															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256020101	Organic Chemistry-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256020102	inorganic Chemistry-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256020103	Physical Chemistry-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256020104	Analytical Chemistry-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256020105	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000007	INTRODUCTION TO ENTREPRENEUSHIP	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

	Semester 2															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256020201	Organic Chemistry-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256020202	inorganic Chemistry-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256020203	Physical Chemistry-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256020204	Analytical Chemistry-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256020205	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000013	Preparing Wider Horizon for Entrepreneurship	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARRNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Chemistry

Masters- Teaching syllabus & examination pattern

	Semester 3															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256020301	Natural Products & Biomolecules	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256020302	Medicinal Chemistry	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256020303	Organic Spectroscopy	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256020304	Industrial Chemistry	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256020305	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000014	ENTREPRENEURIAL MOTIVATION	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

	Semester 4															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256020401	Advanced Organic Chemistry	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256020402	Advanced Organic Synthesis	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256020403	Bio-Organic Chemistry	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256020404	Selected Topics in Medicinal Chemistry	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256020405	Dissertation/Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000017	PROJECT FEASIBILITY & MARKETING SKILLS	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	-	28	170	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Microbiology

Masters- Teaching scheme, syllabus & examination pattern

	Semester 1															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256030101	Gene Structure and Function	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256030102	Bioinstrumentation	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256030103	Microbial Diversity	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256030104	Biogeohydrotechnology and Biofuels	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256030105	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000007	INTRODUCTION TO ENTREPRENEUSHIP	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

	Semester 2															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256030201	Microbial Genetics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256030202	Immunology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256030203	Bioprocess Technology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256030204	Tools and techniques in synthetic microbiology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256030205	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000013	Preparing Wider Horizon for Entrepreneurship	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	120	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Microbiology

Masters- Teaching scheme, syllabus & examination pattern

	Semester 3															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256030301	Microbial Biotechnology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256030302	Enzymology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256030303	Food & Dairy Microbiology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256030304	Agriculture Microbiology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256030305	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000014	ENTREPRENEURIAL MOTIVATION	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

	Semester 4															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256030401	Environmental Microbiology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256030402	r-DNA Technology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256030403	Practicals	4	-	-	6	6	-	-	100	40	-	-	-	-	100
4	256030404	Dissertation	12	-	-	12	12	-	-	300	120	-	-	-	-	300
5	23000017	PROJECT FEASIBILITY & MARKETING SKILLS	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	8	-	18	26	60	-	400	-	140	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Physics

Masters- Teaching syllabus & examination pattern

Semester 1																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256040101	Quantum Mechanics-I and Mathematical Physics-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256040102	Classical Mechanics-I and Statistical Mechanics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256040103	Electrodynamics-I and Programming in C-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256040104	Solid State Physics and Plasma Physics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256040105	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000007	INTRODUCTION TO ENTREPRENEUSHIP	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

Semester 2																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256040201	Quantum Mechanics-II and Mathematical Physics-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256040202	Classical Mechanics-II and Statistical Mechanics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256040203	Semiconductor Physics and Devices	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256040204	Analog Electronics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256040205	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000013	Preparing Wider Horizon for Entrepreneurship	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARRNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Physics

Masters- Teaching syllabus & examination pattern

Semester 3

Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256040301	Advanced Quantum Mechanics-I, Nuclear Physics-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256040302	Numerical Methods and Digital Eleetronics	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256040303	Fiber Optics, Satellite Communication & Microprop	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256040304	Electronic Communication-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256040305	Practicals	4		-	6	6	-	-	100	35	-	-	-	-	100
6	256040306	Project	4			6	4	-		100	35	-	-	-	-	100
7	23000014	ENTREPRENEURIAL MOTIVATION	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	280	-	-	-	600

Semester 4

Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256040401	Advance Quantum Mechanics-II & Nuclear Phys	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256040402	Numerical Techniques & Sophisticated Experimental and Characterization Techniques	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256040403	Microwaves and Microprocessor-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256040404	Remote Sensing & Electronic Communication-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256040405	Practicals	4	-	-	6	6	-	-	100	35	-	-	-	-	100



