

BACHELOR OF SCIENCE PROGRAM OUTCOMES (PO)

PO NO.	PROGRAM OUTCOME DESCRIPTION
PO1	Foundational knowledge: graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical skills: students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical thinking: graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective communication: students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and teamwork: graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information literacy: students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical awareness: graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong learning: students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal impact: graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.

BACHELOR OF SCIENCE PROGRAM SPECIFIC OUTCOMES (PSO)

B.SC. CHEMISTRY:

PSO NO.	PROGRAM SPECIFIC OUTCOME DESCRIPTION
PSO1	Chemical knowledge and application: graduates of the B.Sc. Chemistry program will possess a comprehensive understanding of the principles and theories of chemistry. They will apply this knowledge to analyze chemical phenomena, conduct experiments, and solve complex chemical problems.
PSO2	Laboratory skills and safety: graduates will demonstrate proficiency in laboratory techniques, including chemical synthesis, analysis, and instrumentation. They will prioritize safety protocols, adhere to ethical practices, and effectively communicate experimental findings.

B.Sc. Sem - I(A-Group)

Sr N o.	Course Type	Course Code	Corse Name	Lectu re (hrs.)	Practi cal (hrs.)	Credi ts	Examination		Total Mark s
							Intern al	Exter nal	
1	FOUNDATI ON COMPULS ORY	B101FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLIN E SPECIFIC COURSE (DSC)	BPHY101UD SC		4	0	4	30	70	100
3	DISCIPLIN E SPECIFIC COURSE (DSC)	BMAT101U DSC		4	0	4	30	70	100
4	DISCIPLIN E SPECIFIC COURSE (DSC)	BCHE101U DSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICA L COURSE (PRA)	BPHY101UP RA	Physics Practical	0	4	2	0	50	50
6	PRACTICA L COURSE (PRA)	BMAT101U PRA	Maths Practical	0	4	2	0	50	50
7	PRACTICA L COURSE (PRA)	BCHE101U PRA	Chemistry Practical	0	4	2	0	50	50
8	SUBJECT ELECTIVE	BCHE101US E	Agricultura l Chemistry	2	0	2	15	35	50
9	ELECTIVE GENERIC	B101EG	Elective Generic: Communica tion Skills	2	0	2	0	50	50
TOTAL				18	12	24	135	515	650

B.Sc. Sem - I(B-Group)									
Sr N o.	Course Type	Course Code	Corse Name	Lectu re (hrs.)	Practi cal (hrs.)	Credi ts	Examination		Total Marks
							Intern al	Extern al	
1	FOUNDATI ON COMPULS ORY	B101FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLIN E SPECIFIC COURSE (DSC)	BBOT101UD SC		4	0	4	30	70	100
3	DISCIPLIN E SPECIFIC COURSE (DSC)	BMIC101UD SC/ BZOO101U DSC		4	0	4	30	70	100
4	DISCIPLIN E SPECIFIC COURSE (DSC)	BCHE101U DSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICA L COURSE (PRA)	BBOT101UP RA	Botany practical	0	4	2	0	50	50
6	PRACTICA L COURSE (PRA)	BMIC101UP RA/ BZOO101UP RA	Microbiolog y practical/ Zoology practical	0	4	2	0	50	50
7	PRACTICA L COURSE (PRA)	BCHE101U PRA	Chemistry Practical	0	4	2	0	50	50
8	SUBJECT ELECTIVE	BCHE101US E	Agricultura l Chemistry	2	0	2	15	35	50
9	ELECTIVE GENERIC	B101EG	Elective Generic: Communica tion Skills	2	0	2	0	50	50
TOTAL				18	12	24	135	515	650

B.Sc. Sem - II(A-Group)									
Sr N o.	Course Type	Course Code	Corse Name	Lectu re (hrs.)	Practi cal (hrs.)	Credi ts	Examination		Total Mar ks
							Inter nal	Exter nal	
1	FOUNDATI ON COMPULS ORY	B201FC	Foundation Compulsory- English	2	0	2	30	70	100
2	DISCIPLIN E SPECIFIC COURSE (DSC)	BPHY201U DSC		4	0	4	30	70	100
3	DISCIPLIN E SPECIFIC COURSE (DSC)	BMAT201U DSC		4	0	4	30	70	100
4	DISCIPLIN E SPECIFIC COURSE (DSC)	BCHE201U DSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICA L COURSE (PRA)	BPHY201UP RA	Physics Practical	0	4	2	0	50	50
6	PRACTICA L COURSE (PRA)	BMAT201U PRA	Maths Practical	0	4	2	0	50	50
7	PRACTICA L COURSE (PRA)	BCHE201U PRA	Chemistry Practical	0	4	2	0	50	50
8	SUBJECT ELECTIVE	BCHE201U SE	Subject Elective: Medi cinal Chemistry	2	0	2	15	35	50
9	ELECTIVE GENERIC	B201UEG	Elective Generic: Disaster Management	2	0	2	0	50	50
TOTAL				18	12	24	135	515	650

B.Sc. Sem - II(B-Group)

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	FOUNDATION COMPULSORY	B201FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT201UDSC		4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC201UDSC/ BZOO201UDSC		4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE201UDSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT201UPRA	Botany Practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC201UPRA	Microbiology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE201UPRA	Chemistry Practical	0	4	2	0	50	50
8	SUBJECT ELECTIVE	BCHE201USE	Subject Elective: Medicinal Chemistry	2	0	2	15	35	50
9	ELECTIVE GENERIC	B201UEG	Elective Generic: Disaster Management	2	0	2	0	50	50
TOTAL				18	12	24	135	515	650

B.Sc. Sem - III

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	

1	FOUNDATI ON COMPULS ORY	B301FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLIN E SPECIFIC COURSE (DSC)	BMAT301U DSC/ BPHY301UD SC/ BBOT301UD SC		3	0	3	30	70	100
3	DISCIPLIN E SPECIFIC COURSE (DSC)	BMAT302U DSC/ BPHY302UD SC/ BBOT302UD SC		3	0	3	30	70	100
4	DISCIPLIN E SPECIFIC COURSE (DSC)	BCHE301UD SC	Inorganic and Organic Chemistry	3	0	3	30	70	100
5	DISCIPLIN E SPECIFIC COURSE (DSC)	BCHE302UD SC	Physical Chemistry	3	0	3	30	70	100
6	PRACTICA L COURSE (PRA)	BMAT301UP RA/ BPHY301UP RA/ BBOT301UP RA	Maths Practical/ Physics Practical/ Botany Practical	0	6	3	0	100	100
7	PRACTICA L COURSE (PRA)	BCHE301UP RA	Chemistry Practical	0	6	3	0	100	100
8	SUBJECT ELECTIVE	BCHE301US E	Environmen tal Pollution	2	0	2	15	35	50
9	ELECTIVE GENERIC	B301UEG	Elective Generic: Personality Development	2	0	2	0	50	50
TOTAL				18	12	24	165	635	800

B.Sc. Sem - IV

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	FOUNDATION COMPULSORY	B401FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMAT401UD SC/ BPHY401UD SC/ BBOT401UD SC		3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMAT402UD SC/ BPHY402UD SC/ BBOT402UD SC		3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE401UD SC	Inorganic and Organic Chemistry	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE402UD SC	Physical Chemistry and Spectroscopy	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BMAT401UP RA/ BPHY401UP RA/ BBOT401UP RA	Maths Practical/ Physics Practical/ Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BCHE401UP RA	Chemistry Practical	0	6	3	0	100	100
8	SUBJECT ELECTIVE	BCHE401USE	Green Chemistry	2	0	2	15	35	50
9	ELECTIVE GENERIC	B401EG	Elective Generic: Human Rights	2	0	2	0	50	50
TOTAL				18	12	24	165	635	800

B.Sc. Sem - V

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	FOUNDATION COMPULSORY	B501FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE501U DSC	Inorganic Chemistry	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE502DSC	Organic Chemistry	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE503DSC	Physical Chemistry	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE504DSC	Analytical Chemistry	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BCHE501PRA	Chemistry Practical	0	12	6	0	200	200
7	SUBJECT ELECTIVE	BCHE501SE	Synthetic dyes/ Pharmaceutical chemistry	2	0	2	15	35	50
8	ELECTIVE GENERIC	B501EG	Elective Generic: Environment and Sustainable Development	2	0	2	0	50	50
TOTAL				18	12	24	165	635	800

B.Sc. Sem - VI									
Sr No .	Course Type	Course Code	Corse Name	Lectu re (hrs.)	Practic al (hrs.)	Credi ts	Examination		Total Mar ks
							Intern al	Extern al	
1	FOUNDATI ON COMPULSO RY	B601FC	Foundatio n Compulso ry - English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE601UD SC	Inorganic Chemistry	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE602DS C	Organic Chemistry	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE603DS C	Physical Chemistry	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE604DS C	Analytical Chemistry	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BCHE601PR A	Chemistry Practical	0	12	6	0	200	200
7	SUBJECT ELECTIVE	BCHE601SE	Polymer Chemistry / Food additives	2	0	2	15	35	50
8	ELECTIVE GENERIC	B601EG	Elective Generic: Stress Managem ent	2	0	2	0	50	50
TOTAL				18	12	24	165	635	800

B.SC. SEM-I

SUBJECT CODE: BCHE101UDSC

SUBJECT NAME: INORGANIC- ORGANIC CHEMISTRY & VOLUMETRIC ANALYSIS

Course Objective:

- The objective of the course to impart fundamental knowledge about some selected aspects of chemistry. The topics include inorganic chemistry & physical chemistry as well as Chemical bonding, mechanism of organic reaction; physical chemistry and some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The students will learn the important analytical and instrumental tools used for practicing chemistry.
CO2	To develop interest among students in various branches of inorganic chemistry.
CO3	To impart students a broad outline of the methodology of science in general and Chemistry in particular.
CO4	To impart essential theoretical knowledge on atomic structure, periodic properties and chemical bonding.
CO5	To develop skills for quantitative estimation using the different branches of volumetric Analysis

Unit	Content	Hrs.	Weightage
	<u>Inorganic Chemistry</u>	15	30 %
	Chemical Bonding		

1	Valence bond theory and its limitations, Directional characteristics of Covalent bond, Various types of Hybridization and Shape of Simple Inorganic Molecules V.S.E.P.R.- Theory for NH ₃ & H ₂ O, M.O. Theory –Energy level diagram for homo nucleus diatomic molecules (N ₂ &O ₂) and hetero-nucleus diatomic molecules (CO & NO), Metallic bond: Free electron, valence bond and band theories.		
2	<u>Organic Chemistry</u>	10	15%
	Structure and Bonding		
2	Intramolecular forces (dipol-dipol interaction, vander waal's forces), Electromeric effect, Inductive effect, Resonance effect, Hyper conjugation (o, p-directing effect of Alkyl group, Stability of Carbonium ion and Free radicals), Hybridization, bond lengths and bond angles, bond energy, Localized and delocalized chemical bonds.		
3	Mechanism of Organic Reaction	15	30%
3	Fission of Covalent bond (With at least one example of each intermediates), Types of Reagents, Types of organic Reaction with Mechanism, Elimination Reaction (E ₁ &E ₂).		
4	<u>Volumetric Analysis</u>	15	25%
	Principle, Mechanism and Applications of...		
	Acid-Base titrations		
	Redox titrations		
	Complexometric titrations		
	Precipitation Titrations.		

Reference Books:

- UGC Inorganic Chemistry - H. C. Khera (Pragati Prakashan).
- Concise of Inorganic Chemistry - J. D. Lee.
- Advanced Inorganic Chemistry- Cotton and Wilkinson.
- Organic Reaction Mechanism, including Reaction Intermediates, V. K. Ahluwalia, Ane's

Chemistry active series.

- Undergraduate Organic Chemistry, volume-1, Jagdambasingh, L.D.S.Yadav, Pragati Prakashan, 8th edition-2013.
- Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.

Suggested Readings:

- Principles of Physical Chemistry: B. R. Puri and L. R. Sharma.
- A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand.

Online Resources:

- <https://www.makerspaces.com/organicchemistr-structure/>
- <https://www.analyticalchemistry-tutorials.ws/>
- https://www.inorganic-notes.com/articles/basic_concepts/

Lab Experiments:

1. Organic Chemistry

- Identification of an organic compound through the functional group analysis, Determination of melting point and boiling point, Preparation of suitable derivative.
- Candidate should perform the analysis of at least 10 compounds.

List of compounds

- **Acids:**
Benzoic acid, Cinnamic acid, Phthalic acid, Oxalic acid, Succinic acid.
- **Phenols:**
 α -Naphthol, β -Naphthol.
- **Bases:**
P-Toludine, Diphenylamine, Aniline, Methyl aniline.
- **Neutrals:**

Naphthalene, Anthracene, Acetamide, Benzamide, Acetanilide, m-Dinitrobenzene, Urea, Thiourea, Toluene, Acetone, Benzaldehyde, Methyl acetate, Ethyl acetate, Chloroform, Carbon tetrachloride, Chlorobenzene, Nitrobenzene.

2. Volumetric Titrations

- To determine the strength of NaOH and Na₂CO₃ present in the solution mixture of NaOH & Na₂CO₃ and to find out their percentage composition.
 - To determine the strength of NaHCO₃ and Na₂CO₃ present in the solution mixture of NaHCO₃ & Na₂CO₃ and to find out their percentage composition.
 - To determine the Normality, gm/liter and molarities of H₂C₂O₄.2H₂O and H₂SO₄ present in the solution mixture of H₂C₂O₄.2H₂O & H₂SO₄ by using X N NaOH and Y N KMnO₄ solutions.
 - To determine the Normality, gm/liter and molarity of H₂C₂O₄.2H₂O and K₂C₂O₄ present in the solution mixture of H₂C₂O₄.2H₂O & K₂C₂O₄ by using X N NaOH and Y N KMnO₄ solutions.
 - To determine the amount of Ca⁺² and Mg⁺² ion by EDTA solution from the mixture solution of CaCl₂ and MgCl₂.
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3. Demonstrations

- Melting point and Boiling point of an organic compound.
- Calibration of burette and Pipette.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	1	2	2
CO2	3	1	2	-	1	-	-	-	-	2	2
CO3	3	2	1	-	1	-	-	-	1	2	2
CO4	3	1	2	-	1	-	-	-	-	2	2
CO5	3	2	2	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE101USE

SUBJECT NAME: AGRICULTURAL CHEMISTRY

Course Objective:

- To develop the ability to correlate the fundamental knowledge about some selected aspects of fertilizer and insecticide
- To acquire expertise in Agricultural Chemistry in handling of fertilizer and insecticide.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of Agriculture, farms, Educational Institutes etc as Junior Scientist, Assistant Professor, Content Developer, and Researcher etc.
CO2	Student will be able to relate different kind of Nutrients and Insecticide for standard their uses. They will be able to explain various types of Nutrients and Insecticide.
CO3	Develop basic communication skills through working in groups.
CO4	Apply the various procedures and techniques for the experiments.

Unit	FERTILIZERS	Hrs.	Weightage
I	Plant Nutrients, Major Nutrients, Minor Nutrients, Trace Nutrients • Definition of Fertilizer • Classification of Fertilizer	15	50%

	<ul style="list-style-type: none"> • Synthesis of N Containing Fertilizer i.e. $(\text{NH}_4)_2\text{SO}_4$, $\text{Ca}(\text{CN})_2$, and Urea • Synthesis of P Containing Fertilizer i.e. Super Phosphate, Triple Super Phosphate • Mix Fertilizer 		
II	INSECTICIDE	15	50 %
	<ul style="list-style-type: none"> • Introduction • Inorganic Insecticide • Organic Insecticide • Natural or Plant Insecticide • Synthesis of DDT, BHC, Malathion. 		

Reference Books:

- Industrial Chemistry by B.K.Sharma.
- A course in Nutrients and Insecticide by A.K. Sawhney, Puneet Sawhney

Suggested Readings:

- A course in fertilizers by J.B. Gupta
- Insecticide and fertilizers by David A bell

Online Resources:

- <https://www.makerspaces.com/insecticide/>
- <https://www.fertilizers-tutorials.ws/>
- https://www.fertilizers-notes.com/articles/basic_concepts/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	1	-	2	-	-	1	2	2	2
CO2	3	1	1	-	2	-	-	1	2	2	2
CO3	2	-	-	2	2	-	-	1	2	-	-
CO4	3	1	1	-	2	-	-	1	2	2	2

B.SC. SEM-II

SUBJECT CODE: BCHE201UDSC

SUBJECT NAME: INORGANIC, ORGANIC & PHYSICAL CHEMISTRY

Course Objective:

- The objective of the course to impart fundamental knowledge about some selected aspects of chemistry. The topics include inorganic chemistry & physical chemistry as well as stereo chemistry, mechanism of organic reaction; physical chemistry and some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of chemical bonding and structure of various chemicals. They will be able to explain various bonding of a various groups.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	Apply the various procedures and techniques for the experiments.
CO4	To make students capable of understanding and studying nomenclature, classification of organic compounds and reactions.

Unit	Content	Hrs.	Weightage
I	Inorganic Chemistry	15	25 %
	A. F- Block elements Lanthanide's electronic Configuration, Oxidation state, Lanthanide Contraction, Effects of Lanthanide Contraction, Separation method: (a). Solvent extraction method (b). Ion exchange method. B. Noble Gases Chemical properties of Noble gases, Chemistry of Xenon, Structure and Bonding in Xenon Compounds.		
II	Organic Chemistry	15	25 %
	Stereo Chemistry A. Optical isomerism: - General, Discussion of elements of symmetry, Molecular Chirality, Enantiomers, Optical activity, Properties of enantiomers, Chiral and Achiral molecules with two stereo genic centers, Diastereomers, Threo and Erythro diastereomers, Meso Compounds. B. Geometrical isomerism: - Definition and general discussion of geometric isomers, General methods of structure determination (physical methods), E-Z systems of nomenclature (Simple illustration Should be given). C. Conformational isomerism: - Conformational analysis of ethane and n- butane, Conformations of cyclohexane, axial and equatorial bonds, Newmann projection and sawhorse formulae, Fischer & Flying wedge formulae. Difference between configuration and conformation.		
III	Aromatic Hydrocarbons	15	

	Aromaticity: Criteria for aromatic, non-aromatic and anti-aromatic types, applications of Huckel's rule to simple annulene, cyclic carbocation/anion, Electrophilic aromatic substitution reactions of benzene with Mechanism, Theory of effect of substituents on reactivity and orientation (with resonating structures for activating and deactivating groups), Electrophilic aromatic substitution reactions of the followings With mechanisms: Halogenation, nitration, sulphonation, Friedel Crafts alkylation, Friedel Crafts acylation.		25 %
IV	Physical Chemistry	15	25 %
	Thermodynamics Thermodynamics terms, 1st law of thermodynamics, Heat capacity, work done of ideal gases under isothermal & adiabatic condition for reversible process, 2nd law of thermodynamics, carnot cycle and its efficiency, Entropy, Numerical. Chemical Kinetics Rate of reaction, Order of reaction, Molecularity, Rate equation for second order reaction. ($a=b$) & ($a \neq b$), Characteristics of second order reaction, Rate equation for third order reaction, Characteristics of third order reaction, Numerical.		

Reference Books:

- Advanced Inorganic Chemistry, Vol I & II. Satya Prakash, G.D. Tuli, S.K. Basu and R.D. Madan.
- Inorganic Chemistry', D.F. Shriver, P.W. Atkins, 3rd Edition, Oxford, 1999.
- Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall
- Organic Chemistry, (Volume I, II & III. S. M. Mukherji, S. P. Singh and R. P. Kapoor.
- Physical Chemistry by R.A. Albert and R.J. Silby, John Wiley 1995.
- Advance Physical Chemistry by Gurdeep raj.

Suggested Readings:

- Advanced Inorganic Chemistry - Raymond Chang
- Inorganic Chemistry - P. L. Soni.
- Co-ordination Chemistry – Banerjee
- Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
- Principles of Physical Chemistry, Samuel H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
- Chemical Kinetics, G. R. Chatwal and Harish Mishra, Goel Publication House. Meerut.

Online Resources:

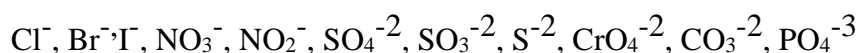
- <https://www.makerspaces.com/organicchemistr-structure/>
- <https://www.analyticalchemistry-tutorials.ws/>
- https://www.inorganic-notes.com/articles/basic_concepts/

Lab Experiments:

1. Inorganic Chemistry

➤ **Semi microanalysis:**

- Cation analysis; separation and identification of ions from group I, II, III-A, III-B, IV, V-A, V-B.
- Anion analysis like



(Water Soluble and insoluble).

- Candidate should perform the analysis of at least 10 compounds.

2. Standardization

- Preparation of standard solution of succinic acid and standardization of NaOH/KOH solution.
- Preparation of standard solution of $\text{Na}_2\text{S}_2\text{O}_3$ and standardization of I_2 solution.
- Preparation of standard solution of EDTA and estimation of $\text{Ca}^{+2}/\text{Mg}^{+2}$ in $\text{CaCl}_2/\text{MgCl}_2$ solution.
- Preparation of standard solution of Oxalic acid and standardization of KMnO_4 solution.
- Preparation of standard solution of $\text{K}_2\text{Cr}_2\text{O}_7$ and standardization of FeSO_4 solution.

3. Demonstrations

- Preparation of standard stock solution by w/v method and their different dilutions.
- Preparation of standard stock solution of HCl by v/v method and their different dilutions.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	-	2	2
CO2	3	1	1	2	1	-	-	1	-	-	-
CO3	3	2	1	-	1	-	-	1	-	2	2
CO4	3	2	1	-	1	-	-	1	-	2	2

Subject Code: BCHE201USE

Subject Name: MEDICINAL CHEMISTRY

Course Objective:

- To develop the ability to correlate the fundamental knowledge about some selected aspects of drugs and anti-malarial drugs.
- To acquire expertise in drugs in handling of medical system.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of medical, pharmacy sector, Educational Institutes etc., As Junior Scientist, Assistant Professor, and a Researcher etc.
CO2	Student will be able to relate different kind of drugs for standard their uses. They will be able to explain various types of anti-malarial drugs
CO3	Develop basic communication skills through working in groups
CO4	Apply the various procedures and techniques for the experiments

Unit	Content	Credit	Weightage
I	Introduction of Drugs, History of medicinal chemistry, Classification of drugs, General importance of drugs, Drug design.	1	50%
II	Anti-Malarial Drugs Introduction and History, Life cycle of Plasmodium, Natural anti-malarial drugs: Role of activity side in quinine structure, Classification of anti-malarial drugs, Synthesis of Quinoline derivatives: 8- Amino Quinoline derivatives (Plasmoquine & Pamaquine)	1	50 %

Reference Books:

- Anti malarial drugs by B.K.Sharma.
- Berger's Medicinal Chemistry (Volume.1-8), VII edition – J Abraham, Wiley

Suggested Readings:

- Medicinal Chemistry – Ashutosh Kar, New Age International Publishers.
- Medicinal Chemistry-An Introduction – G.Thomas, John Wiley.

Online Resources:

1. <https://www.makerspaces.com/insecticide/>
2. <https://www.drugs-tutorials.ws/>
3. https://www.Anti-malarial-drugs-notes.com/articles/basic_concepts/

CO-PO & CO-PSO Mapping

	Program Outcomes/ Program Specific Outcomes
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Course Outcomes	(1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	1	-	1	2	2
CO2	3	2	1	-	1	-	-	-	1	2	2
CO3	3	2	-	2	1	-	-	-	1	-	-
CO4	3	2	1	-	1	-	-	-	1	2	2

B.SC. SEM-III

SUBJECT CODE: BCHE301UDSC

SUBJECT NAME: INORGANIC & ORGANIC CHEMISTRY

Course Objective:

- An advanced knowledge about the acid-base properties.
- An in-depth study of the coordination compounds.

Course Outcomes: At the end of the course, students shall be able to

CO1	To give the students a thorough knowledge of the different theories to explain the bonding in coordination compounds.
CO2	To improve the level of understanding of the chemistry of organometallic compounds, metal carbonyls and metal clusters
CO3	To give knowledge about some bioinorganic compounds.
CO4	To develop interest among students in various branches of inorganic chemistry.

Unit	Content	Hrs.	Weightage
1.	Acid-Base Properties	15	33%

	Proton acids-bases and Lewis's acids-bases, Arrhenius concept of Acids and Bases, Bronsted Lowery theory of acids and bases, pH of acids and bases, Factors effecting on acidity and basicity of compounds, Resonance effect (Drawing resonance structures and the conditions for resonance.), Inductive and electronic effects, Effect of hybridization, Steric effect, Effects by hydrogen bonding.		
2.	Co-ordination Compounds	15	33%
	Definition, Nomenclature of Complex, Werner's theory and its experimental verification, concept of Effective Atomic Numbers (E.A.N.) for Co-ordination Compounds, Limitations of Valence bond theory of transition metal Complexes, An Elementary idea of(C.F.T.) Crystal field splitting of d-orbital in Oh, Td and Square planar, Factors effecting to the Crystal field splitting, Application of common Complexes & chelates.		
3.	Amino acids & Peptides	15	34%
	Amino acids		
	Introduction, Classification and nomenclature, Dipolar ion structure and Isoelectric point, Synthesis of amino acids (Gabriel Phthalimide, Strecker, Fischer-Malonic ester), Reaction of amino acid.		
	Peptides		
	Geometry of peptide linkage, Synthesis of peptides (Bergmann Method, Sheehan Method), Determination of structure of peptide by terminal residue analysis.		

Reference Books:

- Quantum Chemistry by R.K. Prasad, Revised 3rd Edition, Page- 3, 5, 7, 34-37,41,65-68.
- Organic Chemistry by Morrison and Boyd. 4th Edition, Pearson Education-2003
- Advance Organic Chemistry by Arun Bahal and B.S. Bahal.

Suggested Readings:

- Concise Inorganic Chemistry J.D. Lee, 4th Edition, ELBS publication.
- Organic Chemistry by pine, Hendrickson, Cram and Hammond 4th Edition by P.S. Kalsi.
- Organic Chemistry Vol. I & II by S.M. Mukherjee, S.P. Singh, R.P. Kapoor.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

Organic Chemistry

Separation of Organic Mixture.

(Any 7 out of 10)

Mixture Containing Two Compounds (Only Water Insoluble Solid Compounds taken)

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	2
CO3	3	2	1	-	1	-	-	-	1	2	2
CO4	3	2	1	-	-	-	-	-	1	2	2
CO5	3	2	1	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE302UDSC

SUBJECT NAME: PHYSICAL CHEMISTRY

Course Objective:

- An advanced knowledge about the wave mechanics.
- An in-depth study of the free particle system.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the basic postulates of quantum mechanics.
CO2	Learn the measurement of viscosity by Ostwald-viscometer.
CO3	Understand the concept of nuclear particle
CO4	To understand the general characteristics of different states of matter.

Unit	Content	Hrs.	Weightage
1.	Wave Mechanics	15	33%
	Black Body Radiation & Quantum Theory, Basic postulates of quantum Mechanics, Photo electric effect: Wave particle duality of radiation, Compton effect, Free particle system, Particle in one-dimension box, Operator: Definition, Algebra of operators, Addition, Multiplication, Commutative properties, Linear operator, Commutator operators, Laplacian operator.		
2.	Nuclear Chemistry	15	33%
	Concept of Nuclear particle, Definition of Isotopes, Isotones, Isobars, Isomers, Packing fraction, Nuclear binding energy, Nuclear coulomb barrier, Rate of ratio active disintegration, half-life period, Average life period, Rutherford's law (Group transfer law), Numerical.		
3.	The Vacancy Theory of Liquid	15	34%
	Vapor-Pressure, Dipole moment and its measurements & its application, Numerical, Surface tension:(1) Measurement of surface tension by stalagmometer. (2) Perachor and its applications, Measurement of viscosity by Ostwald-viscometer, Measurement of Optical activity by Polarimeter, Refractive index: - (1) Specific refraction (2) Molar refraction (3) Measurement of Refractive index by Abbe's Refractometer.		

Reference Books :

- Advance Physical Chemistry by Gurdeep Raj
- Physical Chemistry (Question and Answers) by R.D. Madan, G.D. Tully, S. Chand.
- Principal of Physical Chemistry by Puri, Sharma, Pathania.
- Chemical Thermodynamics by R.P. Rastogi and R.R. Mishra.

Suggested Readings:

- Essentials of Physical Chemistry by B.S. Bahal, Arun Bahal, G.D. Tully.
- Physical Chemistry by P.W. Atkins, 5th Edition, Oxford, 1994, 7th Edition, 2002

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

Physical Chemistry

(Any 7 out of 10)

- 1) Conductometric titration: - HCl / CH₃COOH Vs NaOH
- 2) Conductometric titration: - HCl Vs NH₄OH
- 3) pH- metric titration: -
 - i. Calibration of pH - meter by 4 - pH buffer
 - ii. HCl Vs NaOH
- 4) Determine the Dissociation constant of the acid of mixtures CH₃COONa and CH₃COOH by determine the pH.
- 5) Determine the specific refraction and molar refraction of the given liquid A, B and mixture C (A+B) and calculate the percentage composition of A and B in the mixture C by Abbe's Refractometer.
- 6) Determine the molar refraction CH₃COOC₂H₅, CH₃COOC₃H₇ and CH₃COOC₄H₉ and show the constancy of reaction equivalent of -CH₂- Group by Abbe's Refractometer.
- 7) To determine the viscosity of a different mixture of liquid A and B and determine the percentage composition of unknown mixture by graphical method.
- 8) To determine the surface tension and compare cleaning-efficiency of two samples of a detergent or soap with stalagmometer.
- 9) To study kinetic reaction of decomposition of H₂O₂ catalysis by iodine ion (Clock reaction).
- 10) Find the solubility and heat of solution of the given organic acid at two different temperatures.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	2
CO3	3	2	1	-	1	-	-	-	1	2	2
CO4	3	2	1	-	-	-	-	-	1	2	2

SUBJECT CODE: BCHE301USE

SUBJECT NAME: ENVIRONMENTAL POLLUTION

Course Objective:

- To develop the ability to correlate the fundamental knowledge about Air and Water Pollution and Soil and Noise Pollution.
- To acquire expertise in pollution control about handling of pollution.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of various pollution control board as Junior Scientist and Researcher etc.
CO2	Student will be able to relate different kind of pollution controls
CO3	Develop basic communication skills through working in groups
CO4	Apply the various procedures and techniques for the experiments

Unit	Content	Credit	Weightage
I	Air and Water Pollution	1	50%
	Introduction Classification of pollutant, Types of pollution, Air pollution Source of air pollution, Acid Rain, Emissions of major industrial air pollutant, Water pollution, Types of Water pollution: Physical & Chemicals, Biological and Physiological, Source of Water Pollution.		
II	Soil and Noise Pollution	1	50 %
	Soil pollution, Sources of soil pollution, Effect of Modern Agro-technology on Soil, Noise Pollution, Thermal Pollution, Radio Active Pollution, Prevention of pollution.		

Reference Books:

- Industrial Chemistry by B.K. Sharma.
- Air Pollution H. V. N. Rao and M. N. Rao, TMH, Pub.

Suggested Readings:

- Environmental Engineering Davis, McGraw Hill- Pub.
- Environmental Engineering Peavy and Rowe, McGraw Hill- Pub.

Online Resources:

- <https://www.makerspaces.com/environmentpollution-air-water/>
- <https://www.environmentpollution-tutorials.ws/>
- https://www.environmentpollution-notes.com/articles/basic_concepts/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	1	-	1	2	2
CO2	3	2	-	-	1	-	-	-	-	2	2

CO3	3	2	-	2	1	-	-	-	1	-	-
CO4	3	2	1	-	1	-	-	-	1	2	2

B.SC. SEM-IV

SUBJECT CODE: BCHE401UDSC

SUBJECT NAME: INORGANIC & ORGANIC CHEMISTRY

Course Objective:

- A basic knowledge about the boron hydrides.
- An in-depth study of the coordination compounds.

Course Outcomes: At the end of the course, students shall be able to

CO1	To improve the level of understanding of the chemistry of organometallic compounds, metal carbonyls and metal clusters.
CO2	To give the students a thorough knowledge of the different theories to explain the bonding in coordination compounds.
CO3	To impart the students thorough idea in the chemistry of enzymes, amino acids, proteins and nucleic acids.
CO4	To study the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.

Unit	Content	Hrs.	Weightage
1.	Boron Hydride	15	33%
	Introduction and Classification of hydrides, Preparation, properties structure and use of Diborane, Bridge bonding in B ₂ H ₆ (M.O. and SP ³ approach), Structure of higher Borones: - B ₄ H ₁₀ , B ₅ H ₉ , B ₅ H ₁₁ , B ₆ H ₁₀ , B ₁₀ H ₁₄ .		
2.	Application of CFT	15	33%
	Application of C.F.T. 1) For determination of colour of complex. 2) Use of C.F.S.E.value		
	Limitation of C.F.T, Isomerism in complexes		
	Magnetic properties of Co-ordination Compound		

	Type of magnetic behavior, Method of determining magnetic susceptibility, Spin only formula, Magnetic properties for 3 rd metal complexes, Gouy Method.		
3.	Heterocyclic Compound	15	34%
	Introduction, Nomenclature, Molecular orbital picture and aromatic characteristics of Pyrrole, Furan, Thiophene and Pyridine, Methods of synthesis for Pyrrole, Furan, Thiophene and Pyridine, Chemical reactions for Pyrrole, Furan and Thiophene, Electrophilic and Nucleophilic substitution reactions of pyridine, Basicity of Pyridine, Piperidine and pyrrole.		
	Carbohydrates		
	Introduction, Definition, Classification of Mono Saccharides, Nomenclature, Reactions of Glucose and Fructose (Methylation, Acetylation, Oxidation with Br ₂ water and Conc.HNO ₃ , Reaction with HCN, NH ₄ OH, Osazone formation and Epimerization.), Lengthening of carbon chain of aldoses, Shortening of carbon chain of aldoses.		

Reference Books:

- Concise Inorganic Chemistry J.D. Lee, 4th Edition, ELBS publication
- Organic Chemistry by Morrison and Boyd. 4th Edition, Pearson Education-2003
- Advance Organic Chemistry by Arun Bahal and B.S. Bahal.

Suggested Readings:

- Organic Chemistry by pine, Hendrickson, Cram and Hammond 4th Edition by P.S. Kalsi.
- Organic Chemistry Vol. I & II by S.M. Mukherjee, S.P. Singh, R.P. Kapoor.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

Inorganic Chemistry:

Inorganic qualitative analysis:

(Any 7 Mixture out of 10)

Mixture Containing 4 Radicals

(Except PO₄⁻³, BO₃⁻³, ASO₄⁻³, ASO₃⁻³, O⁻²)

CO-PO & CO-PSO Mapping

	Program Outcomes/ Program Specific Outcomes
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Course Outcomes	(1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2
CO4	3	2	1	-	-	-	-	-	1	2	2

SUBJECT CODE: BCHE402UDSC

SUBJECT NAME: PHYSICAL CHEMISTRY & SPECTROSCOPY

Course Objective:

- An advanced knowledge about the Ultraviolet Spectroscopy.
- An in-depth study of the different types of electrodes.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the electro chemistry.
CO2	Learn the types of conductometric titrations and to understand the concept of chromophore and auxochrome
CO3	To impart a thorough knowledge of the fundamentals of microwave, infra-red, Raman, electronic, NMR, and ESR spectroscopy.
CO4	To impart the students' concepts of the fundamentals of quantum mechanics and its applications in the study of structure of atoms, bonding in molecules and molecular spectroscopy

Reference Books :

- Physical Chemistry by R.A. Alberty and R.J. Silbey, John Wiley, 1995.
- Physical Chemistry by G.H. Barrow, 5th edition, Mac Graw Hill, 1998, 6th edition.
- Principal of Physical Chemistry by Puri, Sharma, Pathania.

Suggested Readings:

- Essentials of Physical Chemistry by B.S. Bahal, Arun Bahal, G.D. Tully.
- Physical Chemistry by W.J. Moore, 4th edition, Orient Longmans, 1969.

➤ Chemical Thermodynamics by R.P. Rastogi and R.R. Mishra.

Online Resources:

Unit	Content	Hrs.	Weightage
1.	Electro Chemistry	15	33%
	<p>Introduction of terms, Oxidation, Reduction, Redox, Anode, Cathode, Electrode, Half Cell, Oxidation & Reduction Potential, Electrochemical cell (Galvanic Cell) & Representation cell, Electrochemical Series and its Significance, Nernst Equation of Cell EMF and single electrode potential, Numerical.</p> <p>Describe the Electrode:</p> <ol style="list-style-type: none"> 1) Metal-Metal ion Electrode. 2) Standard Hydrogen Electrode. 3) Calomel Electrode. 4) Weston standard Electrode. 5) Glass Electrode. 6) Quinhydrone Electrode <p>Application of cell potential:</p> <ol style="list-style-type: none"> 1) Equilibrium constant. 2) Free energy. 		
2.	IONIC EQUILIBRIUM	15	33%
	<p>Only Introduction, Electrolysis, Ionic Equilibrium, Resistance, Conductance, Specific conductance, Equivalent Conductance, Molar Conductance, Equivalent Conductance at Infinite Dilution.</p> <p>Type of Conductometric Titration: - Acid-Base titration:</p> <ol style="list-style-type: none"> 1. Strong Acid Vs Strong Base. 2. Strong Acid Vs Weak Base 3. Weak Acid Vs Strong Base 4. Weak Acid Vs Weak Base 5. Strong Acid + Weak Acid Vs Strong Base <p>Transport number. Determination of Transport Number.</p> <ol style="list-style-type: none"> 1) Hittorf's Method. 2) Moving Boundary Method <p>Hydrolysis of Salt. Classification of Salt.</p> <ol style="list-style-type: none"> 1) Strong Acid & Strong Base. 2) Strong Acid & Weak Base. 		
	Ultraviolet Spectroscopy		

3.	Type of electronic transitions, Effect of conjugation, Woodward – fisher rules, Concept of Chromophore and Auxochrome, Bathochromic, Hypsochromic, Hyperchromic, and Hypochromic shifts, Problems of conjugated enes, enones and aromatic ketones, aldehydes, acids and esters using empirical rules, numericals based on λ_{max} .	15	34%
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- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

Analytical Chemistry:

Volumetric Analysis of Cu, Zn, Ni (Any Three)

- To determine the amount of Zn by EDTA Method.
- To determine the amount of Ni by EDTA Method.
- To determine the amount of Cu by Iodometry Method.
- To determine the amount of Cu by EDTA titration.

Estimation of Glucose/Aniline/Phenol (Any Two)

- To determine the amount of Aniline by Brominating Method.
- To determine the amount of Phenol by Brominating Method.
- To determine the amount of Glucose by oxidation Method.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2
CO4	3	2	1	-	-	-	-	-	1	2	2

SUBJECT CODE: BCHE401USE

SUBJECT NAME: GREEN CHEMISTRY

Course Objective:

- To develop the ability to correlate the fundamental knowledge about some selected aspects of Green Chemistry.
- To acquire expertise in Green Chemistry in handling of environmental protection.

CO1	3	2	1	-	1	-	-	-	2	2	2
CO2	3	2	1	-	-	-	-	-	2	2	2
CO3	3	-	-	2	1	-	-	-	-	1	1
CO4	3	2	1	-	-	-	-	-	2	2	2

B.SC. SEM-V

SUBJECT CODE: BCHE501UDSC

SUBJECT NAME: INORGANIC CHEMISTRY

Course Objective:

- The course notably contains an extensive knowledge of transition metal complexes, particularly aimed at catalysis.
- The objective of this experiment is to measure the corrosion rate of two different metals and to show the effectiveness of the use of inhibitors to protect metals from corrosion.
- The course aims to provide the students with a thorough understanding of the relationship between the structures, chemical bonds and chemical properties in organometallic chemistry.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

Course Outcomes: At the end of the course, students shall be able to

CO1	Organometallic Chemistry is used extensively in the modern world, from the construction of polymers, plastics, and petrol, to electronic circuitry and solar panel construction, to advances in medicine such as immunization inoculations and chemotherapy.
CO2	Student after learning this course can seek employment in areas of Metallurgy Firms, Hospitals, Educational Institutes etc as Junior Scientist, Assistant Professor, Content Developer, Process Engineer, Site Engineer, and Researcher etc.
CO3	Candidates also hold the opportunity to explore the industrial, pharmaceutical, technological and commercial fields of chemistry as the course.

Unit	Content	Credit	Weightage
I	Reaction Mechanism of Transition Metal Complexes	4	40 %

	Substitution reaction of square planar complexes, Reaction of Platinum II complexes, the trans effect, theories of trans effect, use of synthesis in trans effect and analysis, Substitution reaction in Octahedral complexes, Possible mechanism reactions, Ligand displacement reaction in Octahedral complexes, Acid hydrolysis, Base hydrolysis, Electron transfer reaction, mechanism of redox reaction, mechanism of substitution in square planar complexes		
II	Organometallic Compounds		
	Definition, Types of Organometallic Compounds, Classification, Nomenclature of O.M.C., Structure and bonding in dihapto and metal policies complexes; e.g. Zeise's salt complexes, ferrocene structure, O.M.C. of Li and Al complexes	4	30 %
III	Corrosion		
	Principle of Corrosion, Types of Corrosion: Wet corrosion, Galvanic corrosion, Atmospheric corrosion, Pitting corrosion, Inner granual corrosion, Dezincification, Prevention of Corrosion: Inhibitors- Definition, type and use of inhibitors	4	30 %

Reference Books :

- Inorganic Chemistry by S. Chand.
- Advance Inorganic Chemistry by Satya Prakash Volume-II (S.Chand).
- Concise Inorganic Chemistry by J.D.Lee.
- Metallic Corrosion by M.N. Desai

Suggested Readings:

- Principles of Inorganic Chemistry, Puri, Sharma & Kalia
- Advance Inorganic Chemistry by J.E. Huhee.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

- **Inorganic Chemistry**

(A) Alloy

- 1) Brass alloy ----- Zn (Gravimetric) and Cu (Volumetric)
- 2) German silver alloy -----Ni (Gravimetric) and Cu (Volumetric)
- 3) Bronze alloy -----Sn (Gravimetric) and Cu (Volumetric)

(B) Synthesis by Convention Method

- 1) Ferrous Sulphate or Green vitriol ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)
- 2) Sodium cobaltinitrate $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$
- 3) Tetra amine cupric sulphate
- 4) Hexa thiourea plumbous nitrate
- 5) Cuprous chloride

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2

SUBJECT CODE: BCHE502UDSC

SUBJECT NAME: ORGANIC CHEMISTRY

Course Objective:

- To understand the structure, stereochemistry and reaction pathways of organic molecules.
- Get a basic idea about the nature of bonding in organic molecules and the role of structures in interpreting organic reactions.

Course Outcomes: At the end of the course, students shall be able to

CO1	This course gives the student idea about the Nucleophilic Substitution.
CO2	This is related to saturated carbon atom.

Unit	Content	Hrs.	Weightage
1	Nucleophilic Substitution at saturated carbon atom	17	40%
	The reaction mechanism, stereochemistry of Nucleophilic substitution, Scope of Nucleophilic substitution, Stereochemistry of SN ¹ and SN ² reaction, Relative reactivity in substitution, Solvent effect variation at carbon site, Relative leaving group activity, Neighbouring group participation, Competitive reactions: Elimination E ₁ , E ₂ and E _{1CB} mechanisms.		
2	A. Carbohydrates	14	30%
	Introduction of Disaccharides, Structure determination of (i) Sucrose (ii) Maltose.		
	B. Isoprenoids		
	Classification, General methods of structure determination, Isoprene rule, Constitution of Citral and α- Terpineol and their synthesis.		
3	Stereochemistry	14	30%
	Conformational analysis of mono and di-substituted cyclohexanes, Molecular symmetry as illustrated by allenes and diphenyls, Isomerism of oximes, Determination of geometrical isomerism of Aldoxime, Determination of geometrical isomerism of Ketoxime (Beckmann's transformation)		
CO3	It has a broad decryption about Sucrose and Maltose.		
CO4	This course gives the student brief information about Isoprenoids.		
CO5	In the Stereochemistry students know about Conformational analysis of some organic compounds.		

Reference Books:

- Organic Chemistry by Morrison & Boyd Vth Edition.
- Synthetic Organic Chemistry by Jerry March.
- Organic Chemistry by I.L. Finar Vol. I & II, Vth Edition.
- Synthetic Organic Chemistry by Gurdeep Chatwal.
- Organic reactions and their mechanisms 2nd Edition by P.S. Kalsi.
- Stereochemistry: Confirmation and mechanism VIth edition by P.S. Kalsi.

- Advanced Organic Chemistry by Bahal & Bahal.

Suggested Readings:

- Organic spectroscopy by V.R. Dani. Stereochemistry by Nasipuri.
- Organic Chemistry of natural product Volume I & II by Gurdeep Chatwal.
- Organic Chemistry Volume I & II by S.M. Mukherjee & S.P. Singh.

Online Resources:

- [https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26605%3A_Organic_Chemistry_II_\(Lipton\)/Chapter_10._Nucleophilic_Substitution/10.1%3A_An_Overview_of_Nucleophilic_Substitution](https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26605%3A_Organic_Chemistry_II_(Lipton)/Chapter_10._Nucleophilic_Substitution/10.1%3A_An_Overview_of_Nucleophilic_Substitution)
- <https://courses.lumenlearning.com/wm-biology1/chapter/reading-types-of-carbohydrates/>
- <https://www.britannica.com/science/isoprenoid>
- <https://www.khanacademy.org/science/organic-chemistry/stereochemistry-topic>

Lab Experiments:

- **Organic Chemistry**

Qualitative Analysis (Minimum 08)

Analysis of an organic mixture containing two components using water, NaHCO₃,

NaOH, HCl for Separation /or using distillation process for separation and identification with the Preparation of Suitable derivatives.

Soluble Components: - Oxalic Acid, Succinic Acid, Resorcinol, Urea, Thiourea

Separation of two components from Organic Mixture Such as...

Solid-Solid -----Mixture

Solid- Liquid -----Mixture

Liquid-Liquid ----- Mixture

[Liquid component must be neutral in nature]

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2
CO5	3	2	1	-	-	-	-	-	1	2	1

SUBJECT CODE: BCHE503UDSC
SUBJECT NAME: PHYSICAL CHEMISTRY

Course Objective:

- An advanced knowledge about the Electro Motive Force (E.M.F.)
- An in-depth study of the statistical mechanics, chemistry of macromolecules and adsorption processes on solid surfaces

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the fundamentals of statistical thermodynamics.
CO2	Learn the polymerization reaction with examples.
CO3	Understand the Chemical Cell: Without Transference with Transference.
CO4	Study the physical chemistry of macromolecules.

Unit	Content	Hrs.	Weightage
1	Electro Motive Force (E.M.F.)	14	30%
	Chemical Cell: Without Transference with Transference Verification of Concentration cell and its EMF equation, Electrolyte concentration cell, Concentration cell without Transference Cell, Concentration with transference cell. Electrode concentration cell, Amalgam Concentration, Gas Concentration Cell, Liquid-Liquid junction Potential application of EMF measurements, Degree of hydrolysis of Salt, Solubility of sparingly soluble salt, Stability constant of complex, Dissociation constant of weak acid.		
	Numerical		
2	Statistical thermodynamics	15	30%
	Introduction, combination and permutation, probability, sterling approximate formula, Types of statistics: Maxwell-Boltzman, Bose-Einstein Statistics, Fermi-Direct statistics, Partition Function, translational, vibrational & rotational partition functions.		
	Numerical		
	Macromolecules	16	40%

3	Classification of polymers, Tactility of polymers, polymerization reaction with example, Addition polymerization (Polyethylene, Polystyrene, PVC) Condensation Polymerization (Nylon-66, Dacron), Mechanism of polymerization, - (i) Free radical chain polymerization, (ii) Anionic polymerization, (iii) Cationic polymerization, Kinetics of free radical chain polymerization, Degree of Polymerization, Molar mass of polymer, Number Average Molar Mass, Weight average Molar Mass, Determination of molar mass of Macro molecules, Viscosity Method, Light Scattering method.		
	Numerical		

Reference Books :

- Principal of Physical Chemistry by Puri, Sharma & Pathania.
- Physical Chemistry by Atkins.
- Advance Physical Chemistry by Gurdeep Raj.
- Chemical Thermodynamics by R.P. Rastogi & R.R. Mishra.
- Physical Chemistry (Question and Answer) by R.N. Madan, G.D. Tuli & S.Chand.

Suggested Readings:

- Physical Chemistry by W.J. Moore, 4th edition, Orient Longmans 1969.
- Essentials of Physical Chemistry by B.S. Bahal, Arun Bahal & G.D. Tuli.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

- **Physical Chemistry**

[A] Instruments: (Minimum 05)

- 1) To determine normality and amount of HCl and CH₃COOH in the given solution by Conductometric titration against 0.2N (exact) NaOH solution.
- 2) To determine the solubility product and solubility of sparingly soluble salts PbSO₄ by Conductometry.
- 3) To determine Normality and amount of each acid in the given mixture of HCl + CH₃COOH by pH metrically.
- 4) To determine the strength of strong and weak acid in a given mixture by Potentiometric titration using 0.1 N NaOH.
- 5) To determine the concentration of Nickel in the given solution by Colorimetric estimation.

6) To determine the concentration of unknown solution from given KMnO_4 solution by Colorimetric.

[B] Kinetics & Distributions: (Minimum 03)

- 6) To determine the order of the reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI.
- 7) To determine the order of the reaction between H_2O_2 and HI.
- 8) To determine the distribution coefficient of Iodine between $\text{CCl}_4/\text{CHCl}_3$ and water at a given temperature.
- 9) To study the distribution of Benzoic acid between Benzene and water at room temperature and prove the dimerization of Benzoic acid in Benzene.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE504UDSC

SUBJECT NAME: ANALYTICAL CHEMISTRY

Course Objective:

- To develop the ability to correlate the fundamental knowledge about some selected aspects of Analytical Chemistry.
- To acquire expertise in Analytical Chemistry in handling of spectroscopy, Symmetry of molecules and acid base titration.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of Agriculture, farms, Educational Institutes etc. as Junior Scientist, Assistant Professor, Content Developer, and Researcher etc.
CO2	The student will be able to relate different kind of spectroscopy studies and symmetry classification of various chemicals. They will be able to explain acid-base titration of a various groups.
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	¹H NMR Spectroscopy	1	33%
	Introduction, Principle of NMR spectroscopy, Equivalent & Non-equivalent proton, Shielding & De-shielding, Chemical Shift & Molecular Structure, Spin-Spin Splitting & Coupling constant, Application of NMR, Interpretation of organic molecules i.e. Examples, Toluene, Ethanol, Acetone, Ethyl bromide, Methoxy benzene, Phenitol, etc.		
II	Symmetry of molecules	1	34 %
	Symmetry elements & symmetry operations, Multiplications of symmetry operations, Multiplication table for C _{2v} , C _{3v} , C _{2h} point groups only, Classification of schoenflies point groups, Symmetry & Optical activity, Symmetry property of orbital's for , C _{3v} , C _{2h} point groups.		
III	Acid- Base titration	1	33 %
	Construction of titration curves, Feasibility of titration of poly protic acid, Analysis of acid & base mixture, Differential titration of alkalis, Gran's plot, Buffers, Buffer level, Buffer range & Buffer capacity.		

Reference Books:

- Chemical application of group theory by F.A. Cotton.
- Application of group theory to chemistry by Bhattacharya.
- Advance inorganic chemistry by Cotton & Wilkinson.
- Basic Principles of spectroscopy by R.Chand.
- Spectroscopy organic compounds VIth edition by P.S. Kalsi.
- Organic Chemistry by Morrison & Boyd.

Suggested Readings:

- Symmetry in chemistry by Jafle & Orchin.
- Analytical Chemistry by G.D. Christian.

- Principles of Analytical Chemistry by J.H. Kennedy.
- Organic spectroscopy by V.R. Dani.

Online Resources:

- <https://www.makerspaces.com/organicchemistr-sprectroscopy/>
- <https://www.symmetry-tutorials.ws/>
- https://www.acid base titration.com/articles/basic_concepts

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	1	1	-	-	-	1	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE501USE
SUBJECT NAME: SYNTHETIC DYES

Course Objective:

- An advanced knowledge about synthetic dyes
- An in-depth study of Classification of Dyes- According to Constitution and method of colouring the fibres.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the Dyes & its Classification
CO2	Learn the difference between Dyes and Pigments
CO3	Understand the Chromospheres and Chromogens
CO4	Study the dye Synthesis & it's uses

Unit	Content	Hrs.	Weightage
1	Introduction of Dyes & its Classification	15	50%
	Introduction, Chromospheres, Chromogens, Oxochromes, Bathochromic Shift, Hypsochromic Shift, Difference between Dyes and Pigments, Classification of Dyes- According to Constitution and method of colouring the fibres, Optical Brighteners.		
2	Dye Synthesis & it's uses	15	50%
	Congo red, Eosin, Alizarin, crystal Violet, Indigo, Sefronine-T, Methylene Blue, Eriochrome Black-T, Rhodamine, Rosanilin.		

Reference Books :

- Synthetic Dyes by Venkatramanan.
- Synthetic Dyes by G.R. Chatwal.
- Synthetic Dyes and Drugs by O.P. Agrawal.

Suggested Readings:

- Synthetic Dyes by O.D. Tyagi & M.Yadav.
- Sanshleshit Rangako, Granth Nirman Board.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	1	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

B.SC. SEM-VI

SUBJECT CODE: BCHE601UDSC

SUBJECT NAME: INORGANIC CHEMISTRY

Course Objective:

- The course aims to provide the students with a thorough understanding of the relationship between the structures, chemical bonds and chemical properties in organometallic chemistry.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

Course Outcomes: At the end of the course, students shall be able to

CO1	To develop interest among students in various branches of inorganic chemistry.
CO2	To impart essential theoretical knowledge on atomic structure, periodic properties and chemical bonding.
CO3	This will give the students a basic understanding of nuclear chemistry, Bioinorganic Compounds.
CO4	This paper also gives elementary ideas on metal complexes.

Unit	Content	Hrs.	Weightage
1.	Metal Carbonyl	16	40%
	Introduction, Classification: Mononuclear and Polynuclear, Physical and Chemical properties, Metal Carbonyl (M-CO) bonding (On the basis of V.B.T. and M.O.T), Use of IR Spectra to determination of Structure of metal carbonyl, Structure of Metal carbonyl: Ni(CO) ₄ , Fe(CO) ₅ , Cr(CO) ₆ , Fe ₂ (CO) ₉ , CO ₂ (CO) ₈ , Mn ₂ (CO) ₁₀ , Fe ₃ (CO) ₁₂ , Calculation of EAN of metal atom in metal carbonyl, Classification of metal nitrosyl.		
2.	Bio –Inorganic Chemistry		30%

	Introduction, Essential elements, Trace elements, Metal Porphyrine, Study of haemoglobin and myoglobin, Nitrogen fixation: in Vivo and in Vitro.	14	
3.	Valency Variation method, Secular equation, Stability of H ₂ ⁺ ion, M.O. Approach, stability of H ₂ molecule, V.B. approach, Classical interaction energy, Representation of wave function for SP, SP ² and SP ³ hybrid orbitals, Bond angle and Bond strength, M.O. treatment of Oh molecules, Quantum mechanical representation of Pauli's exclusion principle.	15	30%

Reference Books :

- Inorganic Chemistry by S. Chand.
- Advance Inorganic Chemistry by Satya Prakash Volume-II (S.Chand).
- Concise Inorganic Chemistry by J.D.Lee.
- Metallic Corrosion by M.N. Desai

Suggested Readings:

- Principles of Inorganic Chemistry, Puri, Sharma & Kalia
- Advance Inorganic Chemistry by J.E. Huhee.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

• **Inorganic Chemistry**

Qualitative analysis (Minimum 8) Inorganic mixture should be comprised of six radicals. Candidate if required should be guided once for the wrong group and marks deducted for wrong group. Maximum of five marks can be deducted for wrong group. There shall be no deduction of marks for reporting wrong radicals.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	-	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

Subject Code: BCHE602UDSC
Subject Name: ORGANIC CHEMISTRY

Course Objective:

- To understand the reaction mechanism of various process.
- Get a basic idea about the nature of bonding in organic molecules and the role of structures in interpreting organic reactions.

Course Outcomes: At the end of the course, students shall be able to

CO1	To study the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.
CO2	To impart the student's thorough idea in the chemistry of enzymes, amino acids, proteins and nucleic acids.
CO3	To have an elementary idea of supramolecular chemistry.
CO4	Identification of organic compounds using spectroscopy.

Unit	Content	Hrs.	Weightage
1.	Electrophillic and free radical addition reaction	17	40%
	Addition to carbon carbon double bond, Markovnikov's rule, Electrophillic addition Orientation, Reactivity, Rearrangement, Dimerization, Alkylation, Peroxide effect (Anti Markovnikov's rule), Free radical addition, mechanism of peroxide initiated addition of HBr, Syn and anti addition mechanism for addition of halogens, Electrophillic addition to conjugated dienes (1:2 v/s 1:4 addition), Free radical addition to conjugated dienes, reactivity.		

2.	Active methylene group compounds	14	30%
	Introduction of Tautomerism, Determination of keto-enol tautomerism, Differences between Tautomerism and resonance, Synthesis and application of Ethyl aceto acetate and malonic ester.		
3.	Nucleophilic aromatic substitutions	14	30%
	Nucleophilic aromatic substitution [Bimolecular displacement (SN ²) mechanism], Elimination-Addition mechanism via Benzyne, Stability and properties of Benzyne, Evidences of Benzyne intermediate.		

Reference Books:

- Organic Chemistry by Morrison & Boyd Vth Edition.
- Synthetic Organic Chemistry by Jerry March.
- Organic Chemistry by I.L. Finar Vol. I & II, Vth Edition.
- Synthetic Organic Chemistry by Gurdeep Chatwal.
- Organic reactions and their mechanisms 2nd Edition by P.S. Kalsi.
- Stereochemistry: Confirmation and mechanism VIth edition by P.S. Kalsi.
- Advanced Organic Chemistry by Bahal & Bahal.

Suggested Readings:

- Organic spectroscopy by V.R. Dani. Stereochemistry by Nasipuri.
- Organic Chemistry of natural product Volume I & II by Gurdeep Chatwal.
- Organic Chemistry Volume I & II by S.M. Mukherjee & S.P. Singh.

Online Resources:

- [https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26605%3A_Organic_Chemistry_II_\(Lipton\)/Chapter_10._Nucleophilic_Substitution/10.1%3A_An_Overview_of_Nucleophilic_Substitution](https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26605%3A_Organic_Chemistry_II_(Lipton)/Chapter_10._Nucleophilic_Substitution/10.1%3A_An_Overview_of_Nucleophilic_Substitution)
- <https://courses.lumenlearning.com/wm-biology1/chapter/reading-types-of-carbohydrates/>
- <https://www.britannica.com/science/isoprenoid>
- <https://www.khanacademy.org/science/organic-chemistry/stereochemistry-topic>

Lab Experiments:

- **Organic Chemistry**

(A) Estimation of functional groups: (Minimum 03)

- 1) Estimation of Ester
- 2) Estimation of Amide

- 3) Estimation of Ascorbic acid
- 4) Estimation of Aspirin

(B) Synthesis of Organic Compounds (Minimum 05)

- 1) Preparation of m-Dinitro benzene from Nitrobenzene
- 2) Preparation of p-Nitro acetanilide from Acetanilide
- 3) Preparation of Acetanilide from Aniline
- 4) Preparation of Aspirin from Salicylic acid
- 5) Preparation of Di-benzal acetone from Benzaldehyde
- 6) Preparation of 2, 4, 6-Tribromo aniline from Aniline [Liquid component must be neutral in nature.]

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	-	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE603UDSC
SUBJECT NAME: PHYSICAL CHEMISTRY

Course Objective:

1. An advanced knowledge about the thermodynamics.
2. An in-depth study of third law of thermodynamics.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the thermal and photochemical reactions and its difference, absorption.
CO2	Learn the Nernst heat theorem.
CO3	Understand the Concept of activation energy.
CO4	To derive some thermochemical equations and kinetic equations. To study phase diagrams and elementary idea of catalysis.

Unit	Content	Hrs.	Weightage
1	Thermodynamics	13	30%
	Zeroth Law of thermodynamics, Nernst heat theorem, Third law of thermodynamics, Determination of absolute entropy, Experimental verification of third law, Entropy change in chemical reactions, Concept of Fugacity and determination of graphical method.		
	Numerical		
2	Photochemistry	17	30%
	Introduction of Photochemistry, Thermal and Photochemical reactions and its difference, Absorption, The Law of Absorption, Lambert-Beer Law, Laws of Photochemistry- (i) Grotthuss-Draper Law (ii) Stark-Einstein Law, Quantum Yield or Quantum Efficiency, Reason of High and Low quantum yield, Types of Photochemical Reaction- (i) Photosensitized reaction (ii) Photochemical Equilibrium, Qualitative Description of Fluorescence, Phosphorescence and Chemiluminescence, Flash Photolysis.		
	Numerical		
3	Chemical Kinetics	15	40%
	Arrhenius Equation, Concept of Activation energy, Theories of reaction rate- (i) Collision theory (ii) Transition state theory, Comparison of Collision and transition state theory, Theories of Unimolecular reaction, Lindemann's theory, Trimolecular reaction, Trautz's law, Primary and Secondary salt effect.		
	Numerical		

Reference Books :

- Principal of Physical Chemistry by Puri, Sharma & Pathania.