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Mathematics

Masters- Teaching syllabus & examination pattern

Semester 1																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256050101	Abstract Algebra-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256050102	Real Analysis	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256050103	Statistical Methods	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256050104	Advanced Linear Algebra	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256050105	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000007	INTRODUCTION TO ENTREPRENEUSHIP	3	3	-	-	3	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600

Semester 2																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256050201	Advanced Abstract Algebra-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256050202	Complex Analysis	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256050203	Special Functions	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256050204	Ordinary Differential Equation	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256050205	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000013	Preparing Wider Horizon for Entrepreneurship	3	3	-	-	-	50	20	-	-	50	20	-	-	100
		Total	27	19	-	12	28	170	-	200	-	330	-	-	-	600



Swarnim Startup & Innovation University

SWARNIM SCIENCE COLLEGE

Master of Science (M.Sc.) Mathematics

Masters- Teaching syllabus & examination pattern

	Semester 3															
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256050301	Functional Analysis	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256050302	mathematical modelling	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256050303	Partial Differential Equation	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256050304	Topology-I	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256050305	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200
6	23000014	ENTREPRENEURIAL MOTIVATION	3	3	-	-	3	50	20	-	-	50	20	-	-	100
			Total	27	19	-	12	28	170	-	200	-	330	-	-	600

Semester 4																
Sr. No.	Subject Code	Subject Name	Credit	Teaching scheme per week				Examination								Total
				Th	Tut	Practical	Total	Internal				External				
								Th	PASSING	Pr	PASSING	Th	PASSING	Pr	PASSING	
1	256050401	Number Theory	4	4	-	-	4	30	12	-	-	70	25	-	-	100
2	256050402	Reseach Methodology	4	4	-	-	4	30	12	-	-	70	25	-	-	100
3	256050403	Laplace Transformation	4	4	-	-	4	30	12	-	-	70	25	-	-	100
4	256050404	Topology-II	4	4	-	-	4	30	12	-	-	70	25	-	-	100
5	256050405	Practicals	8	-	-	12	12	-	-	200	80	-	-	-	-	200



Ques. 1 Compare the pathogenic mechanisms of viruses and bacteria.

Answer. Viruses typically invade host cells and hijack the cellular machinery to replicate, often leading to cell death or dysfunction.

They may evade the immune system by altering their surface proteins.

Bacteria, on the other hand, can produce toxins, evade phagocytosis, and form biofilms.

They often have more complex interactions with host tissues, utilizing mechanisms like adhesion factors, invasiveness, and immune evasion strategies.

Ques. 2 Evaluate the advantages and disadvantages of using probiotics in clinical treatments.

Answer.

Advantages

Probiotics can restore gut microbiota balance, improve digestion, enhance immu-

ne function, and may reduce the duration of diarrhea or other gastrointestinal issues.

Disadvantages

Some probiotics can cause infections in immunocompromised individuals, and not all strains are effective for every condition.

Furthermore, the regulation of probiotics is less stringent, leading to variability in product quality and efficacy.

Ques. 3 Assess the implications of antibiotic resistance in healthcare settings.

Answer. Antibiotic resistance leads to higher medical costs, prolonged hospital stays, and increased mortality rates.

It complicates the treatment of infections and requires alternative, often more expensive, treatment options.

The rise of Multi-Drug-Resistant-organisms (MDROs) poses a

significant threat, highlighting the need for improved stewardship, infection control measures, and research into new antibiotics.

* Collision Theory:

- The collision theory, the rate at which chemical reaction proceeds is equal to the frequency of effective collisions.
- Collision theory basically explains how reactions occur and why different reactions have different reaction rates. It states that:-
 - Molecules must collide in order to react.
 - In order to effectively initiate a reaction, the molecules in the collisions must have sufficient energy to bring about disruptions in the bonds of molecules.
 - A rise in temperature will cause the molecules to move faster and collide more vigorously, increasing the likelihood of bond cleavages and rearrangements greatly.
 - The reactions containing neutral molecules cannot take place at all until they have acquired the activation energy needed to stretch.