- Physical Chemistry by Atkins.
- Advance Physical Chemistry by Gurdeep Raj.
- Chemical Thermodynamics by R.P. Rastogi & R.R. Mishra.
- Physical Chemistry (Question and Answer) by R.N. Madan, G.D. Tuli & S.Chand.

Suggested Readings:

- Physical Chemistry by W.J. Moore, 4th edition, Orient Longmans 1969.
- Essentials of Physical Chemistry by B.S. Bahal, Arun Bahal & G.D. Tuli.

Online Resources:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- <https://nptel.ac.in/courses>

Lab Experiments:

- **Physical Chemistry**

(A) [Instruments]: (Minimum 05)

- 1) To determine concentration of the given Iodide solution by Potentiometric titration against 0.1N KMnO₄ solution.
- 2) To determine formal redox potential of Fe⁺²/Fe⁺³ by Potentiometry.
- 3) To determine the concentration of the nitrite in the given solution by Colorimetric estimation method.
- 4) To determine the concentration of unknown solution from given K₂Cr₂O₇ by Colorimetric.
- 5) To determine the Solubility product and solubility of sparingly soluble salt of BaSO₄ by Conductometry.
- 6) To determine the strength of strong and weak base in a given mixture using a pH meter.

(B) Kinetics, Adsorption & Polymer (Minimum 03)

- 7) To study the reaction between KBrO₃ and KI at two different temperature and calculate the temperature coefficient and the energy of activation.
- 8) To study the absorption of Acetic Acid on Charcoal and prove the validity of Freundlich equation.
- 9) To determination of molecular weight of high polymer (i.e. polystyrene) by Viscosity measurement.
- 10) To study the rate constant of the reaction between K₂S₂O₈ and KI and study the influence of ionic strength on the rate constant.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1

CO3	3	2	1	-	1	-	-	-	-	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2

SUBJECT CODE: BCHE604UDSC

SUBJECT NAME: ANALYTICAL CHEMISTRY

Course Objective:

- To develop the ability to correlate the fundamental knowledge about some selected aspects of Analytical Chemistry.
- To acquire expertise in Analytical Chemistry in handling of spectroscopy, Symmetry of molecules and acid base titration.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of Agriculture, farms, Educational Institutes etc. as Junior Scientist, Assistant Professor, and Researcher etc.
CO2	The student will be able to relate different kind of spectroscopy studies and symmetry classification of various chemicals. They will be able to explain acid-base titration of a various groups
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	IR Spectra & Numerical based on UV, IR and NMR Spectra	1	33%
	A) Infrared spectroscopy Molecular vibrations (Fundamental vibrations of AX ₂ type molecules), Characteristics of IR spectroscopy, Sample techniques, Fingerprint zone, Effect of IR in geometrical isomerism, IR spectra & H-bonding, Factor affecting on >C=O group frequencies, Differentiate two compounds by the IR frequencies. (B) Problems pertaining to the structure elucidation of organic Compounds using UV, IR & NMR spectroscopic techniques (one out of two)		
II	Chromatography	1	34 %

	Introduction, Type of Chromatography, Paper Chromatography, Thin-layer Chromatography, Ion Exchange Chromatography, Van-der Waals equation, Examples, HPLC Principle, Application of Chromatography.		
III	Term Symbol & Spectra of d¹-d⁹ Octahedral Complexes	1	33 %
	(A) Term Symbol L-S Coupling, J-J Coupling, Determination of ground state term by Hund's rules, Determination of term symbol for all state for p ² & d ² configuration by pigeon hole diagram. (B) Spectra of d¹ & d⁹ octahedral complexes Selection rules & intensities transitions, Oral diagram for d ¹ -d ⁹ , d ² -d ⁸ , d ³ -d ⁷ , d ⁴ -d ⁶ octahedral & tetrahedral complexes explanation of d ¹ & d ⁹ spectra (only introduction- no application)		

Reference Books:

- Chemical application of group theory by F.A. Cotton.
- Application of group theory to chemistry by Bhattacharya.
- Symmetry in chemistry by Jafle & Orchin.
- Principles of Analytical Chemistry by J.H. Kennedy.

Suggested Readings:

- Advance inorganic chemistry by Cotton & Wilkinson.
- Basic Principles of spectroscopy by R.Chand.
- Spectroscopy organic compounds VIth edition by P.S. Kalsi.
- 7) Organic Chemistry by Morrison & Boyd.
- Application of absorption spectroscopy of organic compounds by John R. Dyer.
- Spectrometric Identification of organic compounds IVth edition by Silverstein, Bassler & Morrill.

Online Resources:

- <https://www.makerspaces.com/organicchemistr-spectroscopy/>
- <https://www.symmetry-tutorials.ws/>
- https://www.acid base titration.com/articles/basic_concepts

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	2	2
CO2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	-	1	2

CO4	3	2	1	-	1	-	-	-	1	2	2
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SUBJECT CODE: BCHE601USE
SUBJECT NAME: POLYMER CHEMISTRY

Course Objective:

- An advanced knowledge about the polymers
- An in-depth study of Mechanism and Kinetics of free radical, Cationic and Anionic Polymerization

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the Polymerization techniques
CO2	Learn the Mechanism and Kinetics of polycondensation
CO3	Understand the Concept of Averages
CO4	Study the theories of Polydispersity and molecular weight distribution

Unit	Content	Hrs.	Weightage
1	Polymers - I	15	50%
	Introduction, Classification of polymers, Chain growth of polymerization- Introduction, Mechanism and Kinetics of free radical, Cationic and Anionic Polymerization, Mechanism and Kinetics of polycondensation.		
2	Polymers - II	15	50%
	Polymerization techniques, Molecular weight and Degree of Polymerization, Concept of Averages- (i) Number average molecular weight, (ii) Weight average molecular weight, (iii) Viscosity average molecular weight, Polydispersity and molecular weight distribution, Membrane Osmometry, Viscometry and Light Scattering.		

Reference Books :

1. Principles of polymers science by P. Bahadur and N. V. Sastry. (2nd Edition)
2. Polymer science by V.R. Gowariker, N.V. vashwanathan and Jaydev Shreedhar.

Suggested Readings:

1. Advanced Polymer Chemistry: A Problem Solving Guide by Manas Chanda
2. Fundamentals of Polymer Science by Paul C. Painter

Online Resources:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
2. <https://nptel.ac.in/courses>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	1	2	1
CO3	3	2	1	-	1	-	-	-	-	1	2
CO4	3	2	1	-	1	-	-	-	1	2	2



COURSE STRUCTURE

**Bachelor of Science
Microbiology**

**Under
Choice Based Credit System (CBCS)**

DEPARTMENT OF MICROBIOLOGY

Bachelor of Science Program outcomes (PO)

PO No.	Program Outcome Description
PO1	Foundational Knowledge: Graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical Skills: Students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical Thinking: Graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective Communication: Students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and Teamwork: Graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information Literacy: Students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical Awareness: Graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong Learning: Students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal Impact: Graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.

B.Sc. Microbiology:

PSO No.	Program Specific Outcome Description
PSO1	Microbiological Proficiency: Graduates of the B.Sc. Microbiology program will acquire in-depth knowledge of microorganisms, their structure, physiology, and genetics. They will demonstrate proficiency in microbiological techniques, including isolation, identification, and characterization of microorganisms.
PSO2	Applied Microbiology and Research Skills: Graduates will apply their knowledge of microbiology to solve practical problems in various sectors such as healthcare, agriculture, and environmental management. They will possess research skills to investigate microbial processes, conduct experiments, and analyze and interpret microbial data.

B.Sc Semester I Teaching scheme with credit

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B101FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC101UDSC	Introduction to Microbial world	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT101UDSC	Botany	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE101UDSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT101UPRA	Botany practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC101UPRA	Microbiology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE101UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BMIC101USE	Subject Elective: Application of Microbiology	2	0	2	15	35	50
9	Elective Generic	B101EG	Elective Generic: Communication Skills	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650

B.Sc Semester II Teaching scheme with credit

Sr No	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		TOTAL MARKS
							Internal	External	
1	Foundation Compulsory	B201FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT201 UDSC	Biomolecules and Cell Biology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC201 UDSC	Systematic Bacteriology	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE201 UDSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT201 UPRA	Botany Practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC201 UPRA	Microbiology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE201 UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BMIC201 USE	Subject Elective:History of microbiology	2	0	2	15	35	50
9	Elective Generic	B201UEG	Elective Generic: Disaster Management	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650

B.Sc Semester III Teaching scheme with credit

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B301FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT301UDSC	Mycology and Phytopathology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT302UDSC	Archegoniate	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC301UDSC	Microbial physiology and metabolism	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC302UDSC	Soil and water Microbiology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT301UPRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC301PRA	Microbiology practical	0	6	3	0	100	100
8	Subject Elective	BMIC301SE	Microbial analysis of air and water	2	0	2	15	35	50
9	Elective Generic	B301UEG	Elective Generic: Personality Development	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B.Sc Semester IV Teaching scheme with credit

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B401FC	Foundation Compulsory - English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT401UDSC	Anatomy of Angiosperms	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT402UDSC	Economic Botany	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC401UDSC	Microbial biodiversity	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC402UDSC	Food and dairy microbiology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT401UPRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC401PRA	Microbiology practical	0	6	3	0	100	100
8	Subject Elective	BMIC401SE	Food fermentation Techniques	2	0	2	15	35	50
9	Elective Generic	B401EG	Elective Generic: Human Rights	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B.Sc Semester V Teaching scheme with credit

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		TOTAL MARKS
							Internal	External	
1	Foundation Compulsory	B501FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC501UDSC	Molecular Biology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC502UDSC	Immunology	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC503UDSC	Classical genetics	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC504UDSC	Gene transfer Techniques	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BMIC501UPRA	Practical Module I	0	6	3	0	100	100
		BMIC502UPRA	Practical Module II	0	6	3	0	100	100
8	Subject Elective	BMIC501USE	Hematology and blood banking	2	0	2	15	35	50
9	Elective Generic	B501EG	Environment and Sustainable Development	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

B.Sc Semester VI Teaching scheme with credit

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		TOTAL MARKS
							Internal	External	
1	Foundation Compulsory	B601FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC601UDSC	Medical Microbiology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC602UDSC	R-DNA technology	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC603UDSC	Industrial Microbiology	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC604UDSC	Bioprocess Technology	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BMIC601UPRA	Practical Module 1	0	6	3	0	100	100
		BMIC602UPRA	Practical Module 2	0	6	3	0	100	100
8	Subject Elective	BMIC601USE	Instrumentation and Biotechniques	2	0	2	15	35	50
9	Elective Generic	B601EG	Stress Management	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800

Subject Code: BMIC101UDSC

Semester: I

Subject Name: Introduction to Microbial World

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
4	0	02	Mid	CE		
						20

Course Objective:

- To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
- To complement the students with the basic knowledge about history of microbiology with contribution of scientists and spontaneous generation and microbiology with society and modern biology.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in microscopy and their handling techniques and staining procedure.
CO2	Know Various characteristics of microorganisms and also understand various physical and chemical means of sterilization.
CO3	Students will gain knowledge about all microscopy methods as well as microbial control's methods.
CO4	Students will gain knowledge about contribution of scientists and microbiology with society and modern biology.

Content

Credit – 04

Unit	Description in detail	Credit	Weightage
I	Microbiology as a field of Biology. .Where exact Microorganisms in living world Haeckel's Three Kingdom and Whittaker's Five kingdom classification, Prokaryotic and Eukaryotic classification.Group of microorganisms (Acellular and Cellular microorganisms)	1	25%
II	.Spontaneous generation Versus biogenesis, Germ theory of disease Development of various microbiological techniques and contribution of Anton von leeuwenhoek, Louis Pasture, Robert Koch, Josheph Lister, Alexander Fleming,Seleman A. Waksman, Sergei N. Winogradsky, Paul ...Ehrlich, Edward Jenner, Elie Metchnikoff .Microbiology and Morden biology .Microbiology and society	1	25%
III	Characteristics of Microorganisms: Morphology, Chemical, Cultural, Metabolic, Antigenic, Genetic, Phylogenetic and Ecological. .Microbial Classification	1	25%

	.Microbial Nomenclature .Microbial Identification		
IV	Microscopy: Bright field microscopy, Dark field microscopy, Phase contact Microscopy , Fluorescence microscopy, Transmission electron microscopy, Scanning electron microscopy. Microbial control: A) Physical method: Moist heat, dry heat, Tyndalization, Filtration, and Radiation.B) Chemical method	1	25%

Reference Books:

1. Prescott's Microbiology by Joanne Willey and Linda Sherwood
2. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martin ko
3. Microbiology: A Systems Approach by Marjorie Kelly Cowan
4. Foundation in Microbiology by Kathleen Park Talaro and Barry Chess
5. Microbiology by Pelczar, Jr., Michael
6. Microbiology by Jacquelyn G. Black
7. .A textbook of microbiology by Dubey R.C. and Maheshwari D.K

Suggested Readings:

- Molecular Biology of the Cell
- Essential Cell Biology
- Cell biology by Thomas D. Pollard
- Karp's Cell Biology

Online Resources:

1. www.shomusbiology.com
2. <https://www.slideshare.net>
3. [Cell and Cell Structure](#)

BMIC101UPRA – Microbiology Practical

Credit: 02

Practical

1. Microbiology Good laboratory practices and biosafety.
 2. To study the principle and application of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, microscope, pH meter) used in microbiology laboratory.
 3. Preparation of culture media for bacterial cultivation.
 4. Sterilization of medium using Autoclave and assessment for sterility.
 5. Sterilization of glassware using Hot Air Oven and assessment for sterility.
 6. Sterilization of heat sensitive material by membrane filtration and assessment for
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sterility.

7. Demonstration of the presence of microflora in the environment by exposing nutrientagar plates to air.
8. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts.
9. Study of Spirogyra and Chlamydomonas, Volvox using temporary mounts.
10. Study of the following protozoans using permanent mounts/photograph:
Amoeba, Paramecium and plasmodium.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	1	-	2	1	-	3	-	3	2
CO2	2	2	1	-	2	1	-	3	-	2	1
CO3	2	3	1	-	2	1	-	2	-	3	1
CO4	3	-	1	2	2	1	2	2	2	2	1

Subject Code: BMIC101USE
Subject Name: Application of Microbiology

Semester: I
Faculty Name/s: Saniya Molapiya

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
02	0	00	Mid	CE		
			10	05	35	50

Course Objective:

- To Study various applications of microbiology in various field.
- To complement the students with the basic knowledge about Recombinant DNA technology, Genetic Engineering, Bioleaching, Production of Enzymes, antibiotics etc.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about application of microbiology in medicines, dairy and food industries, agriculture, Pharmaceutical industries.
CO2	Students will gain knowledge about Recombinant DNA, Vector, Plasmids, Fermentative production of Penicillin, Amylase, and Bioremediation.

Content

CREDIT: 02

Unit	Description in detail	Credit	Weightage
I	Applied areas of Microbiology-1 1.1 Applications of Microbiology in the field of agriculture. 1.2 Application of Microbiology in the field of medicines. 1.3 Applications of Microbiology in the field of Dairy and Food Industries.	1	50%
II	Applied areas of Microbiology-2 2.1 Biotechnology, Recombinant DNA Technology & Genetic Engineering, Ecology & Environment, Pollution Control & Bioremediation. 2.2 Bioleaching, Aeromicrobiology & Exomicrobiology Pharmaceutical Microbiology, Veterinary Microbiology 2.3 Fermentation Industries (Production of Antibiotics, Organic Acids, Enzymes & Other Specialty Biochemicals).	1	50%

Reference Books:

- Microbiology by M.J.Pelczar, ECS Chan & NR Krieg
- Principles of Microbiology by R.M. Atlas
- Microbiology by Prescott, Harley & Klein
- Elementary Microbiology Vol.-1 by H.A.Modi
- Textbook of Microbiology by R.C.Dubey & D.K.Maheshwari

Suggested Readings:

1. Microbiology An introduction by Gerard J. Tortora, Berdella R. Fumke and Christine L. Case
2. Food Microbiology by Martin R Adams, Maurice O Moss, Peter McClure
3. Molecular biotechnology by Bernard R. Glick, Cheryl L. Patten

Online Resources:

1. www.shomusbiology.com
2. <https://www.slideshare.net>

Practical / Activities:

1. Fermentative production of Penicillin.
2. Fermentative Production of Amylase.
3. Fermentative Production of Organic acid.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	1	2	-	-	1	-	1	-	2	2	2
CO2	3	2	2	-	2	2	-	2	1	1	3

Subject Code: BMIC201UDSC

Semester: II

Subject Name: Systematic Bacteriology

Faculty Name/s: Vaishali Patel

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
04	0	02	20	10	70	100

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about bacterial cell size , shape, arrangement, detail structure of flagella, pilli, cell wall, cell membrane.
CO2	Students will gain knowledge about sexual and asexual bacterial reproduction, Bacterial Growth curve, Different type of culture media.
CO3	Demonstrate theory in laboratory and their handling techniques and staining procedure.

Content

CREDIT: 04

Unit	Description in detail	Credit	Weightage
I	Bacterial cell Organization 1.1 Bacterial cell size, Shape and Arrangement. 1.2 Composition and details structure of Flagella, Fimbriae and Pili, Capsule, Structure, function and chemical composition of bacterial and archaeal : Cell Wall and Cell Membrane 1.2 a Cytoplasm: Ribosome, Mesosomes, Inclusion Body, Nucleoid, Chromosome and Plasmid. 1.3 Spore: Structure, Formation, and Stage of sporulation.	1	25%
II	Bacterial Reproduction 2.1 Asexual methods of Reproduction 2.2 Logarithmic representation of bacterial population and phase of bacterial growth. 2.3 Calculation of time and specific growth rate 2.4 Factors affecting microbial growth.	1	25%
III	Microbial Nutrient 3.1 Bacterial nutrition requirement and categorization. 3.2 Introduction to culture media. 3.3 Different types of microbial culture media.	1	25%
IV	Pure Culture Isolation and Preservation 4.1 Introduction to term: Pure culture, Mix culture, Microbial strain, Microbial colony, 4.2 Selection of microbial Diversity from different source.	1	25%

<p>4.3 Laboratory techniques: Serial Dilution, Streak plate method, Spread plate method and Pour plate method. 4.4 Methods for Maintenance and Preservation of bacterial culture.</p>	
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Reference Books:

1. Prescott's Microbiology by Joanne Willey and Linda Sherwood
2. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martinkio
3. Microbiology: A system Approach by Marjorie Kelly Cowan
4. Foundations in Microbiology by Kathleen Park Talaro and Barry Chess
5. Microbiology by Pelczar, Jr., Michael
6. Microbiology by Jacquelyn G. Black
7. A Textbook of Microbiology by Dubey R.C. and Maheshwari D.K.

Suggested Readings:

1. An introduction to microbiology by M.G. Sequeira, K.K. Kapoor, K.S. Yadav and P. Tauro
2. Microbiology An Introduction, by Gerard J. Tortora, Berdell R. Funke and Christine L. Case
3. Hand book of Microbiology, by Prakash S. Bisen and Kavita Verma

Online Resources:

1. www.shomusbiology.com
2. <https://www.slideshare.net>

Practical / Activities:

1. Study of Growth curve of bacteria.
2. Cell wall staining
3. Isolation of pure culture of bacteria by Spread plate method
4. Isolation of pure culture of bacteria by Pour plate method

BMIC201UPRA- MICROBIOLOGY PRACTICAL

CREDIT: 02

Practical

1. Simple staining
2. Negative staining
3. Gram's staining
4. Acid fast staining- permanent slide only
5. Capsule staining
6. Endospore staining

7. Preparation of differential media
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Motility by hanging drop method.
11. Estimation of CFU count by spread plate method and pour plate method.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	2	3	1
CO2	1	-	-	-	2	1	-	-	1	2	1
CO3	3	2	-	-	1	2	-	3	2	3	2

Subject Code: BMIC201USE
Subject Name: History of Microbiology

Semester: II

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
02	0	00	10	05	35	50

Course Objective:

- (a) To complement the students with the basic knowledge about Invention of microscope, abiogenesis and biogenesis theory, contribution of various scientist.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student will gain knowledge about spontaneous generation, pasteurization, Vaccination, Lytic and lysogenic cycle of virus.
CO2	Students will gain knowledge about Germ theory of disease, pure culture technique, Penicillin.

Content

CREDIT: 02

Unit	Description in detail	Credit	Weightage
I	History of Microbiology-1 1.1 History & Invention of Microscope by Anton van LeeuwenHoek, Theory of Abiogenesis (Spontaneous Generation). 1.2 Scientists that helped in disproving the theory of spontaneous generation , Contributions of Louis Pasteur: Pasteurization, Vaccination & others. 1.3 Contributions of Robert Koch: Germ Theory of the Disease, Koch's Postulates, Discovery of Methods for Isolation & Pure Culture techniques.	1	50%
II	History of Microbiology-2 2.1 Discovery of Antibiotics: Alexander Fleming & Penicillin. 2.2 Role of Microorganisms as a causative agent of the disease. Microorganisms and Fertility of Soil. 2.3 Discovery of Viruses, Golden era of Microbiology.	1	50%

Reference Books:

1. Microbiology by M.J.Pelczar, ECS Chan & NR Krieg
2. Principles of Microbiology by R.M. Atlas
3. Microbiology by Prescott, Harley & Klein
4. Elementary Microbiology Vol.-1 by H. A. Modi
5. Textbook of Microbiology by R.C. Dubey & D.K. Maheshwari

Suggested Readings:

1. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martinkio
2. Microbiology An introduction by Gerard J. Tortora, Berdell R. Funke and Christine L. Case.

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

1. Pure culture technique.
2. To study the principle and application of microscope.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	1	-	-	2	2	-	-	1	2	1
CO2	3	2	2	-	1	2	-	3	1	2	1

Subject Code: BMIC301UDSC

Semester: III

**Subject Name: Microbial Physiology and
Metabolism**

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
03	0	01	Mid	CE		
						20

Course Objective:

- (a) To Understand the knowledge about Enzymes, co factors, apo enzyme, Microbial growth, Aerobic respiration and fermentation.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge of competitive, non-competitive inhibition of enzyme, Media formulation, Enzyme classification, Chemotherapy.
CO2	Students will also study EMP, TCA, Pentose Phosphate pathway, Alcohol fermentation, lactate fermentation, Importance of carbohydrates, proteins, lipids, nucleic acid.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	Enzymes 1.1 General introduction : Physical and chemical properties, Structure of enzymes: prosthetic group, apoenzyme, coenzyme, cofactors. 1.2 Localization of enzymes : Extra cellular and intra cellular, Nomenclature and classification of enzymes, IUB system of enzyme classification. 1.3 Enzyme action: active sites of enzyme, Mechanism of enzyme action. 1.4 Factors affecting enzyme activity, Inhibition of enzyme activity: Competitive and noncompetitive.	1	33.33%
II	Microbial nutrition and Growth 2.1 Nutritional categories of microorganisms: carbon, Energy and electron donor source. 2.2 Culture media: principles of media formulations. Types of media : Routine and specialized media, selective media, differential media, Enriched and Enrichment media, Assay media. 2.3 Methods of reproduction in bacteria and new cell formation. 2.4 Principles of chemotherapy and general mode of action of various chemotherapeutic agent: Sulphonamides, antibiotics and semi synthetic antibiotics.	1	33.33%

III	<p>Biomolecules and metabolism</p> <p>3.1 Biomolecules: Chemical structure, properties, classification, and biological significance of Carbohydrate, Proteins, lipid and nucleic acids. Introduction to modes of microbial metabolism: Anabolism, catabolism, primary and secondary metabolism.</p> <p>3.2 Concept of aerobic respiration, and fermentation sugar degradation pathways i.e. EMP, ED, pentose phosphate pathway, TCA cycle. Electron transport chain, Gluconeogenesis, cori cycle</p> <p>3.3 Anaerobic respiration: Anaerobic respiration with special reference to dissimilatory nitrate reduction, Anaerobic fermentation: Alcohol fermentation and Pasteur effect, Lactate fermentation.</p>	1	33.33%
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Reference Books:

1. Microbiology by Pelczar, Jr., Michael
2. General Microbiology stainer R.Y , ingram, Eheelies, M.L. painter, Mac Million India.
3. Introduction to microbiology, J.L, ingram and C.A. Ingram
4. Microbiology, J.G. Black, Edition 5th
5. Biochemistry by U.Satynarayan.

Suggested Readings:

1. Fundamentals of Biochemistry by Dr. J.L. Jian, Dr. Sanjay Jain, Nitin Jain.
2. Principle of Biochemistry by David L. Nelson, Michael M. Cox.

Online Resources:

1. <https://www.britannica.com>
2. www.shomusbiology.com
3. <https://www.slideshare.net>

Practical / Activities:

1. Preparation of Culture Media.
2. Fermentative production of Alcohol
3. fermentative production of Lactic acid.

BMIC301PRA- MICROBIOLOGY PRACTICAL

CREDIT: 03

PRACTICAL

(1). Qualitative analysis of biomolecules:

(A) Carbohydrates: Iodine test, Molisch's test, Benedict's test, Barfoed test, Bial's test and Saliwanoff's test.

(B) Proteins: Biurate test, Ehrlich's test, Glyoxilic acid test, Xanthoproteic test

(2). Determination of absorption maxima of a colored solution (use methylene blue).

(3). Study biochemical reaction of bacteria.

(A) Based on carbon source.

i. Oxidative and fermentative breakdown of glucose.

ii. Fermentation of sugars and sugar alcohol: glucose, xylose, mannitol, lactose, maltose and sucrose.

iii. Glucose breakdown product: Methyl red test.

iv. Citrate utilization test.

v. Starch utilization test.

vi. Lipid utilization test.

(B) Based on nitrogen source.

i. Indole production test.

ii. H₂S production test.

iii. Urea utilization test.

iv. Casein hydrolysis test.

v. Gelatin hydrolysis test.

vi. Deamination test.

(C) Other tests.

i. Catalase test.

ii. Dehydrogenase test.

iii. III. Oxidase test.

(4) Microbiological analysis of soil.

(A) Enumeration of organisms from soil (standard plate count-Soil).

(B) Isolation of symbiotic & non-symbiotic nitrogen fixing bacteria & actinomycetes from soil.

(5). Microbiological analysis of drinking water.

- (A) Standard plate count of drinking water.
- (B) Determination of MPN of coliforms in water
- (C) Detection of fecal pollution of water by performing presumptive test, confirmed test and completed test.

(6). Determination of DO from the water sample.

(7). Study of ingredient used in culture media: Agar, peptones, amino acids, antibiotics, beef extract, bile salt, blood, casein hydrolysate, water, dyes ,gelatin, inorganic salts, meat extract, yeast extract.

(8). Study of effect of antibiotics on bacteria :

Study of sensitivity spectrum of antibiotics against the test organism by use of paperdisc method and Agar ditch method.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	2	-	3	2	-	3	2	2	1
CO2	3	2	2	-	2	2	-	2	2	2	1

Subject Code: BMIC302UDSC
Subject Name: Soil and Water Microbiology

Semester: III

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- (a) To Study Physicochemical properties of soil, soil microflora, Biochemical transformation in soil, Bacteriological examination of drinking water, Types of waste water, Microbial interaction.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will study about role of microorganisms in soil, role of microorganisms in sulphur cycle, iron cycle, phosphorus cycle, nitrogen cycle.
CO2	Students will also learn about Quantitative & Qualitative analysis of drinking water, filtration, sedimentation, Primary and secondary waste water treatment procedure.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>MICROBIOLOGY OF SOIL</p> <p>1.1 Physicochemical properties of soil, soil as a culture medium</p> <p>1.2 Microbial flora of Soil, Role of microorganisms in soil: Mineralization and humus formation.</p> <p>1.3 Methods of studying soil micro flora: Direct microscopic method, agar plate technique, enrichment culture technique, and buried slide method, Molecular methods for study of Soil microorganism.</p> <p>1.4 Microbial interactions and associations in soil:(i) Neutral, Positive (Symbiosis, Mutualism, Syntrophism, Commensalism, Synergism) and Negative(Antagonism, Competition, Parasitism, Predation)associations, Interaction between plant roots and microorganisms: Rhizosphere and its significance (ii) Mycorrhiza.</p>	1	33.33%
II	<p>MICROORGANISM AS BIOGEOCHEMICAL AGENT</p> <p>2.1 Introduction to biogeochemical transformations in soil:Mineralization and immobilization of elements.</p> <p>2.2 Rotation of elements in nature, Nitrogen cycle: Proteolysis, ammonification, nitrification, denitrification and nitrogen fixation. Sulfur cycle: Sulfur oxidation and reduction, Carbon cycle, Degradation of complex organic compounds, carbon dioxide fixation</p> <p>2.3 Iron cycle: Iron oxidation and reduction. Phosphorus cycle:</p>	1	33.33%

	Mineralization, immobilization and solubilization of phosphorus 2.4 Soil fertility: Role of microorganisms in soil fertility, biofertilizers.		
III	<p>MICROBIOLOGY OF DRINKING WATER AND WASTEWATER</p> <p>3.1 Natural waters: Sources of contamination, Microbial indicators of faecal pollution: Coliforms as indicator Microbial indicators other than Coliforms. Nuisance organisms in water: Slime forming bacteria, iron and sulfur bacteria and algae</p> <p>3.2 Bacteriological examination of drinking water: Sampling, Quantitative analysis : Standard Plate Count. Qualitative analysis: Multiple tube fermentation .Purification of drinking water: Sedimentation, filtration and disinfection, softening of hard water, use of Reverse Osmosis process.</p> <p>3.3 Types of wastewater, chemical and microbiological BOD, COD and TOC as indicators of strength of wastewater. Methods of wastewater treatment: Primary treatment and secondary treatment. Principles and role of microorganisms trickling filters, activated sludge process, oxidation ponds.</p> <p>3.4 Efficiency of wastewater treatment procedures.</p>	1	33.33%

Reference Books:

1. Microbiology by Pelczar, Jr., Michael
2. Modi H A., (2013), Soil Microbiology, Aavishkar Publishers, Jaipur.
3. Atlas R M., (1997), Principles of Microbiology. 2nd ed. Wm. C. Brown Pub., Iowa, USA
4. Alexander M, (1977), Soil Microbiology, 2nd ed Krieger Publ. Co., Melbourne, FL.

Suggested Readings:

1. Soil microbiology 5th edition by Subba Rao N.S.
2. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martinkio

Online Resources:

1. <https://www.britannica.com>
2. www.shomusbiology.com
3. <https://www.slideshare.net>
4. <https://agriinfo.in>

Practical / Activities:

1. Determination of BOD, TOC, COD from the water sample.
2. Qualitative analysis of Drinking water by Multiple tube fermentation method.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	1	1	2	-	1	2	-	2	1	2	1
CO2	2	1	-	-	-	2	3	2	-	2	1

Subject Code: BMIC301SE

Semester: III

Subject Name: Microbial Analysis of Air and Water

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
02	0	00	10	05	35	50

Course Objective:

- (a) To complement the students with the basic knowledge about air sample collection and analysis, Water sample collection and quantitative and qualitative analysis of water.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in Laboratory for SPC, MPN, Membrane filter technique.
CO2	Students will gain knowledge about air born microorganisms impact on human health, its importance in pharma and food industries and inactivation mechanisms (UV light, desiccation etc), water born diseases.

Content

CREDIT: 02

Unit	Description in detail	Credit	Weightage
I	<p>Air microbiology</p> <p>1.1 Bioaerosols, air borne microorganisms and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens.</p> <p>1.2 Air sample collection and Analysis: Bioaerosol sampling, air samplers method of analysis CFU, culture media for bacteria and fungi.</p> <p>1.3 Fate of bioaerosols, inactivation mechanisms- UV light, HEPA filters, desiccation, incineration</p>	1	50%
II	<p>Water microbiology</p> <p>2.1 Water borne pathogens, water borne diseases.</p> <p>2.2 Microbial analysis of water: sample collection, treatment and safety of drinking water, methods to detect potability of water sample (a) standard qualitative procedure (b) Membrane filter techniques (c) presence/absence tests.</p> <p>2.3 Control measures: precipitation, chemical disinfection, filtration, high temperature, UV light.</p>	1	50%

Reference Books:

1. Da silva N, Taniwaki MH, Junquera VC, silveria N, Nascimento MS, Gomes RAR(2012) Microbiological examination methods of food and water.
2. Microbial Ecology, Atlas RM and Bartha R.
3. Environmental microbiology, Maier RM. Pepper IL and Gerba CP. (2009) 2nd edition

Suggested Readings:

1. Microbiology An Introduction, by Gerard J. Tortora, Berdell R. Funke and Christine L. Case
2. Brock Biology of Microorganisms, by Michael T. Madigan and John M. Martinkio

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

1. Detect potability of water sample by presence /absence test.
2. Detect potability of water sample by Membrane filter technique.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	-	-	2	1	1	2	1
CO2	3	1	1	-	2	2	-	3	2	1	2

Subject Code: BMIC401UDSC

Semester: IV

Subject Name: Microbial Biodiversity

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
03	0	01	Mid	CE		
						20

Course Objective:

- (a) To complement the students with the knowledge about Biodiversity of Microorganisms, Methods for Biodiversity assessment.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge of evolution and origin of biodiversity, Biochemical, Molecular, Genomic and metabolic cultural methods, Evolutionary tree.
CO2	Students will Study Physiological, metabolic, Morphological, Cellular and ecological diversity, Lichens.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>INTRODUCTION TO BIODIVERSITY & METHODS OF ASSESSING BIODIVERSITY</p> <p>1.1 What is biodiversity? Origin of life, evolution and origin of biodiversity, species concept.</p> <p>1.2 Evolutionary tree of microorganisms. Value of biodiversity, microbial biodiversity as index of environmental change</p> <p>1.3 . Microscopic methods: Basic microscopy and microscopic analysis in microbial diversity assessment. Cultural methods: Biochemical /Metabolite methods.</p> <p>1.4 Molecular and genomic methods: Molecular context of microbial diversity Importance of DNA and r-RNA sequence comparison, determination of GC content</p>	1	33.33%
II	<p>DIVERSITY AMONGST BACTERIA</p> <p>2.1 Morphological and cellular diversity: Diversity in major cell shape and grouping. Diversity in ultra- structure of cell with reference to cell envelope, Cell membrane, cell wall, surface appendages, other cell organelles and spore.</p> <p>2.2 Physiological and metabolic diversity. Diversity in photosynthetic, heterotrophic and autotrophic metabolism.</p> <p>2.3 Ecological diversity: Diversity in major ecosystems.</p>	1	33.33%

	2.4 Diversity in aquatic, marine and extreme environment.		
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III	<p>Biomolecules and metabolism</p> <p>3.1 Biomolecules: Chemical structure, properties, classification, and biological significance of Carbohydrate, Proteins, lipid and nucleic acids. Introduction to modes of microbial metabolism: Anabolism, catabolism, primary and secondary metabolism.</p> <p>3.2 Concept of aerobic respiration, and fermentation sugar degradation pathways i.e. EMP, ED, pentose phosphate pathway, TCA cycle. Electron transport chain, Gluconeogenesis, cori cycle</p> <p>3.3 Anaerobic respiration: Anaerobic respiration with special reference to dissimilatory nitrate reduction, Anaerobic fermentation: Alcohol fermentation and Pasteur effect, Lactate fermentation.</p>	1	33.33%
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Reference Books:

1. Modi H.A., (2014), Introductory Microbial world, Shanti Prakashan, Ahmedabad.
2. Atlas R M, Bartha R, (1998), Microbial Ecology: Fundamentals & Applications. 4th edn. Pearson Education.
3. Ogunseitan O., (2005) Microbial Diversity: Form and Function in Prokaryotes, Blackwell Publishing, Malden, MA, Oxford, Victoria.
4. Cambell R., (1983), Microbial Ecology, 2ndedn. Blackwell Scientific Publication.

Suggested Readings:

1. Principle of microbial diversity by James W. Brown
2. Microbial diversity by T. Satyanarayan, B.N. Johri

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>
- <https://www.sciencedirect.com>

Practical / Activities:

1. Study of microbial biodiversity by Denaturing gradient gel electrophoresis
2. Study of microbial biodiversity by Temperature gradient gel electrophoresis

BMIC401PRA- MICROBIOLOGY PRACTICAL

CREDIT: 03

- (1). Study of ecological diversity amongst bacteria:
 - (A) cultivation of acidophilic and alkaliphilic bacteria.

- (B) cultivation of halophilic and non halophilic bacteria.
- (C) cultivation of thermophilic and mesophilic bacteria
- (2). Study of morphological and cultural diversity of *Escherichia coli*, *Enterobacter aerogenes*, *Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus megaterium* and *Bacillus cereus*, *S. marcescens*.
- (A) Study of morphological diversity by performing Gram's staining, capsule staining and spore staining.
- (B) Study of cultural / growth diversity using nutrient broth and nutrient agar media.
- (3). Study of metabolic diversity amongst bacteria: *Escherichia coli*, *Enterobacter aerogenes*, *Proteus vulgaris*, *Staphylococcus aureus*, and *Bacillus subtilis* by performing various biochemical tests:
- (A) Based on carbon metabolism
- Methyl Red Test
 - Voges-Proskauer (V-P) test,
 - Fermentation of sugars and sugar alcohol: glucose, xylose, mannitol, lactose, maltose and sucrose,
 - Citrate utilization test,
 - Starch utilization test,
 - Lipid utilization test.
- (B) Based nitrogen metabolism.
- Indole production test
 - H₂S production test
 - Urea utilization test,
 - Casein hydrolysis test
 - Gelatin hydrolysis test.
- (C) Presence of respiratory enzymes.
- Catalase test,
 - Dehydrogenase test,
 - Oxidase test.
- (4). Microbiological analysis of food:
- Standard plate count of food sample.
 - Determination of MPN of Coliforms.
- (5). Microbiological analysis of milk:
- Standard plate count of milk sample.
 - Determination of microbial load of milk by use of MBRT of raw milk, boiled milk and pasteurized milk.
 - Detection of acid-fast organisms in milk sample.
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CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	1	1	2	1	1	2	2	2	2	1
CO2	3	2	1	-	1	1	-	2	1	2	1

Subject Code: BMIC402UDSC

Semester: IV

Subject Name: Food and Dairy Microbiology

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- (a) To complement the students with the knowledge about Food born infection, food born poisoning, food spoilage by microbes and their preservations.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about microbial flora of food , Major food born disease, Pasteurization, sterilization, canning, Refrigeration, Freezing.
CO2	Students will gain knowledge about Staphylococcus aureus food poisoning, Botulism, Biochemical changes in food by microbes, Role of microbes in kefir , kumiss, pickles, importance of probiotics, Bacteriological analysis of food by CFU and MPN.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>MICROBES IN FOOD BORNE INFECTION AND POISONING</p> <p>1.1 Food as a substrate for microorganisms Microbial flora of foods: Milk, fruits, vegetables meat, eggs.</p> <p>1.2 Factors affecting kinds and numbers of microorganisms: intrinsic and extrinsic</p> <p>1.3 Food and milk borne infections Sources of contamination and Major food and milk borne diseases.</p> <p>1.4 Food poisoning:</p> <p>A. Microorganisms involved, sources of contamination.</p> <p>B. Role of <i>Staphylococcus aureus</i>, <i>Clostridium botulinum</i> and <i>Salmonella spp.</i></p> <p>C. Molds as poisoning agents</p>	1	33.33%
II	<p>MICROBIAL FOOD SPOILAGE AND PRESERVATION</p> <p>2.1 Microbial Spoilage of food: Causes of spoilage. Biochemical changes due to microbes.</p> <p>2.2 Spoilage of milk and milk products, fruits, vegetables, eggs, meat Spoilage of canned foods.</p> <p>2.3 Preservation of food and Milk: General principles</p>	1	33.33%

	2.4 Methods of preservation: i. Use of aseptic handling. ii. High temperature: Pasteurization (with Phosphatase), sterilization, canning. iii. Low temperature: Refrigeration and freezing.		
III	USE OF MICROBES IN FOOD PRODUCTS AND THEIR METHODS 3.1 Fermented dairy products Starter culture, Cheese: Types, curdling, processing, ripening. Other fermented dairy products Yogurt, cultured buttermilk, Kefir and cultured sour milk. Introduction to probiotics, prebiotics and synbiotics, functional foods. 3.2 Indian fermented food products: Pickles, idli, Khaman and bread. Microbes as food: Mushrooms, spirulina and yeasts. 3.3 Biological methods: Generalized scheme for microbiological examination. Direct microscopic examination, colony forming units (CFU), Most probable number (MPN), 3.4 Bacteriological analysis of milk: Grading of milk -Resazurin test. Determination of efficiency of pasteurization: Phosphatase test.	1	33.33%

Reference Books:

1. Frazier W C and Westhoff D C (1988). Food Microbiology, 4th ed. McGraw-Hill, NY
2. Modi H.A., (2009). Dairy Microbiology, Aavishkar Publishers, Jaipur
3. Prescott L, Harley J P, and Klein D A, (2008). Microbiology, 7th ed. Wm C. Brown McGraw Hill, Dubuque IA
4. Pelczar Jr, M J, Chan E C S, Krieg N R, (1986). Microbiology: An Application Based Approach, 5th edn. McGraw-Hill Book Company, NY.

Suggested Readings:

1. Food microbiology 4th edition by Martin R Adams, Maurice O Moss, Peter McClure
2. Modern Food microbiology by James M. Jay, Martin J. Loessner, David A. Golden

Online Resources:

4. www.shomusbiology.com
5. <https://www.slideshare.net>
6. <https://www.researchgate.net>

Practical / Activities:

1. Preparation of Yogurt
2. Microbial analysis of milk by Resazurin test
3. Determination of efficiency of pasteurization: Phosphatase test

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	-	1	-	2	1	-	-	-	2	-
CO2	3	-	2	-	1	2	-	2	1	2	1

Subject Code: BMIC401USE

Semester: IV

Subject Name: Food fermentation techniques

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
02	0	00	Mid	CE		
			10	05	35	50

Course Objective:

- (a) To complement the students with the basic knowledge about Various microbial diseases, Causative agents, Therapeutics, Control and its prevention.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about the different types of fermentation processes, equipment's used and microbiological processes involved.
CO2	Students will gain knowledge of significance and activities of microorganisms in food.
CO3	Students will gain knowledge about microbiology of milk & fermented products.
CO4	Students will also know the microbial quality control and quality schemes used in food industries.
CO5	Students will gain knowledge about microbiology of grain & vegetables based fermented foods, Microbiology of fermented meat and fish, & Probiotics foods.

Content

CREDIT: 02

Unit	Description in detail	Credit	Weightage
I	<p>Human and Microbial Diseases</p> <p>1.1 Infectious and non infectious diseases, microbial and non microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections</p> <p>1.2 Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases.</p> <p>1.3 Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.</p>	1	50%
II	<p>Therapeutics and Prevention of Microbial Diseases</p> <p>2.1 Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.</p> <p>2.2 General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food,</p>	1	50%

water and insect vectors.

2.3 Vaccines: Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.

Reference Books:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Text Book of Microbiology. 8th Edition, University Press Publication.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th Edition. McGraw Hill Publication.
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th Edition. Elsevier.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th Edition. McGraw Hill Higher Education.

Suggested Readings:

1. Medical microbiology 18th edition (2012) by David Greenwood, Mike Barer and Will Irving
2. Medical microbiology 8th edition by Murray, Rosenthal and Pfaller

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>
- <https://www.sciencedirect.com>

Practical / Activities:

1. Isolation of diseases causing microbes from nasal sample
2. Isolation of Diseases causing microbes from stool (*Vibrio cholera*)

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	1	-	2	2	-	2	2	1	2
CO2	3	-	2	-	1	1	-	2	2	2	1
CO3	2	1	2	-	2	1	-	2	2	1	1
CO4	2	2	1	-	2	1	-	3	-	2	1
CO5	3	-	1	-	-	-	-	3	-	3	-

Subject Code: BMIC501DSC
Subject Name: Molecular Biology

Semester: V

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
- Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development.
- It is a large and ever-changing discipline.
- This course will emphasize the molecular mechanisms of DNA replication, repair, protein synthesis.

Course Outcomes: At the end of the course, students shall be able to

CO1	Molecular Biology gives you in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms
CO2	You will gain an understanding of chemical and molecular processes that occur in and between cells

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>Structures of DNA and RNA</p> <p>1.1 DNA structure: Miescher to Watson and Crick- historic perspective DNA structures, salient features of double helix.</p> <p>1.2 Types of DNA, types of genetic material, denaturation and renaturation, cot curves. DNA topology- linking number, topoisomerases.</p> <p>1.3 Organization of DNA in prokaryotes, viruses, eukaryotes. Organelles DNA of mitochondria and chloroplast DNA.</p> <p>Types of RNA. RNA structure.</p>	1	33.33%
II	<p>Replication of DNA</p> <p>2.1 Unidirectional and Bidirectional replication, semi Conservative, semi discontinuous replication. Mechanism of DNA replication.</p> <p>2.2 Enzyme and proteins involved in DNA replication: DNA ligase, primase.</p> <p>2.3 Various models of DNA replication including rolling circle, D-loop (mitochondrial), theta model of Replication, other accessory proteins.</p>	1	33.33%

III	<p>Transcription & Translation in prokaryotes and Eukaryotes</p> <p>3.1 Transcription: Definition, difference from replication, Transcription in eukaryotes and Prokaryotes: RNA polymerases, general transcription factors. Post transcriptional processing: split genes, concept of intron and exon, RNA splicing, spliceosome machinery.</p> <p>3.2 Translational machinery in Prokaryotes & Eukaryotes, charging of tRNA, aminoacyl tRNA synthetases, mechanisms of initiation, elongation and termination of polypeptides in prokaryotes, fidelity of translation.</p> <p>3.3 DNA methylation and Histone Acetylation mechanisms</p>	1	33.33%
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Reference Books:

1. Watsan JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular biology of the gene, 6th edition, Cold spring Harbour Lab. Press, pearson publication.
2. Becker WM, Kleinsmith Lj, Hardin J and Brtoni GP (2009) The world of the cell, 7th edition, pearson Benjamin Cummings Publishing, san Francisco.
3. Karp G (2010) Cell and Molecular Biology, Concepts and experiments, 6th edition. John Wiley & Sons. Inc.
4. Gardner EJ, Simmons MJ, Snustad DP (2008) Principles of Genetics. 8th Ed. Wiley-India.

Suggested Readings:

1. Essential Cell Biology.
2. Molecular Biology of the Gene.
3. Cell And Molecular Biology.
4. Karp's Cell and Molecular Biology.
5. Lewin's Essential Genes.
6. The Cell: A Molecular Approach.

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

1. DNA Extraction from Agarose Gel
2. Polymerase Chain Reaction
3. Oligonucleotide Handling
4. Agarose Gel Electrophoresis

BMIC501UPRA- MICROBIOLOGY PRACTICAL

CREDIT: 06

LIST OF EXPERIMENTS

MODULE I

- 1) Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer. (A_{260} measurement).
- 2) Resolution and visualization of DNA by Agarose Gel Electrophoresis.
- 3) Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

- 4) Preparation and Identification of different cell types in peripheral blood
 - a. Total count of WBC
 - b. Total count of RBC
 - c. Differential Count of WBC
- 5) Estimation of Blood Glucose by Glucose Oxidase method.
- 6) Estimation of Blood Urea by DAM method
- 7) Determination of human blood groups: ABO and Rh system.
- 8) Study of Agglutination reaction: i) WIDAL test, ii) Double dilution technique.
- 9) Estimation Hemoglobin by Sahli's Method.
- 10) Immunodiffusion techniques.

MODULE II

1. Demonstration of Bacterial Conjugation.
2. Demonstration of bacterial transformation.
3. Demonstration of bacterial transduction.
4. Isolation of antibiotic resistant mutant(s) bacterium by direct selection (Gradient Plate Technique).
5. Monohybrid Ratio and its Modification
6. Dihybrid Ratio and its Modification
7. Chi-Square Analysis
8. Estimation of Linkage: Two Point Test Cross
9. Estimation of Linkage: Three Point Test Cross
10. Study of Trihybrid Ratio and back cross methods
11. Isolation of antibiotic resistant mutant(s) bacterium by indirect selection (Replica Plate Technique).

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	2	-	-	3	-	2	2
CO2	3	1	1	-	1	-	-	2	-	2	2

Subject Code: BMIC502DSC

Semester: V

Subject Name: Immunology

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
- Demonstrate the basic knowledge of immunological processes at a cellular and molecular level.
- Define central immunological principles and concepts.
- The key mechanisms and cellular players of innate and adaptive immunity and how they relate.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate theory in microscopy and their handling techniques and staining procedure.
CO2	Know Various characteristics of microorganisms and also understand various physical and chemical means of sterilization.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	Introduction to immunology 1.1 Concept of innate and adaptive immunity, contributions of various scientists to the development of field of immunology. 1.2 Immune cells: structure, function of immune cells-stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophile, Mast cell, Dendritic cell. 1.3 Immune organs: Bone marrow, Thymus, Lymph node, spleen, GALT, MALT, CALT.	1	33.33%
II	Antigen and Antibody 2.1 Antigen: Characteristics of an antigen, Haptens, Epitopes, T dependent and T independent antigens, Adjuvants. 2.2 Antibody: Structure, Types, function and properties of antibodies, antigenic determinant on antibodies, monoclonal and chimeric antibodies. 2.3 Major Histocompatibility Complex: Organization of MHC locus, structure and function of MHC I and II molecules.	1	33.33%
III	Immunological Techniques, Response and	1	33.33%

	<p>Disorders 3.1 Principles of precipitation, Agglutination, Immuno diffusion, immune electrophoresis ELISA, Western Blotting. RIA, Immuno fluorescence Complement system: Components of the complement system, classical and alternative pathways 3.2 Immune response: Primary and secondary immune response, Generation of Humoral and cell mediated Immune response. 3.3 Immunological Disorders: Types of autoimmunity, autoimmune diseases, Hypersensitivity (Type-I, Type-II, Type-III, Type-IV). Immunodeficiencies: primary immunodeficiency, and secondary immunodeficiency.</p>		
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Reference Books:

1. Immunology: by IM Roitt, J. Brostoff and DK Male (1993) BMP, London.
2. JKuby (1991). Immunology Freeman and company.
3. A.K. Abbas, A.H. Uchtman, J.S. Pober (1994). Cellular Molecular Immunology - W.B. Saunders Co. Philadelphia.

Suggested Readings:

1. Clinical immunology
2. Janeway's immunobiology
3. Paul's Fundamental Immunology

Online Resources:

1. www.shomusbiology.com
2. <https://www.slideshare.net>

Practical / Activities:

1. direct Agglutination
2. Indirect Agglutination
3. Immuno-chromatography
4. Precipitation
5. Complement fixation

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	1	-	2	-	-	2	-	2	2
CO2	3	2	1	-	2	-	-	2	-	3	2

Subject Code: BMIC503DSC

Semester: V

Subject Name: Classical Genetics

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- (a) To complement the students with the basic knowledge about Genetics, importance of genetics, Mendelian genetics, Gene, Genome, Chromosome mapping.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn relationship between genes and traits, various fields, law of dominance, independent inheritance, monohybrid and dihybrid cross, law of segregation, Probability, chi-square analysis.
CO2	Students will gain knowledge about basics of gene, genome, Chromosomes and its types, centromere, sex determination in drosophila, Mitosis, meiosis, types of crossing over, tetrad analysis.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	Information about Genetics & Mendelian Principles 1.1 Overview of genetics. The relationship between Genes and traits. Fields of genetics. 1.2 Principles of inheritance relevance of Mendelian laws. Mendel's genetics: Segregation of two or more genes, The principles of independent assortment. 1.3 Dihybrid test crosses, Mendelian inheritance and probability	1	33.33%
II	Genes and chromosomes 2.1 Nature of genetic material, gene structure and function. 2.2 The stability of chromosomes complement, Mitosis- Meiosis, chromosomes and heredity. 2.3 Determination of X-linked inheritance, sex determination in drosophila.	1	33.33%
III	Genetic linkage and chromosome mapping 3.1 Linkage and recombination of genes in a chromosome, Genetic mapping- crossing over, crossing over takes place at the four strand stage of meiosis. 3.2 The molecular basis of crossing over, multiple crossing over, Genetic mapping for three point- test Crosses double crossing over,	1	33.33%

genetic mapping and functions- genetic distance and physical distance. 3.3 Introduction of tetrad analysis method of genetic Mapping, Mitotic recombination- Recombination within genes closer look at complementation.		
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Reference Books:

1. Genetics: principles and analysis. 4 th addition, Denial L Hartl, Elizabeth tones.
2. Principles of genetics: E.J Gardner
3. Genes 9: Benjamin Levin

Suggested Readings:

1. Genetics analysis and principles by Professor Brooker R.G.
2. Principles of genetics: Peter J, Snustad, M.J. Simmons.

Online Resources:

1. <https://www.khanacademy.org>
2. www.shomusbiology.com
3. <https://www.slideshare.net>

Practical / Activities:

1. Monohybrid test crosses
2. Dihybrid test crosses

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	2	-	2	-	-	2	-	3	1
CO2	3	1	1	-	1	-	-	2	-	3	1

Subject Code: BMIC504DSC
Subject Name: Gene Transfer Techniques

Semester: V

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- (a) To study the basics of Recombination's, bacterial plasmids, Bacterial transformation, transduction and conjugation in *E.coli*.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain knowledge about principle of recombination and its types, and their molecular mechanisms, in vitro plasmid transfer and plasmid replication, Various plasmids and its properties.
CO2	Students will learn Molecular mechanisms of transformation, Types of transduction, specialized transducing particle formation from lysogen, Hfr transfer, Rec A protein and its function.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	Principles of Gene transfer 1.1 Bacterial recombination: General Principles, Introduction To genetic recombination and its biological significance, types of recombination and their molecular mechanisms: Generalized, site- specific and illegitimate recombination, recombination frequency and its significance. 1.2 Bacterial plasmids- fertility factor, Transfer of plasmid DNA – In vitro plasmid transfer – plasmid replication 1.3 Properties of particular bacterial plasmids, f - plasmids, R- plasmids, colicinogenic plasmid, Stringent plasmid, Agrobacterium plasmid Ti – broad, host range plasmid.	1	33.33%
II	Transformation & Transduction 2.1 Introduction of transformation, Molecular mechanism of transformation. Mapping by transformation, other uses by transformation 2.2 Generalized transduction, Co transduction and linkage, Mapping by co-transduction. 2.3 Specialized transduction, Formation of specialized Transducing particle from lambda lysogen, Specialized transduction of a non lysogen. Specialized transduction of a lysogen.	1	33.33%

III	<p>Conjugation</p> <p>3.1 Insertion of F-into the E.coli chromosome Hfr transfer, Interrupted mating and time of entry mapping.</p> <p>3.2 HFr mapping and HFr collection, Mapping Unselected Recessive markers, Chromosomes transfer by F⁺ cultures.</p> <p>3.3 Isolation of Hfr strains, Rec A- protein and its function.</p>	1	33.33%
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Reference Books:

1. Principles of Genetics : Eighth Edition. 1991, John Wiley & Sons by GARDNER, Simmons snustand.
2. Microbial Genetics, Second Edition 1994. Stanley R. Maloy, John E. Cronar, D. Arcid freifelder, Johnes & Barlett publishers.
3. Microbiology: second Edition 1993, Lansing M. Harley, Donald A. Klein. Win C. Brown publishers
4. Textbook of Biotechnology by R. C. Dubey, Publisher : S. Chand, and Co
5. Biotechnology by S.S.Purohit.
6. Genetic Engineering by Sandhya Mitra
7. Fundamentals of Molecular Biology 2009, Tar ganti K. Pal, Saroj S.
8. Molecular Cell Biology 5 th edition by Lodish, Berk, Matsudalia
9. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
10. Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution

Suggested Readings:

1. Genes IX by Benjamin L.
2. Gene cloning and manipulation 2nd edition by Christopher Howe

Online Resources:

3. <https://www.deshbandhucollege.ac.in>
4. www.shomusbiology.com
5. <https://www.slideshare.net>

Practical / Activities:

1. Isolation of gene and vector by PCR
2. Bacterial Conjugtion

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	2	2	-	2	-	2	2
CO2	2	2	2	-	2	-	-	2	-	2	2

Subject Code: BMIC501SE
Subject Name: Hematology and Blood banking

Semester: V

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
02	0	00	Mid	CE		
			10	05		

Course Objective:

- Haematology is the specialty responsible for the diagnosis and management of a wide range of benign and malignant disorders of the red and white blood cells, platelets and the coagulation system in adults and children.
- Haematologists care directly for patients on hospital wards and out patient clinics.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about blood grouping, Major and minor cross matching, blood transfusion and collection.
CO2	Students will gain basic knowledge about blood, plasma, serum, WBC and RBC.

Content

CREDIT: 02

Unit	Description in detail	Credit	Weightage
I	Introduction to hematology and Blood and its components 1.1 Introduction: Hematology, Blood, Plasma and serum. 1.2 Red blood cells, White blood cell and Platelets with its functions 1.3 Morphology and General Hematology 1.4 Hemostasis and Thrombosis in Laboratory	1	50%
II	Blood transfusion and Transfusion reactions 2.1 Collection, storage and transfusion of blood. 2.2 Blood grouping. 2.3 Major and minor cross matching. 2.4 Erythroblastosis Foetalis.	1	50%

Reference Books:

1. Clinical pathology Hematology and blood banking by Nanda Maheshwari, Jaypee Brothers Medical publishers.
2. Essential of Hematology 3rd edition (2020) By Shirish MKawthalkar.

Suggested Readings:

1. Practical *Haematology* by DACIE & LEWIS. VIVIAN
2. Clinical *Haematology* in Medical Practice by GRUCHY
3. *Essential Haematology* by AALAN VICTOR.

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

- Slide preparation and staining
- The White Blood Cell Differential
- Platelet estimation
- Red Blood Cell Morphology
- Alkaline & Acid Hemoglobin Electrophoresis
- Quantification of methemoglobin
- Blood Sucrose Test.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	2	-	-	2	-	2	2
CO2	3	2	1	-	2	-	-	2	-	2	2

Subject Code: BMIC601DSC

Semester: VI

Subject Name: Medical microbiology

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

- To complement the students with the basic knowledge about microbiology, general characteristics of microorganisms, Microscopy, microbial control.
- The course aims to provide students with an understanding of biomolecular, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles and functions and inter relations.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to identify common infectious agents and the diseases that they cause.
CO2	The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
CO3	The student will be able to recall microbial physiology including metabolism, regulation and replication

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>Host Parasite Relationship & Epidemiology</p> <p>1.1 Terms: Pathology, Infection, intoxication and disease, symptoms, sign, syndrome, prophylaxis Normal flora of skin, oral cavity, Gastrointestinal tract, and other body region. Toxins – Endotoxins and Exotoxins Nonspecific host defenses – General, physical, chemical and biological barriers.</p> <p>1.2 Definition - pandemic, epidemic, endemic and sporadic, epizootics and zoonoses, Mortality rate, Immunization, vaccine, adjuvant, serum, antiserum, anamnesis, toxoids, Recognition of Epidemic, antigenic shift and drift, Herd Immunity.</p> <p>1.3 Transmission of disease: Contact, vehicle and vector Transmission, Nosocomial infections, Control of Epidemics. Types of vaccines –whole organism vaccines, Inactivated, Purified macromolecules as vaccines, Recombinant vector vaccines, DNA vaccines, and multivalent subunit</p>	1	33.33%

	vaccines.		
II	Systemic diseases I 2.1 Diseases of Skin and Eyes: Bacterial Viral (Chicken pox and Herpes) and fungal. 2.2 Diseases of Nervous System: Bacterial and Viral (Rabies and Creutzfeldt- Jakob disease) 2.3 Diseases of Cardiovascular and Lymphatic System: Bacterial, Protozoal (Malaria) and Viral (Dengue Fever)	1	33.33%
III	Systemic diseases II 3.1 Diseases of Respiratory System: Bacterial, Viral (Influenza and Common cold) 3.2 Diseases of Digestive System: Bacterial, Viral (Hepatitis) and Protozoa (Amoebic dysentery.) 3.3 Diseases of Urinary and Reproductive System: Bacterial, Viral (Genital Herpes) and Fungal(Candidiasis).	1	33.33%

Reference Books:

1. Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th ed). Benjamin Cummings N.Y.
2. Prescott, L.M., Harley, J.P., Klein, D.A. (2002) Microbiology (5th ed) McGraw Hill International ed.
3. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
4. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
5. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
7. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

Suggested Readings:

- Brock Biology of Microorganisms, 14th Edition.
- Microbiology: An Introduction, 13th Edition.
- Clinical Microbiology Made Ridiculously Simple, 6th Edition.
- Prescott's Microbiology, 10th Edition.

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

- Identifying fungal, parasitic, viral and bacterial infections.
- Testing the strength and virulence of microbes.
- Using a variety of biochemical and molecular methods to determine organisms that cause infection.