- Clausius - Clapeyron equation,

$$\frac{dP}{dT} = \frac{\Delta S}{V_B - V_A}$$

- According to 2nd law of thermodynamics,

$$\Delta S = \frac{q}{T}$$

$$\therefore \frac{dP}{dT} = \frac{q}{T(V_B - V_A)}$$

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- If the free energy of A is slightly changed by dG_A , the free energy of B will change by dG_B and if equilibrium is maintained then ($\because \Delta G = 0$)

$$G_A + dG_A = G_B + dG_B$$

but $G_A = G_B$

$$dG_A = dG_B$$

- As per Maxwell's equation,

$$dG = VdP - SdT$$

$$\therefore V_A dP - S_A dT = V_B dP - S_B dT$$

- Where, V_A and V_B are volume of A and B respectively per mole.
- S_A and S_B are entropies of A and B. dP and dT increase in pressure and change in transition temperature i.e. melting point.

$$\therefore (S_B - S_A) dT = (V_B - V_A) dP$$

$$\therefore \frac{dT}{dP} = \frac{(V_B - V_A)}{(S_B - S_A)}$$

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* clausis - claperon equation:-

- An equation used for one component two phase system in equilibrium at its transition temperature was derived by claperon and independently by clausius.
- It is applied for solid and its liquid at its melting point, or to a liquid and its vapour at its boiling or 2 crystalline allotropes at its transition temperature.

→ Suppose the two phase of a substance are A and B solid and liquid suppose the transition temperature i.e. m.p. A and B being in equilibrium at $T^\circ\text{K}$.



$\therefore$ Free energy of A = G_A and free energy of B = G_B .

$$\therefore \Delta G = G_B - G_A$$

But at equilibrium,

$$\Delta G = 0$$

$$\therefore G_A = G_B$$

Unit:- ICA)

Thermodynamics

* Thermodynamics:

- The study of the relation between heat, work, temperature and energy.

* The most important laws of thermodynamics are:-

1. The zeroth law of thermodynamics:-

- When two systems are each in thermal equilibrium with a third system, the first two systems are in thermal equilibrium with each other.

2. The first law of thermodynamics:-

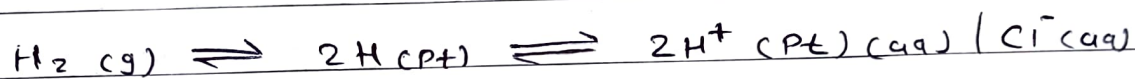
- The law of conservation of energy. the change in a system's internal energy is equal to the difference between heat added to the system from its surroundings and work done by the system on its surroundings.

3. The second law of thermodynamics:-

- Heat does not

(5) Gas electrodes:-

→ A gas is in equilibrium with ions in solution.



→ The chlorine electrode is $\text{Pt} | \text{Cl}_2 (\text{g}) | \text{Cl}^- (\text{aq})$ with half-reaction.



* Electrode:- An electrode is a solid electric conductor that carries electric current into non-metallic solids, or liquid or gases or plasmas or vacuums.

* Primary reference electrode:-

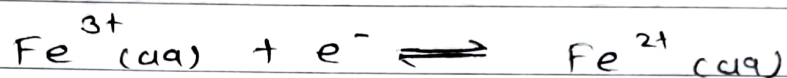
(1) Standard Hydrogen Electrode:-

→ It's standard electrode potential is declared to be 0 at a temperature of 298K.

→ This is because it acts as a reference for comparison with any other electrode.

(3) Redox electrodes:-

- Every electrodes involves an Oxidation-Reduction half reactions.
- This solution serves only to supply and accept electrons.



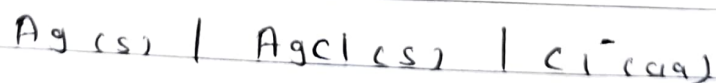
- The half-cell diagram is $\text{Pt} | \text{Fe}^{3+}(\text{aq}), \text{Fe}^{2+}(\text{aq})$

(4) Metal - insoluble - salt electrodes:-

(Electrode reversible w.r.t anion):-

- A metal M is in contact with very slightly soluble salts (sparingly soluble salt).

- for example, the silver - silver chloride electrode consists of Ag metal, solid AgCl , and a solution that contains Cl^- ions and is saturated with AgCl .



- $\text{Ag}(\text{s}) \rightleftharpoons \text{Ag}^+(\text{aq}) + e^-$
- $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightleftharpoons \text{AgCl}(\text{s})$
- $\text{Ag}(\text{s}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + e^-$

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* electrodes:- Electrodes are devices that convert ionic potentials into electronic Potentials.

* Reversible and Irreversible Electrodes:-

(1) metal - metal ion electrodes:-

→ A metal M is in electrochemical equilibrium with a solution containing M^{n+} ions.

→ The half reaction is



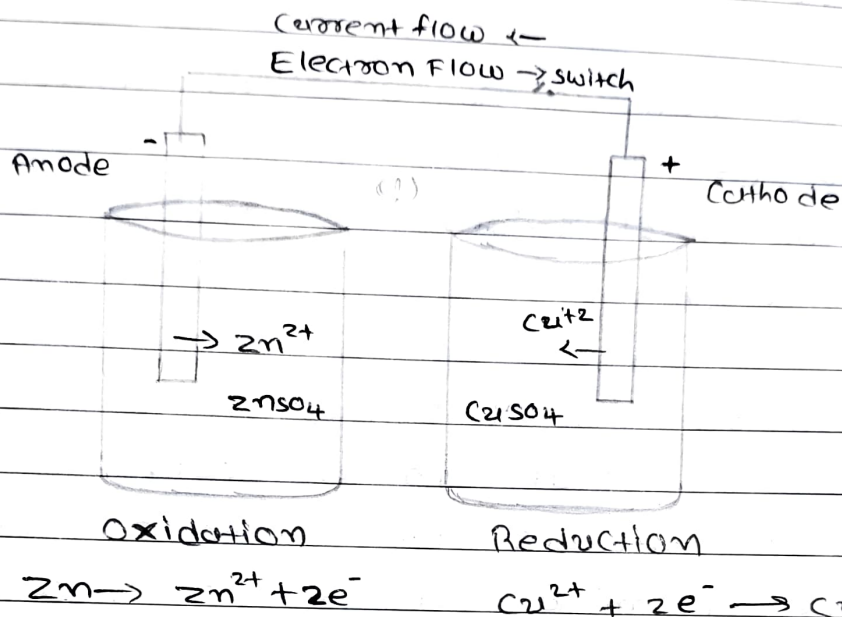
(2) Amalgam electrodes:-

→ An amalgam is a solution of a metal in liquid Hg .

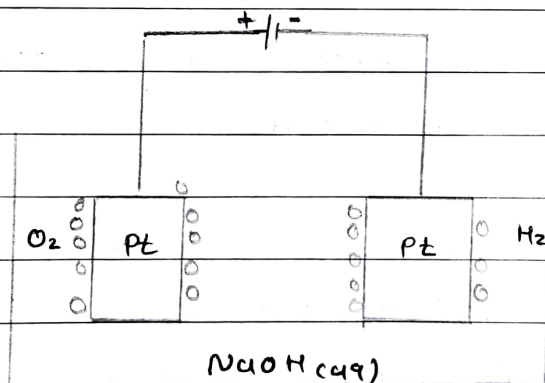
→ In an amalgam electrode, an amalgam of metal M is in equilibrium with a solution containing M^{+2} ions.

→ Na or Cu mostly use in Amalgam.