BMIC601UPRA- MICROBIOLOGY PRACTICAL

CREDIT: 06

LIST OF EXPERIMENTS

MODULE I

1. Demonstration of Southern blotting.
2. Demonstration of Northern blotting.
3. Cloning of DNA insert and Blue white screening of recombinants.
4. Demonstration of RFLP.
5. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
6. Isolation, cultivation, identification and study of antibiotic sensitivity (Antibiogram) of Gram negative bacteria.
7. Study of skin micro flora.
8. Urine examination: Physical, chemical, microscopic.
9. Identification of unknown medically important bacteria from mixed population using identification keys:
 - a. *Escherichia coli*,
 - b. *Enterobacter aerogenes*,
 - c. *Proteus vulgaris*,
 - d. *Salmonella group* : *S. typhi*, *S. paratyphi A*, *S. paratyphi B*,
 - e. *Shigella dysenteriae*,
 - f. *Pseudomonas aeruginosa*.
10. Isolation and enumeration of bacteriophage.

MODULE II

1. Primary screening of (a) Amylase, (b) Organic acid producers, (c) Antibiotic producers, i) crowded plate method, ii) Wilkin's method,
 2. Bioassay of Penicillin using *Bacillus subtilis*.
 3. Determination of Oxygen Transfer Rate (OTR) under static, sparing and shaking condition by sodium sulphite method.
 4. Sterility testing of Pharmaceutical products.
 5. Immobilization of cells/enzyme
-

6. Fermentative production of Amylase and determination of Amylase activity.

7. Typical fermentation of alcohol.

8. Typical fermentation of gluconic acid.

9. Bacterial growth curve.

10. Calculation of thermal death point (TDP) of a microbial sample

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	-	2	2	1	-	-	2	-	2	-
CO2	3	2	2	-	2	1	-	3	-	2	2
CO3	3	-	2	2	1	-	-	2	-	2	2

Subject Code: BMIC602DSC
Subject Name: Recombinant DNA technology

Semester: VI

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
03	0	01	Mid	CE		
						20

Course Objective:

- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.

Course Outcomes: At the end of the course, students shall be able to

CO1	Technical know-how on versatile techniques in recombinant DNA technology.
CO2	An understanding on application of genetic engineering techniques in basic and applied experimental biology.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	<p>Introduction and Scope</p> <p>1.1 What is genetics engineering? Historical perspectives, Milestone in biotechnology and recombinant DNATEchnology.</p> <p>1.2 Blotting: Southern blotting, Western blotting, Northern blotting, Colony blotting, Dot blotting. Hybridization and detection of probe using autoradiography (FISH).</p> <p>1.3 Gene library construction (Genomic & c-DNA library).</p>	1	33.33%
II	<p>Techniques of Genetic Engineering</p> <p>2.1 Requirements of molecular biology laboratory Gene cloning in prokaryotes – isolation of DNA to be cloned – insertion of DNA fragments in to vector –use of linkers and adaptors.</p> <p>2.2 Colony hybridization technique.</p> <p>2.3 Cloning in eukaryotes in plant cell, yeast, filamentous fungi.</p>	1	33.33%
III	<p>Methods Of Gene Transfer & Genome Mapping</p> <p>3.1 Physical (Electroporation, Gene gun- particle bombardment, Microinjection- divert transformation, transformation by ultra sanitation Chemical Method (Competent cell preparation, Cacl2 mediated gene transfer, PEG mediated gene transfer)</p> <p>3.20 Molecular markers (RFLP, RAPD, AFLP, SNP, SCAR, SSR,</p>	1	33.33%

	<p>VNTR), Chromosome walking. Polymerase chain reaction techniques: Basic PCR technique, Variation of PCR techniques and Applications of PCR</p> <p>3.3 Applications of rDNA technology: Gene therapy, Expression of therapeutic proteins, Forensic science, Food, Agriculture</p>		
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Reference Books:

1. Principles of gene manipulation. 1994. Old & Primrose. Blackwell Scientific Publications.
2. Molecular cloning. 3 volumes. Sambrose and Russell. 2000. CSH press.
3. Genome analysis. Four volumes. 2000. CSH Press.

Suggested Readings:

1. Molecular Biotechnology : Principles and Applications of Recombinant DNA
2. Biotechnology, applying the Genetic Revolution
3. Principles of Genetics

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>
- <https://www.coursera.org>

Practical / Activities:

1. Isolation of DNA
2. Gene cloning Techniques
3. Polymerase Chain reaction
4. genome Sequencing
5. Automated Sequencing

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	2	-	-	2	-	2	2
CO2	3	2	2	-	2	-	-	3	-	2	2

Subject Code: BMIC603DSC
Subject Name: Industrial Microbiology

Semester: VI

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
03	0	01	20	10	70	100

Course Objective:

1. Industrial microbiology deals with fermentation process and how these process produced economically important products.
2. It is a large and ever changing discipline
3. This course will emphasize the medium formulation, inoculum development and screening of microorganisms.

Course Outcomes: At the end of the course, students shall be able to

CO1	Industrial microbiology gives you in depth knowledge of growth kinetics and strain improvement.
CO2	Student will gain an understanding of chromatography, preservation techniques, Quality assurance bioassay, Draying & Crystallization, Distillation.

Content

CREDIT:03

Unit	Description in detail	Credit	Weightage
I	Introduction to Bioprocessing and strain improvement 1.1 Concept of Fermentation (definition and applications), Range of fermentation processes & component parts of fermentation process. 1.2 Growth kinetics: Batch, fed-batch and continuous culture (Chemostat and turbidostat). 1.3 Isolation, Enrichment & screening (Primary Secondary) of Industrial important microorganisms, Preservation techniques.	1	33.33%
II	Concept of fermentation media and inoculums Development 2.1 Medium formulations for industry and types (crude and synthetic) of fermentation media. 2.2 Raw materials used in fermentation media and criteria for selection Sterilization of Media & Air. 2.3 Inoculum Development: Typical Inoculums Development Program, Inocula development for Bacteria, Yeast and Fungal processes Scale-up.	1	33.33%

III	<p>Design of fermenter and overview of Downstream Processing</p> <p>3.1 Design of fermentor: Basic function of typical fermenter. Types of fermenters: Tower, Cyllindroconical, Air lift, Acetator - Cavitator, Bioreactors for animal cell cultures.</p> <p>3.2 Removal of Solid & Microbial Cells and other solid Matter, Precipitation, Filtration and Centrifugation. Cell disruption Concentration of extracted product: Liquid-Liquid extraction, Distillation.</p> <p>3.3 Purification products: Chromatography, Membrane processes and ultra-filtration Drying & Crystallization Quality Assurance-Bioassay.</p>	1	33.33%
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Reference Books:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
3. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction. 9th Edition.
5. Biotechnology –The Biological Principles, M.D. Trevan, S. Boffey, K H Goulding, P Stanbury
6. Mukhopadhyay, Process Biotechnology Fundamental. Viva book.
7. Shuler and Kargi, 1992. Bioprocess engineering, Prentice-Hall.
8. Bialy & Ollis. 1986. Biochemical Eng. Fundaments. McGraw-Hill.
9. Schugerl. 1987. Bioreaction engineering, J/W.
10. Stanbury and Whitaker. Principles of fermentation technology.
11. Sikyta. Methods in Industrial microbiology. Ellis Hardwood Lt

Suggested Readings:

1. Industrial microbiology An introduction by Michael J. Waites, Neil L. Morgan, John S. Rocky, Gary Higton
2. Industrial microbiology by Benson K L.
3. An introduction to industrial microbiology by P K Sivakumar, M.M. Joe, K. Sukesh,
4. Industrial Microbiology fundamentals and applications by Agrawal and Parihar

Online Resources:

1. www.classcentral.com
2. www.shomusbiology.com
3. <https://www.slideshare.net>

Practical / Activities:

1. Isolation of industrial important microorganisms
2. Screening of amylase producing microorganism

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	2	1	-	2	-	3	-	2	2
CO2	3	2	2	-	2	-	-	2	-	3	2

Subject Code: BMIC604DSC

Semester: VI

Subject Name: Bioprocess Technology

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
03	0	01	Mid	CE	70	100
			20	10		

Course Objective:

- (a) The course aims to provide students with an understanding of microbial processes in food, primary metabolites like carbohydrates, proteins, vitamins, secondary metabolites like steroids, antibiotics. Bioprocess economics, Scale up.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will gain detail knowledge of single cell protein production and its benefits, Microbial enhance oil recovery, bioleaching of copper, gold, silver.
CO2	Students will learn about microbial processes in agriculture for biopesticides, insecticides, Agitation and Aeration process of fermentation.

Content

CREDIT: 03

Unit	Description in detail	Credit	Weightage
I	Overview of Microbial Processes and Exploration of microbes for over production of metabolites 1.1 Microbial processes in food- SCP and Yeast. Microbial processes in industry: bioleaching and MEOR. Microbial processes in agriculture: Bio insecticide and bio-fertilizer. 1.2 Primary metabolites and strain improvement. Secondary metabolites and strain improvement. 1.3 Current advances and future prospects.	1	33.33%
II	Control parameters and Scale up 2.1 Control systems: Manual and automatic, combined method, requirement for control. 2.2 Biosensor, Recent trends in fermentation control. 2.3 Scale up of industrial products.	1	33.33%

III	Bioprocess Economics		
	3.1 Introduction		
	3.2 Fermentation economics for isolation, Strain improvement and media design.	1	33.33%
	3.3 Fermentation economics for sterilization, aeration and Agitation and effluent treatments.		

Reference Books:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
3. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9thEdition. Pearson Education
5. Biotechnology –The Biological Principles, M.D.Trevaan ,S.Boffey,K H Goulding, P Stanbury
6. Mukhopadhyay, Process Biotechnology Fundamental. Viva book.
7. Shuler and Kargi, 1992. Bioprocess engineering, Prentice-Hall.
8. Bialy & Ollis.1986. Biochemical Eng. Fundamentals. McGraw-Hill.
9. Schugerl. 1987. Bioreaction engineering, J/W.

Suggested Readings:

1. Stanbury and Whitaker. Principles of fermentation technology.
2. Bioprocess technology by Anton M., Springer Verlag publication
3. Bioprocess Engineering principles 2nd edition by Pauline M. Doran,

Online Resources:

1. <https://www.khanacademy.org>
2. www.shomusbiology.com
3. <https://www.slideshare.net>

Practical / Activities:

1. Screening of antibiotic producer by crowded plate method
2. Screening of antibiotic producer by Wilkin's method
3. Fermentative production of amylase and determination of amylase activity.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	2	-	2	-	-	2	-	2	2
CO2	3	2	1	-	2	-	-	2	-	2	2

Subject Code: BMIC601SE

Semester: VI

Subject Name: Instrumentation and Biotechniques

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
02	0	00	10	05	35	50

Course Objective:

- This skill based course will teach the students the various instrumentations that are used in the analytical laboratories.
- This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules.

Course Outcomes: At the end of the course, students shall be able to

CO1	Development of skills related to handling of instruments.
CO2	Enabling the students to design & standardize various analyses, processes and separation techniques.
CO3	At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

CREDIT: 02

Unit	Topic	Content	Credit	Weightage
1		Chromatography and Electrophoresis	1	50%
	1.1	Chromatography: Principles and application of paper chromatography, Thin layer chromatography, column packing and filtration collection.		
	1.2	Gel filtration chromatography, ion exchange chromatography and affinity chromatography GLC, HPLC.		
	1.3	Electrophoresis: Principle and application of native polyacrylamide gel electrophoresis, SDS-PAGE, 2D gel electrophoresis, Isoelectric focusing, agarose gel electrophoresis. centrifugation and ultracentrifugation.		

2		Spectrophotometry and centrifugation	1	50%
	2.1	Spectrophotometry: Principle and use to study of adsorption spectra of biomolecules		
	2.2	Analysis of biomolecules using UV and visible range, Colorimetry and turbidometry.		
	2.3	Centrifugation: Preparative and analytical centrifugation, fixed angle and swinging bucket Differential centrifugation, density gradient centrifugation and ultracentrifugation.		

Reference Books:

1. Wilson, K. and Walker, J., (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambridge University Press (Low price edition), New York.
2. Nelson DL and Cox MM (2008) Lehninger principles of biochemistry
3. Karp G. (2010) Cell and molecular biology: concept and experiments
4. Cooper G. M and Hausman R. E. (2009) The cell: A molecular approach.
5. Nigam A and Ayyagari A. 2007. Lab Manual in biochemistry, immunology and Biotechnology.

Suggested Readings:

- Principles and Techniques of Biochemistry and Molecular *Biology*
- Introduction to Bioinstrumentation:
- Bioinstrumentation: Tools for Understanding Life.

Online Resources:

- www.shomusbiology.com
- <https://www.slideshare.net>

Practical / Activities:

- Paper chromatography
- Thin layer chromatography
- Gel electrophoresis
- SDS PAGE
- Agarose gel electrophoresis

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										
	1: Less relevant, 2: Mild relevant, 3: Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	2	-	2	-	-	2	-	3	2
CO2	2	3	1	1	2	-	-	2	-	2	1
CO3	2	2	2	-	2	-	-	2	-	2	2



**GOKUL
GLOBAL
UNIVERSITY**

FACULTY OF SCIENCE
Department of Microbiology
CO-PO Mapping



**GOKUL
GLOBAL
UNIVERSITY**

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Bachelor of Science

Botany

Under

Choice Based Credit System (CBCS)



**Faculty of Science
Gokul Science College**

University Campus, State Highway-41,

Siddhpur - 384151, Dist. Patan, Gujarat, INDIA, Mobile : 9510973863

E- Mail : dean.fac.sci@gokuluniversity.ac.in, Website : www.gokuluniversity.ac.in





PO No.	Program Outcome Description
PO1	Foundational Knowledge: Graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical Skills: Students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical Thinking: Graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective Communication: Students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and Teamwork: Graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information Literacy: Students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical Awareness: Graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong Learning: Students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal Impact: Graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.

PSO No.	Program Specific Outcome Description
PSO1	Botanical Knowledge and Diversity: Graduates of the B.Sc. Botany program will develop a comprehensive understanding of plant biology, including plant anatomy, physiology, taxonomy, and ecology. They will be able to identify and classify diverse plant species.
PSO2	Plant Conservation and Sustainable Practices: Graduates will demonstrate an understanding of plant conservation principles and possess skills to manage and protect plant ecosystems.





	They will promote sustainable practices, contribute to biodiversity conservation, and raise awareness about the importance of plant conservation.
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Semester I

Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total marks
							Internal	External	
1	Foundation Compulsory	B101FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT101UDSC	Microbiology & Phycology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC101UDSC/ BZOO101UDSC	Introduction to Microbial world/ Non chordates – Protista to psudocoelomates	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE101UDSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT101UPRA	Botany practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC101UPRA/ BZOO101UPRA	Microbiology practical/ Zoology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE101UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BBOT101USE	Horticulture	2	0	2	15	35	50
9	Elective Generic	B101EG	Elective Generic: Communication Skills	2	0	2	0	50	50
Total									800





Semester II

Sr No	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		TOTAL MARKS
							Internal	External	
1	Foundation Compulsory	B201FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT201UDSC	Biomolecules and Cell Biology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC201UDSC/ BZOO201UDSC	Systematic Bacteriology/ Non chordates – Coelmates	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE201UDSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT201UPRA	Botany Practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BMIC201UPRA/ BZOO201UPRA	Microbiology practical/ ZOOLOGY Practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE201UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BBOT201USE	Natural Resource Management	2	0	2	15	35	50
9	Elective Generic	B201UEG	Elective Generic: Disaster Management	2	0	2	0	50	50
Total									650





Semester III

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B301FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT301UDSC	Mycology and Phytopathology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT302UDSC	Archegoniate	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC301UDSC/ BZOO301UDSC/ BCHE301UDSC	Microbial physiology and metabolism /Principles of ecology/ INORGANIC & ORGANIC CHEMISTRY	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC302UDSC/ BZOO302UDSC/ BCHE301UDSC	Soil and water Microbiology/ Chordates I/ PHYSICAL CHEMISTRY	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT301UPRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC301UPRA/ BZOO301UPRA / BCHE301UPRA	Microbiology practical/ Zoology practical/ Chemistry Practical	0	6	3	0	100	100
8	Subject Elective	BBOT301USE	Plant Diversity and Human Welfare	2	0	2	15	35	50
9	Elective Generic	B301EG	PERSONALITY DEVELOPMENT	2	0	2	0	50	50
TOTAL									800





Semester IV

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B401FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT401UDSC	Anatomy of Angiosperms	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT402UDSC	Economic Botany	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC401UDSC/ BZOO401UDSC/ BCHE401UDSC	Microbial biodiversity/ Comparative Anatomy of Vertebrates/ INORGANIC & ORGANIC CHEMISTRY	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BMIC402UDSC/ BZOO402UDSC/ BCHE402UDSC	Food and dairy microbiology/ Chordates II/ PHYSICAL CHEMISTRY & SPECTROSCOPY	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT401UPRA	Botany Practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BMIC401UPRA/ BZOO401UPR/ BCHE401UPRA	Microbiology practical/ Zoology practical/ Chemistry Practical	0	6	3	0	100	100
8	SUBJECT ELECTIVE	BBOT401USE	Plant Breeding	2	0	2	15	35	50
9	Elective Generic	B301EG	PERSONALITY DEVELOPMENT	2	0	2	0	50	50
Total									800





Semester V

Sr. No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (Hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	FOUNDATION COMPULSORY	B501FC	FOUNDATION COMPULSORY – ENGLISH	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT501DSC	ALGAE, FUNGI AND PLANT PATHOLOGY	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT502DSC	BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERMS	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT503DSC	ANGIOSPERM FAMILIES, PLANT ECOLOGY AND PLANT ANATOMY	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT504DSC	CELL BIOLOGY & GENETICS, MICROBIOLOGY AND BIostatISTICS	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT501PRA	BOTANY PRACTICAL	0	12	6	0	200	200
7	SUBJECT ELECTIVE	BBOT501SE	AIR POLLUTION	2	0	2	15	35	50
8	ELECTIVE GENERIC	B501EG	ENVIRONMENT AND SUSTAINABLE DEVELOPMENT	2	0	2	0	50	50
Total									800





Semester VI

Sr. No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (Hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	FOUNDATION COMPULSORY	B601FC	FOUNDATION COMPULSORY – ENGLISH	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT601DSC	MOLECULAR BIOLOGY, PLANT PATHOLOGY, LICHENS AND ANGIOSPERM FAMILIES	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT602DSC	BIOCHEMISTRY AND PLANT PHYSIOLOGY	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT603DSC	ECONOMIC BOTANY, PLANT TISSUE CULTURE & BIOTECHNOLOGY, GENETICS AND PLANT ECOLOGY	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT604DSC	Plant Anatomy and Plant Breeding	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BBOT601PRA	BOTANY PRACTICAL	0	12	6	0	200	200
7	SUBJECT ELECTIVE	BBOT601SE	Fresh Water Ecology	2	0	2	15	35	50
8	ELECTIVE GENERIC	B601EG	Stress Management	2	0	2	0	50	50
Total									800



Syllabus

Semester: I

Course title:	Microbiology & Phycology	Course code:	BBOT101UDSC
Course type:	Discipline Specific Course	Course credit:	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
4 × 15 = 60	00	60	Mid	CE		
						20

Course Objective:

1. To learn important features such as general characteristics of Plant viruses, Bacteria, thallus organization, reproduction and life history of Cynophyta, Chlorophyta, Phaeophyta & Rhodophyta.

Course Outcome:

After successful completion of the course, the student will be able to.....

CO1	Develop an understanding the concept of microbial nutrition.
CO2	Classify viruses based on their characteristics and structures
CO3	Examine the general characteristics of bacteria and their reproduction.
CO4	Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance
CO5	Conduct experiments using skills appropriate to subdivisions

Content

Unit	Description in detail	Credit	Weightage
I	Viruses and Bacteria	1	25 %
	Plant Viruses: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), RNA virus (TMV).		





	General characteristics of Bacteria; Cell structure- Salient features; Types of Bacteria based on flagella, Nutritional types (Brief explanation with suitable example). Reproduction: Vegetative, Asexual and Recombination (conjugation, transformation and transduction). Economic importance of Bacteria with reference to their role in agriculture, fermentation and medicine.		
II	Algae General characteristics of algae, occurrence, and range of thallus organization (included types); Classification system of Fritsch (included types up to family). Cell structure and components: cell wall, pigment system, reserve food. Reproduction in algae: Vegetative and Asexual methods. Role of algae in the environment, agriculture, biotechnology and industry.	1	25 %
III	Cyanophyta and Chlorophyta General characters of Cyanophyta and Chlorophyta. Cell structure and components of Chlamydomonas. Life history of Nostoc with reference to: Systematic position with reasons up to family. Habit and Habitat, Vegetative structure and Reproduction Life history of Oedogonium with reference to: Systematic position with reasons up to family. Habit and Habitat, Vegetative structure and Reproduction.	1	25 %
IV	Phaeophyta and Rhodophyta General characteristics of Phaeophyta and Rhodophyta. Life cycle types: Haplontic, Diplontic and Haplodiplontic. Life history of Ectocarpus with reference to: Systematic position with reasons up to family. Habit and Habitat, Vegetative structure & Reproduction. Life history of Batrachospermum with reference to: Systematic position with reasons up to family. Habit and Habitat, Vegetative structure & Reproduction.	1	25 %

Reference Books:

1. Bell J N B, Treshow M (2002) Air Pollution and Plant Life, John Wiley and Sons Ltd, NewYork.
2. Omasa K, Nouchi I, DeKok L J (2005) Plant responses to air pollution and global change, Springer Japan, Tokyo.
3. Agrawal S B, Agrawal M (1999) Environmental Pollution and Plant Responses, CRC Press, BocaRaton, USA.
4. Gurjar B R, Molina T, Ojha CSP (2010) Air Pollution Health and Environmental Impacts, CRC Press, BocaRaton, USA.
5. Vallero D A (2007) Fundamentals of Air Pollution, Elsevier Academic Press, Amsterdam.
6. Rao M N, Rao H V N (2009) Air Pollution, Mc Graw-Hill Pub Co Ltd, NewDelhi.



Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
4. Sharma T.A., Dubey, R.C. and Maheshwari, D.K. (1999). A Text Book of Microbiology. S Chand and Co, New Delhi.
5. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
6. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky P.V. and Jackson, R.B. (2008). Biology, 8th edition. Pearson Benjamin Cummings, USA..
7. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Online Resources:

1. www.mcq.biology.com
2. <https://biologydictionary.net/bacteria/>
3. <https://www.biologydiscussion.com/algae/reproduction-algae/reproduction-in-algae-botany/53445/>
4. <https://www.biologydiscussion.com/algae/chlorophyta-features-and-distribution-algae/57905/>

Practicals

1. To study viruses using electron micrographs/Models/charts: TMV.
2. To study bacteria using electron micrographs/Models/charts: Types of Bacteria based on flagella
3. To study cell structure of Chlamydomonas through chart/permanent slide.
4. To study the Life history of Nostoc through: Mountings - Thallus and Reproductive structure Permanent Slides of - Thallus and Reproductive structure (Heterocyst)
5. To study the Life history of Oedogonium through: Mountings - Thallus and Reproductive structure Permanent Slides of – Thallus, Cap cell, sex organ - oogonium
6. To study the Life history of Ectocarpus through: Mountings - Thallus and Reproductive structure Permanent Slides of – Thallus, Unilocular and plurilocular sporangia
7. To study the Life history of Batrachospermum through: Mountings - Thallus and Reproductive structure Permanent Slides of – Thallus and cystocarp.





CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	2	-	-	1	-	-	2	-		3	1
CO2	1	3	1	-	-	2	-	-	2		2	1
CO3	2	2	-	1	-	-	2	2	-		2	2
CO4	2	2	-	-	-	2	1	-	-		3	1
CO5	3	3	-	2	1	-	-	2	1		3	2





Course title:	Horticulture	Course code:	BBOT101USE
Course type:	Subject Elective	Course credit:	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
2 × 15 = 30	00	00	Mid	CE	35	50
			10	05		

Course Objective:

1. To discuss important results on Plant Propagation, Nursery Management, Floriculture, Bonsai and Important Horticulture crops of Gujarat.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Understand the different classifications of horticultural crops.
CO2	Understand about the Nursery Management.
CO3	Aware about to use of Horticulture technologies.

Content

Unit	Description in detail	Credit	Weightage
I	Horticulture-I	1	50 %
	Introduction: Aims, Objectives and Scope of Horticulture		
	Plant Propagation-Vegetative, Asexual and Sexual reproduction		
	Nursery Management		
	Ornamental Plants		
II	Horticulture-II	1	50 %
	Landscape: Principles, Types and Planning		
	Floriculture and its implements		
	Bonsai		
	Important Horticulture crops of Gujarat		



Reference Books:

1. C.R. Adams (2018). Principles of Horticulture. Amsterdam. Boston.
2. Michael A. Dirr (2009). Manual of Woody and land Plants. Stipes Pub .

Suggested Readings:

1. Salaria and Salaria (2013).A2Z Solutions Horticulture at a glance Vol.I. Jain Bros.
2. Chadha K. L. (2003).Handbook of Horticulture. Indian Council of Agricultural Research.

Online Resources:

5. <https://www.britannica.com/science/horticulture/>
6. https://www.canr.msu.edu/hrt/about-us/horticulture_is/

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	2	-	-	1	-	-	2	-		2	2
CO2	1	3	1	-	-	2	-	-	2		3	2
CO3	2	2	-	1	-	-	2	2	-		2	3

Semester: II

Course title:	Biomolecules and Cell Biology	Course code:	BBOT201UDSC
Course type:	Discipline Specific Course	Course credit:	04

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4 × 15 =60	00	60	20	10	70	100

Course Objective:

1. To discuss important results on the structure and function of cells & explain the development of cells.
2. To discuss important results on the Carbohydrates, Lipids, Amino acids, Proteins, Structure of DNA etc.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student Develop understanding on chemical bonding among molecules.
CO2	The course Identify the concept that explains chemical composition and structure of cell organelles.
CO3	To offer detailed knowledge of bimolecular for living systems.
CO4	Describe the evolution, diversity and replication of cells.
CO5	Students will understand how these cellular components are used to generate and utilize energy in cells.

Content

Unit	Description in detail	Credit	Weightage
I	Biomolecules- I	1	25 %
	Brief account and importance of: pH and buffers.		
	Carbohydrates: Definition, classification and significance Structure and functions of Monosaccharides (trioses, pentoses and hexoses) Structure and functions of Disaccharides (maltose, lactose and		





	<p>sucrose) and Structure and functions of Polysaccharides (starch and cellulose).</p> <p>Lipids: Definition, classification and significance Structure and functions of Fatty acids: Saturated and unsaturated Essential fatty acids.</p> <p>Simple and Conjugated Lipids: Structure and functions of Triglycerides and waxes. Conjugated lipids with examples.</p>		
II	<p>Biomolecules – II</p> <p>Amino acids: Definition and classification (based on polarity) Properties of amino acids. Peptide bond, Dipeptide and polypeptide.</p> <p>Proteins: Definition, classification and significance General (Physical) properties of Proteins. Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation.</p> <p>Enzymes: Classification and Functions</p> <p>Nucleic acids: Definition, classification and significance. Structure of nitrogenous bases; Structure and function of nucleotides. Types of nucleic acids; Structure of DNA (Watson and Crick's model); Types of RNA; Structure of tRNA.</p>	1	25 %
III	<p>Cell Biology – I</p> <p>Cell as a basic unit of structure and function, Characteristics and comparison of Prokaryotic and Eukaryotic cell.</p> <p>Cell wall: Ultra structure, chemical composition and functions</p> <p>Plasma membrane: Ultra structure, chemical composition and functions, fluid mosaic model, Membrane transport – Passive, active and facilitated transport.</p> <p>Nucleus: Structure-nuclear envelope, nuclear lamina, molecular organization of chromatin; nucleolus.</p>	1	25 %
IV	<p>Cell Biology – II</p> <p>Chloroplast: Structural organization and Functions</p> <p>Mitochondria: Structural organization and Functions</p> <p>Introduction and functions of: Endoplasmic Reticulum, Golgi apparatus and Lysosomes.</p> <p>Cell division: Eukaryotic Cell Cycle, Mitosis, meiosis and their significance.</p>	1	25 %

Reference Books:

1. Campbell, M.K. (2012). Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.

Suggested Readings:



1. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H. Freeman.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011). Biochemistry, W.H. Freeman and Company.
3. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
4. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
5. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
6. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
7. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Online Resources:

1. <https://www.mrgscience.com/topic-23-carbohydrates-and-lipids.html/>
2. https://saylordotorg.github.io/text_the-basics-of-general-organic-and-biological-chemistry/s21-amino-acids-proteins-and-enzym.html/
3. <https://www.toppr.com/guides/biology/the-fundamental-unit-of-life/structure-of-cell/>
4. <https://www.toppr.com/ask/question/describe-the-functions-of-the-three-organelles-viz-golgi-bodies/>

Practicals

- 1) Preparation of solutions and plant juices to determine their pH using Universal indicator/pHmeter.
- 2) To determine iso-electric point of Protein (Casein).
- 3) Estimation of Free Fatty acids by titration method.
- 4) Bio-Molecules: Tests for detection of Carbohydrates: The following tests are to be performed to detect the nature of carbohydrates available in the supplied sample (Glucose, Fructose, Maltose, Sucrose and Starch). 1. Molisch's test, 2. Benedict's test, 3. Barfoed's test, 4. Seliwanoff's test, 5. Iodine test, 6. Cobalt chloride test.
- 5) Tests for detection of Lipids i.e., Fats and oils: Micro-chemical tests on sections of Plant materials- Sudan III stain, Solubility test.
- 6) Tests for detection of Proteins: Biuret test/Xanthoprotic test.
- 7) Akaryota - Bacteriophage, Prokaryota - Cyanophycean cell & Eukaryota - typical Animal & Plant cell.





- 8) To study the various types of cell organelles through micrographs/charts
(As per theory syllabus).
- 9) Study of mitosis from onion root tip using squash method.
- 10) Study of different stages of meiosis (Chart/Permanent Slides).

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	1	-	-	1	-	-	2	-		3	2
CO2	1	3	1	-	-	1	-	-	2		2	-
CO3	2	2	-	1	-	-	2	1	-		3	2
CO4	2	3	-	-	-	2	-	-	-		3	1
CO5	3	3	-	2	1	-	-	2	1		2	-





Course title:	Natural Resource Management	Course code:	BBOT201SE
Course type:	Subject Elective	Course credit:	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
2 × 15 =30	00	00	Mid	CE	35	50
			10	05		

Course Objective:

1. Develop understanding on the concept of Sustainable utilization, Soil degradation and management.
2. To discuss important results on Renewable and non-renewable sources of energy.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Understand the concept of different natural resources and their utilization.
CO2	Critically analyze the sustainable utilization land, water, forest and energy resources.
CO3	Reflect upon the different national and international efforts in resource management and their conservation.

Content

Unit	Description in detail	Credit	Weightage
I	Natural Resource Management - I	1	50 %
	Natural Resource: Definition, types and management.		
	Sustainable utilization: Concept, approaches (economic, ecological and sociocultural).		
	Land: Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.		
	Water: Fresh water (rivers, lakes, groundwater, aquifers, watershed), Marine; Estuarine; Wetlands.		
II	Natural Resource Management - II	1	50 %
	Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.		





Energy: Renewable and non-renewable sources of energy.		
Contemporary practices in resource management: EIA (Environmental Impact Assessment), Resource Accounting, Waste management.		
National and international efforts in resource management and conservation		

Reference Books:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Suggested Readings:

1. United States Government Accountability Office (2008) Natural Resource Management. Nova Science Publishers Inc, 10th Edition
2. Stacy Keach (2016) Natural Resources Management. Syrawood Publishing House
3. Rathor, V.S. and Rathor B. S. (2013) Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi

Online Resources:

5. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/natural-resource-management>
6. <https://byjus.com/physics/manage-natural-resources/>

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	-	-	2	-	-	2	-		2	3
CO2	2	3	2	-	-	2	-	-	2		2	2
CO3	2	2	-	1	-	-	2	2	-		2	2





Semester: III

Course title:	Mycology and Phytopathology	Course code:	BBOT301UDSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on Thallus organization, Nutrition, lifecycle and classification of fungi.
2. To discuss important results on Host-Pathogen relationships and Disease cycle and control measures of plant diseases.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Demonstrate skills in laboratory, field and glasshouse work related to mycology and plant pathology.
CO2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies.
CO3	Identify true fungi and demonstrate the principles and application of plant pathology in the control of plant disease.
CO4	Identify the common plant diseases according to geographical locations and devise control measures.
CO5	Study about the general characters, somatic structures, reproduction of Plant diseses.

Content

Unit	Description in detail	Credit	Weightage
I	Fungi-I General characteristics; Affinities with plants. Thallus organization; Cell wall composition; Nutrition; Classification (Ainsworth).	1	34 %





	Phycomycetes: Zygomycetidae: Characteristic features. Thallus organisation; Reproduction; Life cycle and classification with reference to Rhizopus.		
	Ascomycetes: General characteristics (asexual and sexual fruiting bodies); Life cycle and classification with reference to Claviceps.		
	Basidiomycetes: General characteristics; Life cycle and Classification with reference to Agaricus.		
II	Fungi-2		
	Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.		
	Lichens: Occurrence; General characteristics; Classification; Study of thallus (morphological and anatomical), Reproduction; Economic importance.	1	33 %
	Mycorrhiza: Ectomycorrhiza, Endomycorrhiza and their significance.		
	Applied Mycology: Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Medicines (Pharmaceutical preparations); Agriculture (Bio fertilizers).		
III	Phytopathology		
	Terms and concepts; General symptoms.		
	Geographical distribution of diseases. Host-Pathogen relationships.		
	Pathogen, Symptoms, Dissemination, Disease cycle and control measures of following plant diseases: Bacterial diseases – Citrus canker.	1	33%
	Fungal diseases – White rust of crucifers, Black rust of wheat.		

Reference Books:

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.

Suggested Readings:

1. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
2. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
3. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Online Resources:

- <https://www.biologyexams4u.com/2013/02/classification-of-fungi.html/>
<https://pragatiprakashan.in/new-pattern-mycology-and-phytopathology-ii-sem-odisha.html/>
<https://www.apsnet.org/about/Pages/WhatisPhytopathology.aspx>

Practicals





1. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides/photographs/charts.
2. Claviceps: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs/charts.
3. Agaricus: Specimens of button stage and full-grown mushroom; sectioning of gills of Agaricus. Permanent slides/photographs/charts.
4. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structure (apothecium) through Permanent slides/photographs/charts/specimen.
5. Mycorrhizae: Ectomycorrhiza and Endomycorrhiza (Photographs).
6. Phytopathology: Study of Plant diseases: Citrus Canker, White rust of crucifers and Black rust of wheat.

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome										PSO1	PSO2
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	2	2	-	-	2	-	-	2	-		2	3
CO2	2	3	2	-	-	2	-	-	2		2	1
CO3	1	2	-	1	-	-	2	2	-		3	2
CO4	2	3	3	-	-	2	-	-	-		1	2
CO5	3	3	2	2	2	-	-	2	2		3	1





Course title:	Archegoniate	Course code:	BBOT302UDSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on General characteristics, morphology, anatomy and reproduction, Economic importance of Bryophytes, Pteridophytes and Gymnosperms.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands; Demonstrate an understanding of archegoniate, Bryophytes, Pteridophytes and Gymnosperms.
CO2	Understanding of plant evolution and their transition to land habitat.
CO3	Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, and Gymnosperms.
CO4	To discuss important results on General characteristics, morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
CO5	Understand the economic importance of Bryophytes, Pteridophytes and Gymnosperms.

Content

Unit	Description in detail	Credit	Weightage
I	Bryophytes	1	34 %
	General characteristics of Bryophytes; Adaptations to land habit; Classification (Rothmaler); Alternation of generations.		
	Classification (up to family), morphology, anatomy and reproduction of Marchantia.		
	Classification (up to family), morphology, anatomy and reproduction of Funaria		





	Vegetative reproduction and economic importance of bryophytes.		
II	Pteridophytes	1	33 %
	General characteristics of Pteridophytes; Classification (Smith); Economic importance of Pteridophytes.		
	Classification (up to family), morphology, anatomy and reproduction of Equisetum (Developmental details not to be included).		
	Classification (up to family), morphology, anatomy and reproduction of Nephrolepis (Developmental details not to be included). Heterospory and seed habit.		
III	Gymnosperms	1	33 %
	General characteristics, classification of Gymnosperms (Sporne, 1965).		
	Affinities with Pteridophytes and Angiosperms.		
	Morphology, anatomy (leaflets and coralloid root) and reproduction of Cycas (Developmental details not to be included). Economic importance of Gymnosperms.		

Reference Books:

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

Suggested Readings:

1. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
2. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
3. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

Online Resources

1. <https://www.biologydiscussion.com/bryophyta/bryophyta-features-classification-and-economic-importance/5654>
2. <https://www.biologydiscussion.com/pteridophytes/pteridophytes-meaning-general-characters-and-affinities/53012>
3. <https://www.biologydiscussion.com/gymnosperm/gymnosperms-definition-external-features-and-reproduction/53316>

Practicals

1. Marchantia- Morphology of thallus, whole mount of rhizoids & scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (temporary slides), vertical section



of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).

2. Funaria- Morphology, whole mount of leaf, antheridial and archegonial heads, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads; longitudinal section of capsule and protonema.
3. Equisetum- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
4. Nephrolepis- Morphology, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rachis, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
5. Cycas- Morphology (coralloid roots, bulbil, leaf, microsporophyll, megasporophyll), vertical section of leaflet, whole mount of spores (temporary slides), vertical section of microsporophyll, longitudinal section of ovule (permanent slide).

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2	1	2	-	-	2	2		3	-
CO2	2	3	2	-	-	2	-	-	2		3	2
CO3	2	2	-	1	-	-	2	2	-		2	1
CO4	2	3	1	-	1	2	-	-	-		3	2
CO5	3	3	-	2	2	-	-	2	2		3	3



Course title:	Plant Diversity and Human Welfare	Course code:	BBOT301USE
Course type:	Subject Elective	Course credit:	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3× 15 =30	00	00	Mid	CE	35	50
			10	05		

Course Objective:

1. To discuss important results on Plant diversity and its scope, Conservation of diversity and Importance of forestry their utilization and commercial aspects.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Identify the causes and implications of loss of biodiversity.
CO2	Apply skills to manage plant biodiversity.
CO3	Utilize various strategies for the conservation of biodiversity.

Content

Unit	Description in detail	Credit	Weightage
I	Plant Diversity	1	50 %
	Plant diversity and its scope- Genetic diversity, Species diversity and Ecosystem diversity.		
	Values and uses of Biodiversity: Ethical and aesthetic values, uses of plants (Food value), Uses of microbes.		
	Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity.		
	Conservation of diversity, In situ and ex situ conservation, Sustainable development.		
II	Human Welfare	1	50 %
	Importance of forestry their utilization and commercial aspects.		





Avenue trees of India.		
Ornamental plants of India.		
Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.		

Reference Books:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Singh, J.S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.

Suggested Readings:

1. Reddy, K.V. and Veeraiah, S. (2010). Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
2. Heywood, V. H. and Watson, R. T. (1995). Global biodiversity and Assessment. Cambridge University Press

Online Resources:

- <https://cbs.umn.edu/wildlife-bioenergy/project-design/plant-diversity>
- <https://byjus.com/neet/important-notes-of-biology-for-neet-microbes-in-human-welfare/>

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High, 2: Moderate, 1:Poor]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2	2	2	-	-	2	-		3	3
CO2	2	2	2	-	-	2	-	-	2		3	2
CO3	2	2	2	1	-	-	2	2	-		2	3



Semester: IV

Course title:	Anatomy of Angiosperms	Course code:	BBOT401UDSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on Classification of tissues, types of vascular bundles, Evolution concept of organization of shoot and root apex, Secondary growth in plants.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Examine the internal anatomy of plant systems and organs .
CO2	Develop critical understanding on the evolution of concept of organization of shoot and root apex.
CO3	Analyze the composition of different parts of plants and their relationships.
CO4	Evaluate the adaptive and protective systems of plants.
CO5	Students know about the internal structure of plant organs.

Content

Unit	Description in detail	Credit	Weightage
I	Anatomy	1	34 %
	The three tissue systems, types of cells and tissues.		
	Classification of tissues; Simple and complex tissues; tracheary elements and sieve elements.		
	Types of vascular bundles; Structure of dicot & monocot stem and leaf.		





	Ergastic substances (starch grains of Potato & Wheat, Aleurone layer of Maize, Aleurone crystal of Castor seed), Hydathodes, Cavities, Cystolith and Laticifers.		
II	Meristems Definition & characteristics of meristem, Evolution concept of organization of shoot apex (Apical cell theory, Histogen theory and Tunica Corpus theory). Organization of root apex (Histogen theory, Korper-Kappe theory and Quiescent centre theory). Epidermal tissue system; cuticle, epicuticular waxes. Trichomes (Uni-and Multicellular, Glandular and Nonglandular, two examples of each), Stomata: types, location, structure & function, classification (Metcalf and Chalk).	1	33 %
III	Secondary growth Structure, function and activity of cambium; Secondary growth definition and types normal and anomalous. Secondary growth in Sunflower stem and root. Anomalous Secondary growth in Salvadora stem and Tinospora aerial root. Sapwood and heartwood; Ring and diffuse porous wood; Tyloses, Periderm and Lenticels.	1	33 %

Reference Books:

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.

Suggested Readings:

1. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
2. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

Online Resources:

<https://byjus.com/jee/anatomy-of-flowering-plants/>
<https://byjus.com/biology/meristematicissue/#:~:text=Meristematic%20tissues%20contain%20living%20cells,exist%20is%20known%20as%20meristem.>
<https://byjus.com/biology/secondary-growth-vascular-cork-cambium/>

Practicals

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples.





- Ergastic substances (Aleurone layer of Maize, Aleurone crystal of Castor seed), Hydathodes, Cavities, Cystolith (Ficus leaf).
- Apical meristem of root and shoot.
- Xylem: Tracheary elements-tracheids, vessel elements; thickenings (Sunflower & Cucurbita stem).
- Wood: ring porous; diffuse porous; tyloses; heart- and sapwood (chart).
- Phloem: Sieve tubes-sieve plates; companion cells (Cucurbita stem).
- Epidermal system: stomata types (Dicot & Monocot); trichomes: non-glandular (Abutilon/Cotton), glandular (Ocimum), Periderm (PS) & Lenticels (PS).
- Root: Secondary growth (Sunflower root & aerial root of Tinospora).
- Stem: secondary growth (Sunflower & Salvadoria stem).

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	3	-	-	1	-	-	2	-		2	1
CO2	3	1	1	-	-	2	-	-	-		3	1
CO3	3	1	2	-	-	-	-	-	-		3	1
CO4	2	3	-	-	-	2	-	-	-		2	1
CO5	3	3	-	2	2	-	-	-	-		3	2





Course title:	Economic Botany	Course code:	BBOT402UDSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 =45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on Classification of economic important plants based on their uses and Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of plants.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Understand core concepts of Economic Botany.
CO2	It is relate with environment, populations, communities, and ecosystems.
CO3	Develop critical understanding on the evolution of concept of organization of apex new crops/varieties.
CO4	Understand about importance of germplasm diversity, issues related to access and ownership.
CO5	Develop a basic knowledge of taxonomic diversity and important families of useful plants.

Content

Unit	Description in detail	Credit	Weightage
I	Plant Resources-1	1	34 %
	Introduction of plant resources.		
	Concept of centres of origin, their importance with reference to Vavilov's work.		
	Classification of economic important plants based on their uses.		
	Origin, morphology, processing and uses of Wheat and Rice, Brief account of millets.		
II	Plant Resources- 2	1	33 %





	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Chick pea and Pigeon pea.		
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Potato.		
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of spices: Clove and Black Pepper		
	Morphology and processing of Sugarcane, products and by-products of sugarcane industry.		
III	Plant Resources- 3		
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Groundnut and Mustard.		
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Fennel.	1	33 %
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Tea.		
	Introduction, Origin, cultivation, morphology, family, scientific name, useful parts, chemical constituents and uses of Cotton and Jute.		

Reference Books:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.

Suggested Readings:

1. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.

Online Resources:

1. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/plant-resource>
2. <https://www.mmcmadinagar.ac.in/econtent/botany/resource.pdf>
3. <https://www.biologydiscussion.com/plant-breeding/crop-genetic-resources/crop-genetic-resources-and-centers-of-diversity-crops-plant-breeding/80643>

Practicals

Write Scientific name, Family, Useful part, Chemical constitutes, economic important and draw labelled diagram of plant:

1. Cereals: • Wheat (habit sketch, starch grains, micro-chemical tests).
• Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: • Chick pea and Pigeon pea (habit, fruit, seed structure, micro-chemical tests).





3. Sources of oils and fats: • Mustard and Groundnut –plant specimen, seeds; tests for fats in crushed seeds.
4. Sources of sugars and starches: • Sugarcane • Potato: Potato tuber morphology, w.m. starch grains, Iodine test).
5. Spices: • Black pepper (habit) • Fennel (habit) and •Clove (habit).
6. Beverages: • Tea (plant specimen and tea leaves).
7. Fiber-yielding plants: • Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), • Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome										PSO1	PSO2
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	3	1	-	-	2	-	-	2	-		2	1
CO2	2	3	2	2	3	2	-	1	2		3	2
CO3	2	3	2	-	-	-	-	1	-		3	2
CO4	3	3	2	-	-	2	-	1	2		2	3
CO5	3	3	1	2	2	1	1	2	2		3	3





Course title:	Plant Breeding	Course code:	BBOT401USE
Course type:	Subject Elective	Course credit:	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2 × 15 =30	00	00	10	05	35	50

Course Objective:

1. To discuss important results on Breeding systems, Important achievements and undesirable consequences of plant breeding, Selection methods and Hybridization procedure.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Familiarize with genetic basis of heterosis.
CO2	Explain monogenic and polygenic inheritance.
CO3	Reflect upon the role of various non- conventional methods used in crop improvement.

Content

Unit	Description in detail	Credit	Weightage
I	Plant Breeding	1	50 %
	Introduction, definition and objectives of plant breeding.		
	Breeding systems: modes of reproduction in crop plants.		
	Important achievements and undesirable consequences of plant breeding. Vegetatively propagated plants – Procedure, advantages and limitations.		
II	Inbreeding depression and heterosis	1	50 %
	History, genetic basis of inbreeding depression and heterosis; Applications.		
	Selection methods: Mass selection and Pure line selection. Hybridization procedure		
	Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.		

Reference Books:





1. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH.
2. 2nd edition. 2. Das, L.D. Vijendra (2006) Plant Breeding. New Age International Publishers, New Delhi.
3. 3. Sharma, J.R.(1994) : Principles and practices of Plant Breeding. Tata McGraw-Hill Publishing Company Ltd. , New Delhi

Suggested Readings:

1. Singh, B.D. (2012). Plant Breeding: Principles and Methods. Kalyani Publishers. 9th edition.
2. Singh, Phundan (1996): Essentials of Plant Breeding. Kalyani Publishers, New Delhi-2.

Online Resources:

1. <https://www.britannica.com/science/plant-breeding#:~:text=plant%20breeding%2C%20application%20of%20genetic,certain%20in%20dividuals%20among%20the%20progeny.>
2. <http://eagri.org/eagri50/GBPR211/lec21.pdf>

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2	2	2	-	-	2	-		3	3
CO2	2	2	2	-	-	2	-	-	2		3	2
CO3	2	2	2	1	-	-	2	2	-		2	3





Semester: V

Course title:	Algae, Fungi and Plant Pathology	Course code:	BBOT501DSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 = 45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on general characters, thallus organization, reproduction and life history of Cynophyta, Chlorophyta, Phaeophyta and Rhodophyta.
2. To discuss important results on Thallus organization, Nutrition, lifecycle and classification of fungi.
3. To discuss important results on Host-Pathogen relationships and Disease cycle and control measures of plant diseases.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	Identify true fungi and demonstrate the principles and application of plant pathology in the control of plant disease
CO2	Demonstrate skills in laboratory, field and glasshouse work related to mycology
CO3	Demonstrate skills in laboratory, field and glasshouse work related to plant pathology
CO4	Develop an understanding of microbes, fungi appreciate their adaptive strategies
CO5	Identify the common plant diseases according to geographical locations and device control measures

Content

Unit	Description in detail	Credit	Weightage
I	Algae	1	34 %
	Cyanobacteria: General characters, Organization of Thallus: Unicellular forms, Collonial forms: Non-filamentous and Filamentous colonies. Economic importance of Cyanobacteria		





	General characters of Algae and Thallus organization of Algae: Colonial, Coenobium and Filamentous. Ultra structure of Algal (Eukaryotic) cell i.e., Chlamydomonas cell. Harmful aspects of Algae.		
	Typical life histories of algae belonging to various divisions including classification (Smith, 1958), occurrence, structure, reproduction (excluding development): Cyanophyta: Nostoc Chlorophyta: Oedogonium		
	Phaeophyta: Ectocarpus Rhodophyta: Batrachospermum		
II	Fungi		
	General characters, Thallus organization: Unicellular, Filamentous - aseptate and septate mycelia.		
	Typical life histories of fungi belonging to various divisions including Classification (G C Ainsworth, 1973), occurrence, structure, reproduction (excluding development):	1	33 %
	Oomycetes: Pythium, Ascomycetes: Erysiphae Basidiomycetes: Agaricus		
	Forms of spore in Fungi: Asexual Spores, Sexual Spores.		
	Modes of nutrition of fungi		
III	Plant Pathology		
	The Fundamentals of Plant Pathology: Plant Pathogens: Bacteria, Virus and Fungi.		
	Classification of plant diseases on the basis of nature of the causal agent and occurrence.	1	33 %
	General symptoms, causal organism, disease cycle and control measures of following Plant diseases: White rust of Crucifer,		
	Black rust of Wheat and Wilt of Cotton		

Reference Books:

- Hait G, Bhattacharya K and Ghosh A K (2008) A Text Book of Botany , Vol-I, New Central Book Agency (P) Ltd., Kolkata(1 st Edition's Reprint).
- Singh V, Pande P C and Jain D K (2008-09) A Text Book of Botany, Rastogi Publications, Meerut(4 th Revised Edition's Reprint).
Vasishtha B R, Sinha A K and Singh V P (2007), Botany for degree students -Algae (5th edition), S. Chand & Co. Ltd., New Delhi. Pandey B P (2001), College Botany Vol. I, S. Chand & Co. Ltd., New Delhi.
- Purohit S S and Deo P P (2005), UGC Unified College Botany –First Year, Student edition, Jodhpur.
- Gangulee S.C., Das K.S., Dutta C.D. and Kar (1985), College Botany Vol. I, II & III , New Central Book Agency, Kolkata.

Suggested Readings:





1. Singh V, Pande P C and Jain D K (2008-09) A Text Book of Botany, Rastogi Publications, Meerut (4th Revised Edition's Reprint).
2. Sharma P D (2003) The Fungi, Rastogi Publications, Meerut (2nd Edition's Reprint).
3. Vashishta B R and Sinha A K (2007) Botany for Degree Students - Fungi, S Chand & Company Ltd., New Delhi (1st Edition's Revised and Multicolour -Reprint).
4. Vashishta B R and Sinha A K (2002), Botany for degree students -Fungi (5th edition), S. Chand & Co. Ltd., New Delhi Sharma O P (2002), Text Book of Fungi (9th edition), Tata McGraw-Hill Publishing Co Ltd., Delhi

Online Resources:

4. [https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with-diagram/46727#:~:text=The%20algae%20are%20ubiquitous%20\(present,mainly%20dwell%20in%20aquatic%20environments./](https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with-diagram/46727#:~:text=The%20algae%20are%20ubiquitous%20(present,mainly%20dwell%20in%20aquatic%20environments./)
5. <https://pragatiprakashan.in/new-pattern-mycology-and-phytopathology-ii-sem-odisha.html/>
6. <https://www.apsnet.org/about/Pages/WhatIsPhytopathology.aspx>

Practicals

Unit- 1: Algae

- Classify with reasons (up to family), identify and describe structural peculiarities of Algae mentioned in Theory syllabus.
- Cyanophyta: Nostoc
- Material: Vegetative structure.
- Permanent slide: Thallus, Heterocyst. Chlorophyta: Oedogonium
Material: Vegetative structure (Thallus), Antheridium: Macrocarous sp., Oogonium: Macrocarous sp.
- Permanent slide: Thallus, Antheridium: Macrocarous sp., Antheridium: Nanandrous species.
Oogonium: Macrocarous species. Zygote.
- Phaeophyta: Ectocarpus
- Material: Veg. structure, asexual reproductive structures - Uni & Pluri-ocular sporangia
- Permanent slide: Thallus, asexual reproduction - Uni and Pluri-ocular sporangia. Rhodophyta: Batrachospermum
- Material: Vegetative and reproductive structure - carposporangia and cystocarp
- Permanent slide: Thallus, cystocarp.

Unit- 2: Fungi

- Classify with reasons (up to family), identify and describe structural peculiarities of Fungi mentioned in Theory syllabus.
- Oomycetes: Pythium
- Material: Vegetative structure, Reproductive body: Asexual and Sexual.
- Permanent slide: Mycelium, Reproductive structure: Asexual, Sexual and Zygospore.
Ascomycetes: Erysiphae





- Material: Vegetative structure, reproductive body -cleistothecium.
- Permanent slide: Mycelium, reproductive structure - cleistothecium.
- Basidiomycetes: Agaricus Material: reproductive fruiting bodies
- Permanent slide: reproductive structure, L. S. and T. S. of gills.

Unit- 3: Plant pathology

- Plant diseases: Study through Fresh/Preserved material and Permanent slide
- White rust of Crucifer- reproductive structure -conidia
- Black rust of Wheat- reproductive structures -Telutospores, Uredospores
- Wilt of Cotton- reproductive structure -conidia, cleistothecium

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	2	1	2	-	1	2	1		3	1
CO2	2	3	2	-	2	1	-	-	2		2	1
CO3	2	3	2	-	2	1	-	-	2		2	2
CO4	2	3	1	-	-	2	-	2	1		2	1
CO5	3	3	-	2	2	-	-	2	2		3	2





Course title:	Bryophyta, Pteridophyta and Gymnosperms	Course code:	BBOT502DSC
Course type:	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on General Characteristics, morphology, anatomy and reproduction, Economic importance of Bryophytes, Pteridophytes and Gymnosperms.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands of archegoniate, Bryophytes, Pteridophytes and Gymnosperms
CO2	The student Demonstrate an understanding of archegoniate, Bryophytes, Pteridophytes and Gymnosperms
CO3	Understanding of plant evolution and their transition to land habitat.
CO4	Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms
CO5	Know about the structure , life history and economic importance of some plant of Bryophytes, Pteridophytes, Gymnosperms

Content

Unit	Description in detail	Credit	Weightage
I	Bryophyta	1	25 %
	General characters of Bryophyta. Origin of Bryophyta: From Algae and From Pteridophytes.		
	Vegetative reproduction in Bryophytes		
	Typical life-histories of Bryophyta belonging to various divisions including Classification (Proskauer, 1957), Occurrence, External and Internal Structure of Thallus and Reproduction (excluding development). Hepaticopsida: Riccia Anthocerotopsida: Anthoceros		





	Bryopsida: Funaria		
	Economic importance of bryophyta		
II	Pteridophyta	1	25 %
	General characters of Pteridophyta. Apospory and Apogamy.		
	Typical life-histories of Pteridophyta belonging to various divisions including Classification (Smith, 1955), Occurrence, External and Internal Structure of Plant body and Reproduction (excluding development). Lycophyta: Selaginella ArthropHYta: Equisetum		
	Pterophyta: Leptosporangiopsida :Marsilea		
	Types of Stele in Pteridophytes		
III	Gymnosperms	1	25 %
	Introduction: Affinities of Gymnosperms with Pteridophytes and Angiosperms		
	Economic importance of Gymnosperms.		
	General characters of Gymnosperms		
	Typical life-histories of Gymnosperms belonging to various divisions including Classification (Taylor, 1981), Occurrence, Structure and Reproduction (excluding developmnt). Coniferales: Pinus Ephedrales: Ephedra		

Reference Books:

1. Singh V, Pande P C and Jain D K (2008-09) A Text Book of Botany, Rastogi Publications, Meerut(4 th Revised Edition's Reprint)
2. Vashishta B R and Sinha A K (2007) Botany for Degree Students –Bryophyta, S Chand & CompanyLtd., New Delhi (1st Edition's Revised and Multicolour -Reprint).
3. Vashishta B R and Sinha A K (2007) Botany for Degree Students –Pteridophyta, S Chand & CompanyLtd., New Del hi (1st Edition's Revised and Multicolour -Reprint).

Suggested Readings:

1. Pandey B P (2003) College Botany –Vol.-II,S Chand & Company Ltd., New Delhi(1st Edition's Reprint)
2. Pandey S N, Misra S P and Trivedi P S (2003) A Text Book of Botany –Vol.-II,Vikas Publishing House Pvt Ltd., New Delhi(11th Revised Edition's Reprint).
3. Singh V, Pande P C and Jain D K (2008-09) A Text Book of Botany, Rastogi Publications, Meerut(4 th Revised Edition's Reprint).
4. Pandey B P (2003) Simplified Course in Botany –B Sc-II,S Chand & Company Ltd., New Delhi(1 st Edition's Reprint)
5. Bhatnagar S P and Moitra Alok (2006) Gymnosperms,,New Age International (P) Ltd.,Publishers.,NewDelhi(1stEdition'sReprint)

Online Resources:

1. <https://www.biologydiscussion.com/bryophyta/bryophyta-features-classification-and-economic-importance/5654>





2. <https://www.biologydiscussion.com/pteridophytes/pteridophytes-meaning-general-characters-and-affinities/53012>
3. <https://www.biologydiscussion.com/gymnosperm/gymnosperms-definition-external-features-and-reproduction/53316>

Practicals

Unit- 1: Bryophyta

- Classify with reasons (up to family), identify and describe structural peculiarities of Bryophytes mentioned in Theory syllabus.
- Hepaticopsida: Riccia
- Material: Vegetative structure: Thallus, Reproductive body: Antheridia and Archegonia.
- Permanent slide: Tallus (W M), V S of Thallus, Reproductive structure: Antheridia (W M) and Archegonia (W M), V S of Sporophyte/Capsule.
- Anthocerotopsida: Anthoceros
- Material: Vegetative structure: Thallus, Reproductive body: Sporophyte/Capsule.
- Permanent slide: Tallus (W M), V S of Thallus, Reproductive structure: Antheridia (W M) and Archegonia (W M), T S of Sporophyte/Capsule V S of Sporophyte/Capsule.
- Bryopsida: Funaria
- Material: Vegetative structure: Thallus, Sex organs, Sporophyte/Capsule, Spores, Peristomal teeth.
- Permanent slide: Tallus (W M), Sex organs, L.S. of capsule, Peristome, Protonema.

Unit- 2: Pteridophyta

- Classify with reasons (up to family), identify and describe structural peculiarities of Pteridophytes mentioned in Theory syllabus.
- Lycophyta: Selaginella
- Material: Plant body (Veg organs -root, stem, rhizophoe, leaf), reproduction - cone/ strobilus. Permanent slide: Plant body (WM), T.S. of root, T.S. of stem, T.S. of rhizophore, leaf (WM), reproduction: L. S. of cone, Megaspore (WM), Microspore (WM).
- Arthrophyta: Equisetum
- Material: Plant body (Veg. organs - stem, scaly leaves), reproduction - cone/ strobilus.
- Permanent slide: Plant body (WM), T. S. of stem, scaly leaves (WM), reproduction: L. S. of cone, T. S. of cone, Spores (WM).
- Pterophyta: Leptosporangiopsida – Marsilea
- Material: Vegetative structure (External and Internal): Root, Stem, Leaf. Reproductive body: Sporocarp.
- Permanent slide: T S of Root, Stem, Leaf, Reproductive structure: T S/V S of Sporocarp, Microspore, Megaspore.

Unit- 3: Gymnosperms





- Classify with reasons (up to family), identify and describe structural peculiarities of Gymnosperms mentioned in Theory syllabus.
- Coniferales: Pinus
- Material: Vegetative organs-leaves (needles), reproductive structures - male cone, female cone, Microspores (pollen grains).
- Permanent slide: Sections of stem, T.S. of leaf, reproduction: L. S. of male cone, T. S. of ovule,
- Microspores/Pollen grains (WM).
- Ephedrales: Ephedra
- Material: Vegetative organs. Reproductive structures - Male cone, Female cone, Microspores (pollen grains).
- Permanent slide: Sections of vegetative organs. L. S. of male cone, T. S. of ovule, Microspores/Pollen grains (WM).

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2	1	2	-	-	2	2		3	-
CO2	2	3	2	-	-	2	-	-	2		2	-
CO3	2	2	-	1	-	-	2	2	-		2	-
CO4	2	3	1	-	1	2	-	-	-		3	-
CO5	3	3	-	2	2	-	-	2	2		3	-





Course title :	Angiosperm Families, Plant Ecology and Plant Anatomy	Course code :	BBOT503DSC
Course type :	Discipline Specific Course	Course credit :	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on Studies of Angiosperm families, Climatic Factors, Autecology, Stomata, Nodal Anatomy, Secretory Tissue and Ergastic substances.