* Daniell Cell :-



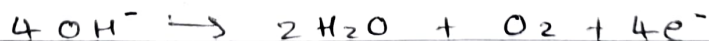
* Electrolytic cell :-



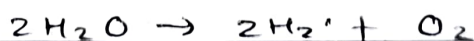
$\rightarrow$ Negative electrode :-



$\rightarrow$ Positive electrode, O_2 is liberated :-



$\rightarrow$ Overall electrolysis reaction :-



Ans:

- Since rate is $\propto [N_2O_5]$ it is first order reaction. The integrated rate equation is

$$K = \frac{2.303}{t} \log \frac{[N_2O_5]_0}{[N_2O_5]}$$

- When 90% of N_2O_5 has reacted, the initial concentration is reduced to $1/10$ that is,

$$[N_2O_5] = 1/10 [N_2O_5]_0$$

Substituting values in the rate equation,

$$K = \frac{2.303}{3600} \log \frac{[N_2O_5]_0}{1/10 [N_2O_5]}$$

$$= \frac{2.303}{3600} \log 10$$

$$= \frac{2.303}{3600} \times 1$$

$$K = 6.40 \times 10^{-4} \text{ s}^{-1}$$

Ex:-2 The half-life of a substance in a first order reaction is 15 min. calculate constant.

$$\rightarrow t_{1/2} = 15, \quad K = (?)$$

$$t_{1/2} = \frac{0.693}{K}$$

$$15 = \frac{0.693}{K}$$

$$K = \frac{0.693}{15}$$

$$K = 0.0462$$

$$K = 4.6 \times 10^{-2}$$

Ex:-3 for the reaction



the rate is directly proportional to $[N_2O_5]$.
At $45^\circ C$, 90% of the N_2O_5 reacts in 3600 seconds. Find the value of the rate constant K .

① What is biotechnology?

Ans: Biotechnology is a broad field of science and technology that utilizes living organisms and their components to create products & processes for specific applications.

It encompasses a wide range of disciplines, including biology, biochemistry, genetics, microbiology, immunology and engineering.

Some core concepts and principles are as follows:

- Genetic Engineering:

This involves the manipulation of an organism's genetic material to introduce new traits or modify existing ones.

Techniques like recombinant DNA technology & CRISPR-Cas9 are widely used.

- Bioinformatics:

This field uses computational methods to analyze & interpret biological data.

such as DNA sequence, protein structure, and gene expression patterns.

Metabolic Engineering:

This involves modifying the metabolic pathways of organisms to produce specific compounds or increase their yield.

Bioprocess Engineering:

This focuses on the design & operation of biological systems for industrial production, such as fermentation & bioreactors.

27) What are the applications of biotechnology.

Biotechnology has revolutionized numerous industries, leveraging living organisms & their components for various purposes.

Below are some key applications:

* Medicine

- Pharmaceutical production:
- Recombinant DNA technology - Genes encoding therapeutic proteins are inserted into host organisms to produce large quantities of these proteins.

Monoclonal antibodies * Produced using hybridoma technology, these highly specific antibodies are used for diagnosis, therapeutics & research.

- Gene therapy & vaccines:

Somatic gene therapy - Introduction of a functional gene into somatic cells to treat genetic disorders.

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Vaccine - Produced using DNA technology, these vaccines contain antigens from pathogens, stimulating an immune response without the need for the entire pathogen.

*** Food industries:**

- Food processing:

Enzymes are used for processing, preservation, & flavor enhancement.

- Food safety:

Bioteknology is used for detecting food borne pathogens & contaminants.

- Food additives:

Enzymes & microorganisms are used to produce food additives.

35) What are the important techniques of biotechnology?

ans) Biotechnology, a field that merges living organisms & their components, relies on various techniques to achieve its goals.

Some of them are as follows;

* Recombinant DNA technology:

- Restriction Enzyme Digestion:
Enzymes that cut DNA at specific sequences, creating fragments with compatible sticky ends.
- Ligation:
Joining of DNA fragments using DNA ligase to create rDNA molecules.
- Transformation:
Introduction of rDNA into host cells.
- Cloning:
Production of multiple copies of a specific DNA sequence within a host organism.

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- Expression: Production of a protein encoded by the cloned gene in the host organism.

Gene Editing:

- CRISPR - Cas 9:

A system that allows precise editing of genes by targeting specific DNA sequences.

- Zinc Finger Nucleases (ZFNs):

Protein-based tools that can bind to specific DNA sequences & introduce breaks.

- Transcription Activator-Like Effector Nucleases (TALENs):

Similar to ZFNs, but with a different protein structure.