Course Outcome:

CO1	The student understands the concept of important results on understand core concepts of biotic and abiotic
CO2	Classify the soils on the basis of physical, chemical and biological components Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
CO3	Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium. Evaluate the Important herbaria and botanical gardens.
CO4	Interpret the rules of ICN in botanical nomenclature. Generalize the characters of the families according to Bentham & Hooker's system of classification.
CO5	examine the internal anatomy of plant systems and organs. Develop critical understanding on the evolution of concept of organization of shoot and root apex. Analyze the composition of different parts of plants and their relationships. Evaluate the adaptive and protective systems of plants

Content

Unit	Description in detail	Credit	Weightage
I	<p>Angiosperm Families</p> <p>Studies of Angiosperm families: Distinguishing characters and classification up to family with reasons as per Bentham and Hooker's (1862-80) system of classification of the following families including floral formula, floral diagram and botanical names of economically important any five plants.</p> <p>Dicotyledons: Polypetalae: Tiliaceae, Rhamnaceae, Cucurbitaceae. Gamopetalae: Solanaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Lamiaceae.</p>	1	25 %





	Monochlamidae: Amaranthaceae.		
	Monocotyledons: Commelinaceae, Amaryllidaceae.		
II	Plant Ecology Climatic Factors: Light factor: Light in relations to Plants. Temperature factor: Effects of temperature on Plants, Variations in temperature and its effects on distribution on Plants. Precipitation (Rainfall), Humidity in air and Wind. Abiotic environment: Liebig's Law of Minimum, Shelford's Law of Tolerance. Autecology: Introduction, Regeneration of a species: Seed output, Seed dispersal, Seed viability, Seed germination and reproductive capacity. Edaphic Factor: Soil: Soil Complex: Components and Properties: Mineral matter: Soil Texture, Soil structure and Porosity. Soil air, Soil Water, Soil Solution, Soil Organic matter and Soil Organisms.	1	25 %
III	Plant Anatomy Stomata: Structure and Function, Types -According to Metcalfe and Chalk (1950). Nodal Anatomy: Leaf Traces and Leaf gaps. Types of nodes. Secretory Tissue: Glandular trichomes, Hydathodes, Resin ducts and Laticifers. Ergastic substances: Food Pro ducts-Carbohydrates, Nitrogenous Products and Fats. Mineral crystals and Alkaloids. Leaf fall and wound healing.	1	25 %

Reference Books:

1. Lawrence G H M (1967) Taxonomy of Vascular Plants , Oxford & IBH Publishing Co.Pvt Ltd., New Delhi (1 st Indian Edition). Singh V Pande P C and Jain D K (1995) A Text Book of Botany-Angiosperms, Rastogi Publications, Meerut(1 st Edition's Reprint).
2. Singh V and Jain D K (1999) Taxonomy of Angiosperms, Rastogi Publications, Meerut (2 nd Edition's Reprint).

Suggested Readings:

1. Singh V, Pande P C and Jain D K (1998) Anatomy of Seed Plants , Rastogi Publications, Meerut(1 st Edition's Reprint).
2. Pandey B P (1997) Plant Anatomy, S Chand & Co. Ltd, New Delhi. (1st Edition's Reprint).
3. E John Jothi Prakash (2000) A Text Book of Plant Anatomy, Emkay Publications, Delhi. (2 nd Revised Edition).
4. Tayal M S (2001) Plant Anatomy, Rastogi Publications, Meerut(5 th Edition's Reprint).





Online Resources:

1. <https://www.slideshare.net/AvishekDas47/plant-ecology-96989720/>
2. [https://bio.libretexts.org/Bookshelves/Botany/Botany_\(Ha_Morrow_and_Algers\)/Unit_1%3A_A_Biodiversity_\(Organismal_Groups\)/08%3A_Angiosperm_Diversity/8.04%3A_Angiosperm_Families](https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algers)/Unit_1%3A_A_Biodiversity_(Organismal_Groups)/08%3A_Angiosperm_Diversity/8.04%3A_Angiosperm_Families)
3. <https://byjus.com/jee/anatomy-of-flowering-plants/>

Practicals

Unit- 1: Angiosperm Families

- Identify and classify (as per Bentham and Hooker's system) the family giving reasons and Draw diagrams: A flowering twig, L S of Flower, other floral structures, floral formula and floral diagram of locally available plant specimens of families as mentioned below.
- Dicotyledons: Polypetalae: Tiliaceae, Rhamnaceae, Cucurbitaceae. Gamopetalae: Solanaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Lamiaceae.
- Monochlamydae: Amaranthaceae. Monocotyledons: Commelinaceae, Amaryllidaceae.

Unit- 2: Plant Ecology

- Study of ecological instruments:
- Maximum and Minimum Thermometer, Dry and Wet Bulb Thermometer, Hygrometer
- Anemometer, Rain guage
- To determine Carbonate, Nitrate and Base deficiency in scale of 0-5 in soil sample.
- To determine Chloride content in a water sample.
- To determine pH in a water and soil sample.
- To determine Total hardness of a water sample.
- To determine Carbonate and Bi -carbonate in a water sample.
- To determine field/water holding capacity of different soil samples.
- Mechanical separation of soil sample to study the percentage of different particle s (contents) of soil samples.
- Study of Physical characters i.e., weight, length, width, volume, colour and shape of the seed.

Unit- 3: Plant Anatomy

- To study the various types of Stomata as per theory syllabus:
- Anomocytic: From any plant species of families Papaveraceae, Cappar aceae, Nyctaginaceae. Anisocytic: From any plant species of families Brassicaceae, Solanaceae, Convolvulaceae. Diacytic: From any plant species of families Lamiaceae, Acanthaceae and Paracytic: From any plant species of family Rubiaceae. To study the Glandular Trichomes from Datura, Ocimum stem epidermis, fruit wall of Boerhaavia diffusa. Hydathode from Colocasia leaf, Nephrolepis leaflet. Resin ducts from Pinus leaflet, Sunflower stem.





- To study Articulated or Non -Articulated Latex tissue from the plant species of families viz., Convolvulaceae, Sapotaceae, Caricaceae, Asteraceae, Euphorbiaceae, Asclepiadaceae, Moraceae, Papaveraceae and Apocynaceae.
- To study the UniTri and Multilacunar nodes from stem (Nodal region) of Annona, Azadirachta and Chenopodium respectively.
- To study the ergastic substances with appropriate staining:
- Starch grains: various types e.g., Caryopsis of Maize, Wheat, Rice and tuber of Potato.
- Aleurone layer e.g, Maize. Aleurone crystals e.g., Seed of castor. Fat particles e.g., seed of Castor, Groundnut and Coconut (endosperm). Mineral Crystals e.g., Calcium oxalate: Raphids-Petiole of Colocaciaand Stem of Commelina. Sphaeraphids: Nerium leaf. Calcium carbonate: Cystoliths-Ficus (Banyan) leaf Alkaloids e.g. Withania -Root, Vinca-Stem and Nicotiana-leaf and leaf of Adhatoda and Datura

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	-	-	1	2	-	-	2	-		3	-
CO2	2	3	2	-	-	2	-	-	2		2	-
CO3	2	2	-	1	-	-	2	2	-		2	2
CO4	2	3	1	-	1	2	-	-	-		3	1
CO5	3	3	-	2	2	-	-	-	-		3	2





Course title :	Cell Biology & Genetics, Microbiology and Biostatistics	Course code :	BBOT504DSC
Course type :	Discipline Specific Course	Course credit :	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 =45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on Cell biology, Linkage maps, Cell structure of Bacteria, Measure of Dispersion and Theorems of Probability.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands the concept of Have conceptual understanding of Chromosomal Aberrations ,genetic
CO2	Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
CO3	Analyze the effect of mutations on gene functions and dosage. Examine the structure, function and replication of DNA.
CO4	Develop understanding on the concept of microbial nutrition
CO5	Increase the awareness and appreciation of human friendly viruses and bacteria their economic importance

Content

Unit	Description in detail	Credit	Weightage
I	Cell Biology & Genetics	1	25 %
	Cell biology: Mitochondria: Morphology and Ultra structure, Chemical composition and Functions. Plastids: Types of Plastids, Chloroplasts: Morphology, Chemical composition, Ultra structure and Functions.		
	Genetics: Non-Mendelian Inheritance: Genetic Inter action: 9:6:1 and 13:3. Crossing over and		





	Linkage maps: Recombination frequencies from a test cross and F 2 data. Linkage groups: Introduction, Chi-square test for segregation ratios and detection of linkage.		
	Chromosomal Aberrations: Structural Changes in Chromosomes- Deletion, Duplication, Inversion, Translocation. Numerical Changes in Chromosomes - Euploidy: Monoploidy Polyploidy: Autopolyploids, Allopolyploids Aneuploidy: Monosomy, Nullisomy, Trisomy and Tetrasomy.		
II	Microbiology (Bacteriology)		
	Cell structure of Bacteria: Cellwall -structure and chemical composition, Cytoplasmic membrane, Mesosomes, Cytoplasmic inclusions and vacuoles, Nuclear material.		
	Preparation for light microscope examination: Wet mount and Hanging drop technique. Fixed stained smear- Gram staining.	1	25 %
	Isolation, Maintenance and Preservation of Pure cultures: Streak -plate, Pour plate and Spread plate techniques. Maintenance and Preservation: Periodic transfer, overlaying cultures with mineral oil, Freeze-drying, storage at low temperatures.		
	The Immune response: Antigens, Antibodies, Monoclonal antibodies.		
III	Biostatistics		
	Measure of Dispersion -I: Definition, computation, Merits and Demerits and Properties of: Mean Deviation and Standard Deviation: Ungrouped data, Grouped data: Discrete series and Continuous series.		
	Measure of Dispersion-II: Definition, computation, Merits and Demerits and Properties of: Variance and Co-efficient of Variance. Standard Error	1	25 %
	Probability: Important terms, Definition of Probability		
	Theorems of Probability: The Addition Theorem and The Multiplication Theorem		

Reference Books:

1. Strickberger M W (2005) Genetics, Prentice-Hall of India Pvt Ltd., New Delhi (3 rd Edition-EEE).
2. Rastogi Veer Bala (1991-92) A Text Book of Genetics , Kedar Nath Ram Nath, Meerut (9 th Revised Edition).
3. Singh B D (2001) Plant Breeding -Principles and Methods, Kalyani Publishers, Ludhiana (1st Edition's Reprint).
4. Gupta P K (2005) Genetics, Prentice-Hall of India Pvt Ltd., New Delhi (3 rd Edition-EEE)
5. Verma P S and Agarwal (2006) Cell Biology, Genetics , Molecular Biology, Evolution and Ecology .S Chand & Company Ltd., New Delhi(1st Multicolour Edition-Reprint).
6. Sambamurty (), Genetics (2nd edition)
7. Gupta P K (2007), Genetics-classical to modern (1st edition)





8. Patel B C (2012) Human Genetics (Manav Janinivgnan -in Gujarati) Gujarat Vishvakosh Trust, Ahmedabad-380 013 (1st edition).

Suggested Readings:

1. Banerjee P K (2004) Introduction to Biostatistics [A Textbook of Biometry], S Chand & Company Ltd., New Delhi (1st Edition).
2. Prasad S (2001) Elements of Biostatistics, Rastogi Publications, Meerut (1st Edition).

Online Resources:

9. Chandel S R S (2006) A Hand Book of Agricultural Statistics, Achal Prakashan Mandir, Kanpur (1st Edition).
1. <https://www.toppr.com/guides/biology/the-fundamental-unit-of-life/structure-of-cell/>
2. <https://byjus.com/neet-questions/give-the-classification-of-bacteria-based-on-the-arrangement-and-number-of-flagella/>
https://sphweb.bumc.bu.edu/otlt/mph-modules/bs/bs704_biostatisticsbasics/bs704_biostatisticsbasics_print.html

Unit- 1: Cell Biology & Genetics

- Study of cell organelles (as per theory syllabus) through Permanent Slides/Charts/Models/Photographs.
- Study of chromosomal aberrations (as per theory syllabus) through Charts/ Models/ Photographs.
- Solve Genetical problems and conclude from topics given in the theory syllabus.

Unit- 2: Microbiology (Bacteriology)

- Study of bacterial cell through diagram, chart/microphotograph.
- Wet mount and Hanging drop technique.
- Fixed stained smear-Gram staining.
- Study of Microorganisms's Isolation techniques through prepared plates.
- Principles and working of following apparatus: Autoclave, Hot air oven and laminar air flow.
- Detection of Blood group -A, B, AB, O/Rh+, Rh- using Blood grouping test.

Unit- 3: Biostatistics

- Solve and conclude the statistical problems on: Mean deviation, Standard deviation, Variance, Co-efficient of Variance, Standard error and Probability





CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-		2	-
CO2	2	2	2	-	-	2	-	-	2		2	-
CO3	2	2	1	1	-	-	-	-	-		2	-
CO4	2	3	1	-	1	2	-	-	-		2	1
CO5	3	3	-	2	2	-	-	2	2		3	2





Course title :	Air Pollution	Course code :	BBOT501SE
Course type :	Subject Elective	Course credit :	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2 × 15 =30	00	00	10	05	35	50

Course Objective:

1. To discuss important results on Pollution and pollutants, Green House Effect, Global Warming and Prevention and control of air pollution.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands the concept of Understand the fundamental issues of environment . .
CO2	Analyze different sources of environmental problems
CO3	Analyze different methods of measurement of pollution

Content

Unit	Description in detail	Credit	Weightage
I	Pollution and pollutants	1	50 %
	Define Pollution and pollutants. Various principal environmental pollutants with examples		
	Kinds of pollutants: Non -degradable and Bio -degradable.		
	Air Pollution: Introduction, Air quality, sources and pollutants: Industrial Chimany wastes.		
	Thermal power station and Automobile.		
II	Effect of pollution	1	50 %
	Nitrogen oxides: Nitrogen oxide, Nitric oxide and Nitrogen dioxide.		
	Fluorocarbons and Hydrocarbons. Metals and Photo-chemicals products.		
	Prevention and control of air pollution.		
	Green House Effect, Global Warming, Ozone -depletion, and Acid rain.		



Reference Books:

1. Sharma P. D. (7th Edition - Reprint 2003). Ecology and Environment. Rastogi Publications, Meerut.

Suggested Readings:

1. Sharma P. D. (7th Edition - Reprint 2003). Ecology and Environment. Rastogi Publications, Meerut.

Online Resources:

- <https://www.yourarticlelibrary.com/essay/pollution-and-pollutants-classification-causes-effects-and-sources/27407/>
<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/pollution-effect/>

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome										PSO1	PSO2
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	3	2	2	1	2	-	-	2	2		3	2
CO2	2	3	2	-	-	2	-	-	2		2	3
CO3	2	2	1	1	-	-	2	2	1		2	2



Semester: VI

Course title :	Molecular Biology, Plant Pathology & Lichens and Angiosperm Families	Course code :	BBOT601DSC
Course type :	Discipline Specific Course	Course credit :	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 =45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on Chemical Nature of Genetic materials, Replication of DNA, Lichens, Dissemination of Plant Pathogens and Classification (as per Bentham and Hooker's system).

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands the concept of Identify the principles and application of plant pathology in the control of plant disease, differentiate the main types of prokaryotes through their grouping abilities and their characteristic.
CO2	Acquaintance with various laboratory equipment and their uses in plant pathology
CO3	Evaluate the experiments establishing central dogma and genetic code
CO4	Gain an understanding of various steps in transcription, protein synthesis and protein modification
CO5	Generalize the characters of the families according to Bentham & Hooker's system of classification.

Content

Unit	Description in detail	Credit	Weightage
I	Molecular Biology	1	34 %
	Chemical Nature of Genetic materials: Molecular structure of De -oxy riboNucleic Acid-Watson and Crick model, Molecular structure of RiboNucleic Acid and Types of RNA.		
	Replication of DNA: Mechanism of DNA replication in Eukaryotes and Prokaryotes		
	Transcription: Mechanism of Prokaryotic Transcription, Mechanism of Eukaryotic Transcription		





	Genetic Code and Translation: Genetic Code -Characteristics and Genetic codon/dictionary. Translation-Mechanism of Protein Synthesis.		
II	Plant Pathology & Lichens Plant Pathology: Defense Mechanisms in Plants: Morphological Defense Mechanism and Biochemical Defense Mechanism. Dissemination of Plant Pathogens: Direct dissemination and Indirect dissemination. Study of Plant Diseases: Following diseases of Plants, their symptoms, causal organisms, disease cycle and their control measures: 1. Late Blight of Potato 2. Tikka disease of Groundnut and 3. Powdery mildew of Cucurbits . Lichens: General Characters of Lichens, Classification of the Lichens - Ascolichens and Basidiolichens. Structure of Thallus - Crustose, Foliose and Fruticose and Reproduction of Lichen- Asexual and Sexual	1	33 %
III	Angiosperm Families Classification (as per Bentham and Hooker's system), distinguishing characters, floral formula, floral diagram, common examples of economically important plants of the following families. Dicotyledons: Polypetalae: Cruciferae (Brassicaceae), Papaveraceae, Rutaceae. Gamopetalae: Sapotaceae, Asteraceae. Monochlamydae: Moraceae. Monocotyledons: Cannaceae, Cyperaceae, Poaceae. Dichotomous Key Angiosperm Taxonomy in relation to anatomy and embryology.	1	33 %

Reference Books:

1. Verma P S and Agarwal (2006) Cell Biology, Genetics , Molecular
2. Biology, Evolution and Ecology .S Chand & Company Ltd.,New Delhi(1st
3. Multicolour Edition-Reprint).
4. Rangaswami G (1988) Diseases of Crop plants in India, Prentice -Hall of India
5. Pvt. Ltd., New Delhi (3rdEdition).
6. Pandey B P (2006) Plant Pathology -Pathogen and Plant Diseases, S Chand &
7. Co. Ltd., Ne w Delhi (1st Edition's Reprint).
8. Mehrotra R S (1991) Plant Pathology, Tata McGraw -Hill Publishing Co. Pvt.
9. Ltd., New Delhi (8th Edition's Reprint).
10. Agrios George N (2004) Plant Pathology, Academic Press, Reed Elsevier India

Suggested Readings:

1. Lawrence H M (1951) Taxonomy of Vascular Plants, Oxford Publication.
2. Sambamurty A V S S (2005) Taxonomy of Angiosperms, I K International P
3. L, New Delhi





4. Pandey B.P. (2005) Taxonomy of Angiosperms, S Chand A.S. Foster & E.M.
5. Gifford Comparative Morphology of Vascular Plants
6. K.R. Sporne The Morphology of Vascular Plants
7. R.N. Sutaria A Text Book of Systematic Botany
8. Y.D. Tyagi & S.Kshetrapal An Introduction to Taxonomy of Angiosperms
9. P.C. Vashishta Taxonomy of Angiosperm

Online Resources:

2. <https://www.nature.com/subjects/molecular-biology#:~:text=Molecular%20Biology%20is%20the%20field,the%20cell's%20functions%20and%20maintenance.>
3. <https://pddc.wisc.edu/2015/07/28/lichens/>
4. <https://www.slideshare.net/YOGITASHARMA92/key-characters-of-some-major-angiosperm-families-220934133>

Practicals

Molecular Biology, Plant Pathology & Lichens and Angiosperm Families

Unit- 1: Molecular Biology

- Study through Permanent Slides/Charts/Models/Photographs:
- Watson and Crick's model of DNA / Molecular structure of DNA,
- Types of RNA / Molecular structure of RNA,
- DNA Replication,
- Transcription and
- Translation: Genetic code and Protein synthesis

Unit- 2: Plant Pathology & Lichens

- Plant diseases: Study through Fresh/Preserved material and Permanent slide
- Late Blight of Potato - reproductive structure -sporangia
- Tikka disease of Groundnut - reproductive structure -conidia
- Powdery mildew of Cucurbits - reproductive structures
- Study of different specimens: Crustose, Foliose and Fruticose.
- Material/Permanent slide: Thallus of Lichen, Fruiting bodies, T S of Lichen Thallus and V S of fruiting bodies.

Unit- 3: Angiosperm Families

- Identify and classify (as per Bentham and Hooker's system) the family giving reasons and Draw diagrams: A flowering twig, L S of Flower, other floral structures, floral formula and floral diagram of locally available plant specimens of families as mentioned below.
- Dicotyledons:
 - o Polypetalae: Cruciferae (Brassicaceae), Papaveraceae, Rutaceae.
 - o Gamopetalae: Sapotaceae, Asteraceae.
 - o Monochlamydae: Moraceae.
- o Monocotyledons: Cannaceae, Cyperaceae, Poaceae.





o Prepare dichotomous key with the help of locally available plant species.

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	-	-	1	-	1	-	-		3	1
CO2	2	3	-	-	1	1	-	-	-		2	1
CO3	3	3	-	-	-	1	-	-	1		2	1
CO4	3	-	-	-	-	-	-	-	-		2	1
CO5	2	3	1	-	2	-	1	-	-		3	1





Course title :	Biochemistry and Plant Physiology	Course code:	BBOT602DSC
Course type :	Discipline Specific Course	Course credit:	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 =45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on Lipid, Vitamins, Enzymes, Translocation of Food in Plants, Path of Carbon in Photosynthesis, Respiration, Seed Dormancy and Physiological role of Phytohormones.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands the concept of Comprehend different fundamental concepts related to plant biochemistry like plant cell organelles, photosynthesis, respiration and lipid metabolism etc.
CO2	The student Analyze the structure and properties of various enzymes
CO3	The student Evaluate the process of ATP Synthesis, nitrogen metabolism and lipid metabolism
CO4	The student Explain chemical properties and deficiency symptoms in plants. Classify aerobic and anaerobic respiration
CO5	The student Explain the significance of Photosynthesis and respiration. Assess dormancy and germination in plants

Content

Unit	Description in detail	Credit	Weightage
I	Biochemistry	1	34 %
	Lipids: Beta-Oxidation of Fatty acid: Activation of Fatty acid, Reaction of Fatty acid. Bio -synthesis of Fatty acid: Acetyl Co -A transport, Production of Malonyl Co -A, The Priming Phase and Elongation Phase		
	Vitamins: Definition, types and significance. Water soluble vitamins: their functions and deficiency disease. Fat soluble vitamins: their functions and deficiency disease.		
	Enzymes: Definition, Nomenclature and Classification		
	Isoenzymes, Properties of Enzymes, Factors influencing action of Enzymes.		
II	Plant Physiology-I	1	33 %





	Translocation of Food in Plants: Phloem sap composition, Mechanism of Phloem transport: Pressure-driven Flow, Factors affecting Translocation.		
	Photosynthesis-I: Light Reaction: Introduction, Hill reaction, Plant pigments, Light as a biological agent, Mechanism of Light absorption and emission, Light harvesting and transfer of Energy, Photosynthetic Unit, Red drop and Emerson Enhancement effect, Photosystem I and II.		
	Photo-phosphorylation: Non-cyclic electron flow and Photo - phosphorylation, Cyclic electron flow and Photo-phosphorylation.		
	Photosynthesis-II: Path of Carbon in Photosynthesis: C3 Photosynthetic cycle, C 4 Photosynthetic cycle, Anatomical characteristics of C 4 Plants, Significance of C 4 Cycle, Crassulacean Acid Metabolism (CAM), Significance of CAM, Relationship between C 4 and CAM.		
III	Plant Physiology-II		
	Respiration: Introduction, Glycolysis, Fermentation, Citric Acid Cycle, Oxidative Phosphorylation, Respiratory Quotient, Energy yield of Aerobic respiration.		
	Photoperiodism: Definition, critical day length and types of plants [i.e., SDPs, LDPs and Day neutral Plants] and importance of both dark and light periods. Florigen concept and Vernalization.	1	33 %
	Seed Dormancy: Definition, causes of seed dormancy and measures to break seed dormancy.		
	Physiological role of Phytohormones i.e., Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene.		

Reference Books:

1. Deb A C (2008) Fundamentals of Biochemistry, New Central Book (P) Ltd., Kolkata (9 th Edition Revised).
2. Jain J L, Jain Sanjaya and Jain Nitin (2005) Fundamentals of Biochemistry, S Chand & Co. Ltd., New Delhi (6 th Revised Edition).
3. Mukherji S and Ghosh A K (2005) Plant Physiology, New Central Book Agency (P) Ltd., Kolkata (1 st Central Edition).
4. Devlin Robert M and Witham Francis H (1986) Plant Physiology, CBS Publishers and Distributors, Delhi (4 th Edition/ 1st Indian Edition)
5. Gill P S , Plant Physiology (1st edition)
6. Ross Salisbury , Plant Physiology (4th edition)
7. Srivastava H S (2004), Plant Physiology (2nd edition)
8. Sundara Rajan S , Plant Physiology (edition).

Suggested Readings:

1. Sornathai Annie, Rajakumar K, Jayakumar M and Rajarathinam K , Plant Physiology (edition).
2. Verma S K and Verma Mohit , Plant Physiology, Biochemistry and





4. Biotechnology, Verma V, A Text Book of Plant Physiology, Emkay
5. Publication, New Delhi.
6. Sundara Rajan S (2001), Practical Manual of Plant Ecology and Plant
7. Physiology (1st edition), Jain V.K., Fundamentals of Plant Physiology
8. Pandey S.N. and B.K. Sinha, Plant Physiology
9. Verma P.S. and P.K. Agarwal, Plant Physiology

Online Resources:

2. <https://www.britannica.com/science/biochemistry>
3. <https://byjus.com/biology/plant-physiology/>
4. <https://www.biologydiscussion.com/plant-physiology-2/notes-plant-physiology/34597>.

Practicals

Biochemistry and Plant Physiology

Unit- 1: Biochemistry

- Major Experiments:
 - To determine the effect of different concentration of substrate on enzyme amylase.
 - To determine the effect of concentration of enzyme amylase on substrate.
 - Minor Experiments:
 - Estimation of Free Fatty acids from fat/oil by titration method. Demonstration Experiment:
 - Demonstration of respiratory enzymes in plant tissues: Polyphenol oxidase, Dehydrogenase.
- Study of deficiency diseases through charts/photographs.

Unit- 2: Plant Physiology-I

- Physiological Experiments to be performed by students.
- Major experiments:
 - To isolate Plant pigments by solvent extraction method using separating funnel.
 - To determine Respiratory Quotient (RQ, i.e., CO_2/O_2) using Ganong's Respirometer.
 - To determine rate of Photosynthesis under varying CO_2 concentration.
 - To determine rate of Photosynthesis under different wavelengths of light.
 - To determine rate of Photosynthesis under various intensity of light.
- Minor experiments:
 - To show the process of Photosynthesis is by Simple glass apparatus/Wilmott's Bubbler.
 - To separate Plant pigments using Paper Chromatography.

Unit- 3: Plant Physiology-II

- Physiological Experiments to be demonstrated to the students.
- To demonstrate alcoholic fermentation using Kuhne's tube.
- To demonstrate light is essential using Ganong's light screen.
- To demonstrate CO_2 is essential using Moll's half-leaf experiment.
- To demonstrate food translocation by phloem through ringing experiment.
- To demonstrate Hill's reaction





CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-		3	1
CO2	3	-	-	-	-	1	-	-	-		2	1
CO3	3	2	1	-	-	-	-	-	-		2	2
CO4	3	2	1	-	-	1	1	-	-		3	1
CO5	2	3	-	1	2	-	-	-	-		3	2





Course title :	Economic Botany, Plant Tissue Culture & Biotechnology and Genetics&Plant Ecology	Course code :	BBOT603DSC
Course type :	Discipline Specific Course	Course credit :	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3 × 15 =45	00	90	20	10	70	100

Course Objective:

1. To discuss important results on Economic Botany, Plant Tissue Culture, Recombination DNA Technology, Sex Determination and Sex Linkage, Maternal Effects and Cytoplasmic Heredity, Energy Flow in the Ecosystems and Production Ecology.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The student understands the concept of Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.
CO2	The student Develop their competency on different types of plant tissue culture.
CO3	The student understands Critically analyze the major concerns and applications of transgenic technology.
CO4	The student is able to Analyze the enzymes and vectors for genetic manipulations.
CO5	The student Examine gene cloning and evaluate different methods of gene transfer.

Content

Unit	Description in detail	Credit	Weightage
I	Economic Botany	1	34 %
	Introduction, cultivation, scientific name, family, useful part(s), chemical constituents and economic importance of the following plants: Oil seeds: Ground nut, Mustard, Sunflower.		
	Introduction, cultivation, scientific name, family, useful part(s), chemical constituents and economic importance of the following plants: Fibres: Cotton, Jute		
	Medicinal Plants: Root: Ashwagandha. Underground stem: Turmeric. Leaf: Amla. Fruit: Amla. Seed: Isabgol		
	Dyes: Henna, Kesudo Wood: Timber: Teak and Fire wood: Baval.		





II	Plant Tissue Culture & Biotechnology	1	33 %
	Plant Tissue Culture-I: Nutrition medium: Media composition -Inorganic nutrients, Carbon and energy source, Vitamins, Growth regulators, Organic supplements, Gelling agents and pH. Sterilization Techniques: Steam sterilization, Dry sterilization and Chemical sterilization of explants.		
	Plant Tissue Culture-II: Types of Culture: Embryo culture, Callus culture and Meristem culture.		
	Recombination DNA Technology: Gene cloning -I: Basic events in gene cloning, Enzymes for cutting-Restriction Endo-Nuclease-II, Enzymes for joining- DNA ligase, DNA-modifying enzymes-Kinase, Alkaline Phosphatase, DNA Polymerase and Terminal transferase. Linkers and adaptors.		
	Recombination DNA Technology: Gene cloning-II: Features of vector, Vectors: Plasmids - pBR322, Cosmids and Bacteriophage -Lemda.		
III	Genetics & Plant Ecology	1	33 %
	Genetics: Sex Determination and Sex Linkage: Chromosome Theory: Sex - chromosomes and Autosomes, Types of chromosomal mechanisms of Sex - determination. Sex-linkage: Sex-linked inheritance in Drosophila, Sex -linked inheritance in Man, Sex - influenced and sex-limited genes.		
	Maternal Effects and Cytoplasmic Heredity: Maternal effect. Cytoplasmic Inheritance: Plastid inheritance in Mirabilis jalapa and male sterility in corn (Zea mays), Respiratory deficiencies.		
	Plant Ecology: Energy Flow in the Ecosystems: Single channel Energy model and Y-shaped Energy Flow Model. Bio-geo Chemical Cycles: Carbon, Nitrogen and water cycles.		
	Production Ecology: Productivity: Definition, Primary Productivity -GPP and NPP, Measurement of Primary Productivity -Harvest method, Leaf Area Index method and Chlorophyll estimation method. Secondary Productivity.		

Reference Books:

1. Singh V, Pande P C and Jain D K (1998) Anatomy of Seed Plants , Rastogi Publications, Meerut(1 st Edition's Reprint).
2. Pandey B P (1997) Plant Anatomy, S Chand & Co. Ltd, New Delhi. (1 st Edition's Reprint).
3. E John Jothi Prakash (2000) A Text Book of Plant Anatomy, Emkay Publications, Delhi. (2nd Revised Edition).
4. Tayal M S (2001) Plant Anatomy, Rastogi Publications, Meerut (5th Edition's Reprint).
5. Chawla H S (2002) Introduction to Plant Biotechnology, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi (2 nd Edition).
6. Sambamurty , Genetics (2nd edition),
7. Rastogi Veer Bala A Text Book of Genetics (9th edition)



9. Gupta P K (2009), Genetics (3rd edition),
10. Gupta P K (2007), Genetics-classical to modern (1st edition)

Suggested Readings:

1. Sharma P D (2003) Ecology and Environment, Rastogi Publications, Meerut. (7th Edition's Reprint).
2. Agrawal K C (2001) Fundamentals of Environmental Bio logy, Nidhi Publishers (India),Bikaner. (1 st Edition).
3. Subrahmanyam N S and Sambamurty A V S (2000) Ecology, Narosa Publishing House, NewDelhi. (1 st Edition).
4. Kormondy E J (2002) Concept of Ecology, Prentice-Hall of India Pvt Ltd., New Delhi (12 thIndian Edition Reprint).
5. Patel B C (2012) Human Genetics (Manav Janinvignan -in Gujarati) Gujarat Vishvakosh
6. Trust, Ahmedabad -380 013 (1st edition)

Online Resources:

2. <https://www.springer.com/journal/12231#:~:text=Economic%20Botany%20is%20a%20quarterly,and%20potential%20uses%20of%20plants.>
3. <https://www.banglajol.info/index.php/PTCB>
4. <https://academic.oup.com/aobpla/article/13/6/plab057/6364968>

Practicals

Economic Botany, Plant Tissue Culture & Biotechnology and Genetics & Plant Ecology

Unit- 1: Economic Botany

- Give scientific name, family, useful parts, chemical constituents and economic importance of given plants.
- Oil seeds: Ground nut,
- Mustard, Sunflower.
- Fibers: Cotton, Jute.
- Root: Ashwagandha,
- Undergroundstem: Turmeric,
- Leaf: Arduasi, Fruit: Amla, Seed:
- Isabgul
- Dyes: Henna,
- Kesudo Timber:
- Teak.Fire wood:
- Baval

Unit- 2: Plant Tissue Culture & Biotechnology

- Prepare Nutrition Media for Embryo culture, Callus culture and



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- Meristem culture. Learn various sterilization techniques required
- for ex plants and media.
- Study of various vectors through charts/diagrams, etc.

Unit-- 3: Genetics & Plant Ecology

- Study of sex determination, sex linkage, cytoplasmic
- inheritance through chart/diagram/photographs.
- Solve Genetical problems as per theory syllabus.
- To measure the Primary productivity as per theory syllabus.
- Study of energy models and bio-geo chemical cycles through
- chart/diagram/photographs. Calculation of leaf area index.
- To determine above and below ground Biomass by monolith (25cm x25cm x30cm)
- method

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-		3	2
CO2	2	3	-	-	2	-	-	-	1		2	2
CO3	2	3	1	-	1	-	-	-	-		2	2
CO4	3	-	-	-	-	-	-	-	-		3	2
CO5	2	3	-	-	2	-	-	1	1		3	2





Course title :	Plant Anatomy and Plant Breeding	Course code :	BBOT604DSC
Course type :	Discipline Specific Course	Course credit :	03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3 × 15 =45	00	90	Mid	CE	70	100
			20	10		

Course Objective:

1. To discuss important results on Root-Stem Transition, Methods in Plant Anatomy, Origin of Crop Plants, Artificial Vegetative Reproduction, Selection in Self-pollinated crops, Breeding Methods and Hybrid vigour.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The students Gain knowledge about basic Familiarize with genetic basis of heterosis.
CO2	The students Classify Sexual and Asexual modes of reproduction. Explain monogenic and polygenic inheritance. Reflect upon the role of various non- conventional methods used in crop improvement.
CO3	The students examine the internal anatomy of plant systems and organs.
CO4	The students Develop critical understanding on the evolution of concept of organization of shoot and root apex
CO5	The students Analyze the composition of different parts of plants and their relationships. Evaluate the adaptive and protective systems of plants

Content

Unit	Description in detail	Credit	Weightage
I	Plant Anatomy	1	34 %
	Root-Stem Transition: Definition and Types. Anatomy of Special organs: Epiphytic root -Orchid and Aerial/Stilt root-Banyan.		
	Anatomy in relation to Taxonomy: Trichomes, Stomata, Epidermis, Internal structure of Leaf, Petiole and Node.		
	Methods in Plant Anatomy: Collection of Material, Fixation and Preservation, Dehydration, Infiltration, Embedding and Block making. Sectioning with Microtome Stains, Staining and Mounting.		
	Anomalous Secondary Growth: Stem - Boerhaavia, Achyranthes, and Dracaena. Root- Ipomoea batatas.		
II	Plant Breeding-I	1	33 %





	Introduction: Definition, Origin and evolution of Crop plants: Centres of Origin and Patterns of Evolution.		
	Origin of Crop Plants: Origin of Rice, Wheat, Cotton. Scope and Objectives of Plant Breeding.		
	Artificial Vegetative Reproduction: Cutting, Layering, Grafting, Budding, Potting and re -potting. Sexual Reproduction: Apomixis -apospory and apogamy, Significance of Apomixis.		
	Selection in Self-pollinated crops: The Pure -line selection - Purpose, Procedure, Merits and Demerits and Achievements. Mass selection - Purpose, Procedure, Merits and Demerits and Achievements. Comparison between Pure line selection and Mass selection		
III	Plant Breeding-II		
	Breeding Methods: Hybridization: Purpose and General Technique - Choise of Parents, Crossing Schedule, Emasculation and Bagging, Tagging, Pollination, Harvesting and Storing F1 seeds, Raising F1 generation, Selfing, Consequences of hybridization.		
	Breeding Methods: Methods in Hybridization: Methods in Self - pollinated crop-Pedigree method: Procedure, and Merits and Demerits and Achievements	1	33 %
	Bulk method -Procedure, Merits and Demerits and Achievements. Comparison between Bulk and Pedigree method.		
	Hybrid vigour (Heterosis): Definition, its various effects, Causes: Dominance hypothesis and over dominance hypothesis, Achievements, Utilization and limitations.		

Reference Books:

1. Singh V, Pande P C and Jain D K (1998) Anatomy of Seed Plants, Rastogi Publications, Meerut(1 st Edition's Reprint).
2. Pandey B P (1997) Plant Anatomy, S Chand & Co. Ltd, New Delhi. (1st Edition's Reprint).
3. E John Jothi Prakash (2000) A Text Book of Plant Anatomy, Emkay Publications, Delhi. (2 nd Revised Edition).

Suggested Readings:

1. Tayal M S (2001) Plant Anatomy, Rastogi Publications, Meerut (5 th Edition's Reprint).
2. Kar Dipak Kumar and Halder Soma (2006) Plant Breeding and Biometry, NewCentral Book Agency (P) Ltd. Kolkata (1 st Edition).
3. Singh B D (2001) Plant Breeding-Principles and Methods , Kalyani Publishers, Ludhiana(1st Edition's Reprint).





Online Resources:

- <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-anatomy#:~:text=Abstract%3A-.Plant%20anatomy%20is%20the%20study%20of%20the%20tissue%20and%20cell,light%20microscope%20or%20electron%20microscope.>
- <https://www.britannica.com/science/plant-breeding#:~:text=plant%20breeding%2C%20application%20of%20genetic,certain%20individuals%20among%20the%20progeny.>
2. <https://byjus.com/biology/plant-breeding/>

Practicals

Plant Anatomy and Plant Breeding

Unit- 1: Plant Anatomy

- To study the Anomalous Secondary Growth in stems of Boerhaavia, Achyranthes, Dracaena and root of Ipomoea batatas.
- To study the Anatomy of Orchid Root (Epiphyte) and Aerial/Stilt Root of Banyan.
- Any 3/more examples which are helpful in Taxonomy of each organ viz., Trichome, Stomata, Epidermis, Node from Plant specimens of allied genera or family.
- Paraffine Block making with Microtomy Technique of any plant material mentioned in Theory syllabus.
- Use of Appropriate Double staining Technique applied for sections embedded in Paraffine Rib bon or hand sections of fresh material as per theory syllabus.

Unit- 2: Plant Breeding-I

- Preparation of male flowers for hybridization.
- Preparation of female flowers for hybridization

Unit- 3: Plant Breeding-II

- Describe the horticulture techniques: Cutting, Layering, Grafting, Budding, Potting and re -potting.
- Study of different methods of plant breeding through Charts/Models/Photographs/Specimens/Herbarium sheet.
- Make a modern new world species from old X new variety breeding with chromosome





CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome											
	[3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	2	-	-	3	1	-	-	-		2	1
CO2	3	2	-	-	-	-	-	-	1		3	2
CO3	2	3	-	-	2	-	-	-	-		2	2
CO4	3	1	2	-	-	1	-	-	-		2	2
CO5	2	3	1	-	-	-	-	-	1		3	2





Course title:	Fresh Water Ecology	Course code:	BBOT601SE
Course type:	Subject Elective	Course credit:	02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
2 × 15 =45	00	00	Mid	CE	35	50
			10	05		

Course Objective:

- To discuss important results on Properties of freshwater, Types of Freshwater Ecosystem, Global issues and legislation for conservation and management of aquatic systems.

Course Outcome:

After successfully completion of the course, the student will be able to.....

CO1	The students understands the concept of Reflect upon the values Fresh water
CO2	The students understands uses of aquatic plans
CO3	The students Develop their understanding on commonly occurring marine planktons of Indian coasts along with the current understanding of its biology.

Content

Unit	Description in detail	Credit	Weightage
I	Fresh water structure	1	50 %
	Definitions: Freshwater, Limnology, Lakes, Ponds, Benthos, Bogs, Marshes and Swamps.		
	Properties of freshwater: Physio -chemical characteristic, Factors affecting to fresh water ecosystem: abiotic and biotic (Light, Temperature, Vegetation, etc.).		
	Types of Freshwater Ecosystem/Clasification of Freshwater Habitat - Lentic ecosystems (still water) and lotic ecosystems (flowing water).		
	Structure of lake (Freshwater Zonation). Aquatic biodiversity (Freshwater only): Aquatic flora (Algae, fresher plants).		
II	Ecosystem	1	50 %
	Aquatic food web and food pyramids, primary productivity. Aquatic ecosystem: goods and services.		
	Energy flow in freshwater ecosystem.		





Threats to aquatic ecosystem and remediation: Eutrophication, Acidification, Pollution.		
Global issues and legislation for conservation and management of aquatic systems.		

Reference Books:

1. Brown L. (1971). Ecology of Fresh Water. Heinemann Educational Books Ltd, London.
Gopal, B, and Bhardwaj, N. (1979). Elements of ecology. Vikash Publishing House Pvt Ltd., New Delhi.
2. Shurma P. D. (7th Edition - Reprint 2003). Ecology and Environment. Rastogi Publications, Meerut. Eugene P. Odum (1971). Fundamentals of Ecology. Toppan Company, Japan

Online Resources:

<https://www.earthreminder.com/freshwater-ecosystem-types-characteristics-and-animals/>

CO-PO & CO-PSO Mapping

Course outcome	Programme Outcome [3: High relevant, 2: Mild relevant, 1:less relevant]											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	2	2	1	-	1	2	2	1	2		2	2
CO2	1	3	1	2	2	1	3	2	2		2	2
CO3	2	1	-	-	2	2	1	--	-		3	1





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Bachelor of Science

Mathematics



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Program Outcomes: At the end of the Program, students shall be able to

PO No.	Program Outcome Description
PO1	Foundational Knowledge: Graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical Skills: Students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical Thinking: Graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective Communication: Students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and Teamwork: Graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information Literacy: Students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical Awareness: Graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong Learning: Students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal Impact: Graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.

Program specific outcome

PSO No.	Program Specific Outcome Description
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PSO1	Mathematical Proficiency: Graduates of the B.Sc. Mathematics program will possess a strong foundation in mathematical concepts, theories, and techniques. They will demonstrate proficiency in mathematical reasoning, problem-solving, and the application of mathematical tools and methods in various domains.
PSO2	Analytical Thinking and Modeling: Graduates will develop advanced analytical thinking skills and the ability to construct mathematical models to represent and solve real-world problems. They will apply mathematical principles to analyze data, make predictions, and provide insights in fields such as finance, engineering, and computer science.



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Semester I

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

B.Sc. Semester – I Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2021-22)

Semester	Subject Code	Study Component	Hrs./Week	Marks Pattern			Credit Per Paper
				Internal	Uni. Exam	Total	
Semester- I		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT101UDSC	CORE COURSE- I (PAPER-I) (MATHEMATICS) DIFFERENTIAL CALCULUS	4	30	70	100	4
	BPHY101UDSC	CORE COURSE- II (PAPER-II) (PHYSICS) MECHANICS AND BASIC ELECTRONICS	4	30	70	100	4
	BCHE101UDSC	CORE COURSE- III (PAPER-III) (CHEMISTRY) INORGANIC, ORGANIC, PHYSICAL & VOLUMETRIC ANALYSIS	4	30	70	100	4
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT101UPRA	PRACTICAL CORE COURSE- I (PAPER-I) (MATHEMATICS) MATHEMATICS PRACTICAL – I	4	--	50	50	2



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BPHY01UPRA	PRACTICAL CORE COURSE- II (PAPER-II) (PHYSICS) PRACTICAL MODULE-01	4	--	50	50	2
BCHE101UPRA	PRACTICAL CORE COURSE- III (PAPER-III) (CHEMISTRY) PRACTICAL CORE COURSE-III(CHEMISTRY)	4	--	50	50	2
	ELECTIVE COURSE (ES) (CHOOSE ANY ONE)					
BMAT101USE	ELECTIVE COURSE- I (COURSE-I) BUSINESS MATHEMATICS -I	2	15	35	50	2
	ELECTIVE GENERIC					
B101EG	ELECTIVE GENERIC: COMMUNICATION SKILLS	2	50	--	50	2



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Semester-II

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

B.Sc. Semester - II Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2021-22)

Semester	Subject Code	Study Component	Hrs./Week	Marks Pattern			Credit Per Paper
				Internal	Uni. Exam	Total	
Semester- II		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT201UDSC	CORE COURSE- I (PAPER-III) (MATHEMATICS) INTEGRAL CALCULUS & DIFFERENTIAL EQUATION	4	30	70	100	4
	BPHY201UDSC	CORE COURSE-II (PAPER-II) (MATHEMATICS) INTEGRAL CALCULUS & DIFFERENTIAL EQUATION	4	30	70	100	4
	BCHE201UDSC	CORE COURSE- III (PAPER-III) (MATHEMATICS) INTEGRAL CALCULUS & DIFFERENTIAL EQUATION	4	30	70	100	4
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT201UPRA	PRACTICAL CORE COURSE- I (PAPER-II) (MATHEMATICS) MATHEMATICS PRACTICAL – II	4	--	50	50	2



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BPHY201UPRA	PRACTICAL CORE COURSE- II (PAPER-II) (PHYSICS) PRACTICAL MODULE-02	4	--	50	50	2
BCHE201UPRA	PRACTICAL CORE COURSE- III (PAPER-II) (CHEMISTRY) PRACTICAL CORE COURSE-III(CHEMISTRY)	4	--	50	50	2
	ELECTIVE COURSE (ES) (CHOOSE ANYONE)					
BCHE201USE	ELECTIVE SUBJECT- I (COURSE-I) MEDICINAL CHEMISTRY	2	15	35	50	2
BMAT201USE	ELECTIVE COURSE- I (COURSE-I) BUSINESS MATHEMATICS -II					
	ELECTIVE GENERIC					
B201EG	ELECTIVE GENERIC: DISASTER MANAGEMENT	2	50	--	50	2



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Semester-III

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

B.Sc. Semester – III Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2022-23)

Semester	Subject Code	Study Component	Hrs./ Week	Marks Pattern			Cred it Per Pape r
				Inter nal	Uni. Exa m	Total	
		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT301UDSC	CORE COURSE- I (PAPER-I) (MATHEMATICS) LINEAR ALGEBRA AND CALCULUS	3	30	70	100	3
	BMAT302UDSC	CORE COURSE- II (PAPER-II) (MATHEMATICS) NUMERICAL ANALYSIS	3	30	70	100	3
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT301UPRA	PRACTICAL CORE COURSE- I (PAPER-I) (MATHEMATICS) MATHEMATICS PRACTICAL -III	3	--	50	50	3
		ELECTIVE COURSE (ES)					
	BMAT301USE	ELECTIVE COURSE- I (COURSE I) BUSINESS MATHEMATICS -III	2	15	35	50	2
		ELECTIVE GENERIC					
	B201EG	ELECTIVE GENERIC: PERSONALITY DEVELOPMENT	2	50	--	50	2



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Semester-IV

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

B.Sc. Semester – IV Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2022-23)

Semester	Subject Code	Study Component	Hrs./Week	Marks Pattern			Credit Per Paper
				Internal	Uni. Exam	Total	
		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT401UDSC	CORE COURSE- I (PAPER-I) (MATHEMATICS) ADVANCED CALCULUS	3	30	70	100	3
	BMAT402UDSC	CORE COURSE- II (PAPER-II) (MATHEMATICS) ADVANCED LINEARALGEBRA	3	30	70	100	3
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT401UPRA	PRACTICAL CORE COURSE- I (PAPER-I) (MATHEMATICS) MATHEMATICS PRACTICAL -IV	3	--	50	50	3
		ELECTIVE COURSE (ES)					
	BMAT401USE	ELECTIVE COURSE- I (COURSEI) BUSINESS MATHEMATICS -IV	2	15	35	50	2
		ELECTIVE GENERIC					



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B201EG	ELECTIVE GENERIC: HUMAN RIGHTS	2	50	--	50	2
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Semester-V

GOKUL GLOBAL UNIVERSITY, SIDHPUR

FACULTY OF SCIENCE

B.Sc. Semester – V Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2020-21)

Semester	Subject Code	Study Component	Hrs./ Week	Marks Pattern			Credi t Per Pape r
				Inter nal	Uni. Exa m	Total	
		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT501DSC	CORE COURSE- I (PAPER-I) (MATHEMATICS) GROUP THEORY - I	3	30	70	100	3
	BMAT502DSC	CORE COURSE- I (PAPER-II) (MATHEMATICS) MATHEMATICAL ANALYSIS - I	3	30	70	100	3
	BCHE503DSC	CORE COURSE- I (PAPER-III) (MATHEMATICS) DIFFERENTIAL EQUATIONS	3	30	100	100	3
	BMAT504DSC	CORE COURSE- I (PAPER-IV) (MATHEMATICS) OPERATIONS RESEARCH - I	3	30	70	100	3
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT501PRA	PRACTICAL CORE COURSE- I (PAPER-V) (MATHEMATICS) MATHEMATICS PRACTICAL - V	6	--	200	200	6
		ELECTIVE COURSE (ES) (CHOOSE ANY ONE)					
	BMAT501SE	ELECTIVE SUBJECT- I (COURSE-I) BUSINESS MATHEMATICS - V	2	15	35	50	2



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BMAT502SE	ELECTIVE SUBJECT- II(COURSE-II) BUSINESS MATHEMATICS - VI					
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Semester-VI

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FACULTY OF SCIENCE

B.Sc. Semester – VI Course Structure

MATHEMATICS DEPARTMENT

(IN EFFECT FROM ACADEMIC YEAR: 2020-21)

Semester	Subject Code	Study Component	Hrs./Week	Marks Pattern			Credit Per Paper
				Internal	Uni. Exam	Total	
				Internal	Uni. Exam	Total	
		DISCIPLINE SPECIFIC COURSE (DSC)					
	BMAT601DSC	CORE COURSE- I (PAPER-I) (MATHEMATICS) RING THEORY	3	30	70	100	3
	BMAT602DSC	CORE COURSE- I (PAPER-II) (MATHEMATICS) MATHEMATICAL ANALYSIS - II	3	30	70	100	3
	BMAT603DSC	CORE COURSE- I (PAPER-III) (MATHEMATICS) TOPOLOGY	3	30	100	100	3
	BMAT604DSC	CORE COURSE- I (PAPER-IV) (MATHEMATICS) OPERATIONS RESEARCH - II	3	30	70	100	3
		DISCIPLINE SPECIFIC PRACTICAL COURSE (PRA)					
	BMAT601PRA	PRACTICAL CORE COURSE- I (PAPER-VI) (MATHEMATICS) MATHEMATICS PRACTICAL - VI	6	--	200	200	6
		ELECTIVE COURSE (ES)					



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(CHOOSE ANY ONE)						
BMAT601SE	ELECTIVE SUBJECT- I (COURSE-I) BUSINESS MATHEMATICS - VII	2	15	35	50	2
BMAT602SE	ELECTIVE SUBJECT- II (COURSE-II) BUSINESS MATHEMATICS - VIII					



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GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT101UDSC	Semester :	I	
DIFFERENTIAL CALCULUS				
Course type :	Discipline Specific Course	Total Credit :	04	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
60	----	30	70	100

Course Objective:

- Construct mathematical expressions and graphs involving functions and their derivatives.
- Compute mathematical quantities using differential calculus and interpret their meaning
- Write logical progressions of precise statements to justify and communicate mathematical reasoning

Course Outcomes: At the end of the course, students shall be able to

CO1	The students will be solve differentiable equation, define power series and solve other equation of cone, sphere.
CO2	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bendiness of a curve.
CO3	Solve first-order linear/nonlinear ordinary differential equations analytically using standard methods
CO4	Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.





Unit	Content	Hrs.	Weightage	
1	Matrices:	15	25%	
	1.1			Introduction of matrices, different types of matrices, Operations on matrices, theorems on matrices.
	1.2			Symmetric and skew -symmetric matrices, Hermitian and skew-Hermitian matrices.
	1.3			Linear dependence and independence of row and column matrices.
	1.4			Row rank, Column rank and rank of matrix, Row reduced Echelon form of a matrix and matrix inversion using it.
2	Vector analysis:	15	25%	
	2.1			Vector analysis: scalar and vector product of three vectors, Product of four vectors.
	2.2			Reciprocal vectors, vector differentiation.
	2.3			Polar co-ordinates
	2.4			Spherical and cylinder co-ordinates and their relations.
3	Successive differentiation:	15	25%	
	3.1			Successive Derivatives, Some standard results for n^{th} derivatives.
	3.2			Leibnitz's Theorem and its examples, Cauchy's Mean Value Theorem.
	3.3			Taylor's Theorem (without proof), Maclaurin's series (without proof) and its examples
	3.4			Expansion of power series of $\sin x$, $\cos x$, e^x
4	Geometry:	15	25%	
	4.1			Sphere, Cone and Cylinder and introduction to Conicoids: Plane section of sphere, intersection of two sphere, intersection of sphere and line, power at a point, tangent plane and normal Plane of contact, angle of intersection of two Spheres, condition of orthogonality.
	4.2	Cone: Definition of cone, vertex, guiding curve, generators, equation of a cone with a given vertex and a guiding curve, right Circular cone with given vertex, axis and semi vertical angle.		





4.3	Cylinder: Definition of a cylinder, equation of a cylinder whose generators intersect a given cone and are parallel to a given line equation of a right circular cylinder
4.4	Conicoids: Standard equation of ellipsoid, hyperboloid of one and two sheets, Elliptic cone and are parallel to a given line, equation of a right circular cylinder.

Reference Books:

1. Shantinayaran: Text book of Matrices, S. Chand and Co.
2. Vector Analysis, by Murry R. Spiegel.
3. Vector Analysis, by Dr. K. S. Rawat, SARUP& SONS, DELHI
4. Gorakhprasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019
2. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
3. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Online Resources:

1. <https://www.classcentral.com/subject/maths>
2. <https://www.youtube.com/watch?v=WX6O9TiFYsA&list=PLU6SqDYcYsfIJRl8mo2Rv1MpdvmVD0YyI>
3. https://www.youtube.com/watch?v=L6_c6qvIB8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL

Practical / Activities:

1. Assignment
2. Quiz/Unit test

Teaching Examination Scheme :

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
0	0	4S	00	00	50	50





Content

Unit	Description in detail	Credit	Weightage
1	Solution of simultaneous linear equations using matrices.	1	50%
	Application of the inverse matrix by row reduction method.		
	Application of the rank of a matrix.		
	Application of the rank of a matrix by transforming into echelon form.		
	Application of Hermitian and skew – Hermitian matrices.		
2	Application of gradient & divergent.		
	Application of curl.		
3	Find the nth derivative of the given function at given point	1	50%
	Application of Leibnitz's theorem.		
	Application of Cauchy Mean value theorem.		
	Application of Taylor's theorem.		
	Application of Maclaurin's theorem.		
4	Application on Sphere.		
	Application on Cone		
	Application on Cylinder		

Reference Books:

1. Shantinakaran: Textbook of Matrices, S.Chand and Co.
2. Vector Analysis, by Murry R. Spiegel.
3. Vector Analysis, by Dr. K.S. Rawat, SARUP & SONS, DELHI.
4. Gorakhprasad: Differential Calculus, Pothishala Pvt.Ltd. Allahabad.

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019



Faculty of Science
Gokul Science College

University Campus, State Highway-41,

Siddhpur - 384151, Dist. Patan, Gujarat, INDIA, Mobile : 9510973863

E- Mail : dean.fac.sci@gokuluniversity.ac.in, Website : www.gokuluniversity.ac.in





2. B. S. Grewal: “Higher Engineering Mathematics”, Khanna publishers, 44th Ed.2018
3. E. Kreyszig: “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Ed. (Reprint), 2016.

Online Resources:

1. <https://www.classcentral.com/subject/math>s
2. <https://www.youtube.com/watch?v=WX6O9TiFYsA&list=PLU6SqdYcYsfIJRI8mo2Rv1MpdvmVD0YyI>
3. https://www.youtube.com/watch?v=L6_c6qv1B8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL

Practical / Activities:

1. practices

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	2	1	1					3	
CO2	3	3					1	1			2
CO3	2	1		1		1		1			1
CO4	3	3	1			1				2	





GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme code:	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT101USE	Semester :	I	
Business Mathematics – I				
Course type :	Elective Course	Total Credit :	02	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	----	15	35	50

Course Objective:

- (a) Apply mathematical skills to business application and banking situations.
- (b) Better understand the foundation of business scenarios.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understanding the application of Differentiation.
CO2	Know about the Business Application of Derivatives.
CO3	Study and use Hedging parameters, trading strategies and currency swaps.

Unit	Content	Hrs.	Weightage
1	Differentiation:		





	Definition of derivatives of function (x), Derivative of definition. Derivatives of function of the type x^n , a^x and $\log X$ (without proof). Rules of differentiation (without proof). Logarithmic differentiation. Maxima and Minima. Cases of one variable involving second order derivative.	15	50%
2	Business Application of Derivatives: Mathematical functions of demand and supply, price elasticity of demand and supply, Cost functions-average, marginal cost, marginal revenue and average revenue and their relationship with Elasticity of demand. Market equilibrium, Monopoly problems.	15	50%

List of References:

1. Business Statistics by Rana, Dalal and others By SudhirPrakashan, Ahmedabad.
2. Hooda R.P.: Statistics for Business and Economics, Macmillan, New Delhi.
3. Levin and Rubin: Statistics of Management, Prentice-Hall of India, New Delhi

Suggested Readings:

1. Khan, S.M. (2005). A textbook of Business Mathematics

Online Resources:

1. <http://www.udemy.com>
2. <https://onlinecourses.swayam2.ac.in>

Practical / Activities:

1. Quiz /Assignment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	2		1		1	1		3	
CO2	2	3		1	2	1					3
CO3	3	3	1		1			1		2	





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :		BMAT	Programme Name :	
Course Code		BMAT201UDSC	Semester :	
			II	
INTEGRAL CALCULUS & DIFFERENTIAL EQUATION				
Course type :		Discipline Specific Course	Total Credit :	
			04	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
60	----	30	70	100

Course Objective:

- Analyze functions using limits, derivative, and integrals.
- Calculate definite integrals that may involve logarithms, exponentials, and polynomials.
- The applications of differential calculus and also organize results in appropriate visual displays or tables.

Course Outcomes: At the end of the course, students shall be able to

CO1	Explain the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point.
CO2	Compare and contrast the ideas of continuity and differentiability
CO3	To inculcate to solve algebraic equations and inequalities involving the sequence root and modulus function.
CO4	Solve basic application problems described by second order linear differential equations with constant coefficients.

Unit	Content	Hrs.	Weightag
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		e		
1	Integration:		15	25%
	1.1	Reduction formula: $\int_0^{\frac{\pi}{2}} \sin^n \theta d\theta, \int_0^{\frac{\pi}{2}} \cos^n \theta d\theta, \int_0^{\frac{\pi}{2}} \sin^m \theta \cos^n \theta d\theta, m, n \in N$		
	1.2	Application of definite integrals to :Summation of the series		
	1.3	Application of definite integrals to :Rectification		
	1.4	Application of definite integrals to : Surface and volume revolution		
2	De ‘Morve’s theorem and its applications:		15	25%
	2.1	Roots of a complex number		
	2.2	Application of Expansion of $\sin^n \theta, \cos^n \theta, n \in N$ in terms of sine and cosine of multiples of θ		
	2.3	Expansion of $\sin, \cos n\theta$ and $\tan n\theta$ in terms power of sine, cosine and tangent respectively.		
	2.4	Exponential, Circular and hyperbolic function, Logarithmic and inverse functions		
3	Linear Differential Equation:		15	25%
	3.1	Linear differential equation $\frac{dy}{dx} + Py = Q$ and Q are functions of x , Bernoulli’s differential equation		
	3.2	Differential equation of first order and higher degree solvable For x , solvable for y , solvable for $P = \frac{dy}{dx}$.		
	3.3	Solution of Clairaut’s and Lagrange’s differential equation.		
	3.4	Linear differential equation with constant coefficients.		
4	Sequence and series:			
	4.1	Definition of sequence & series.		





4.2	Definition of convergence and divergence of sequence and series, Partial sum	15	25%
4.3	Application of Comparison test, ratio test, root test and its examples.		

Reference Books:

1. Shantinayaran: Integral Calculus, S. Chand and Co., New Delhi
2. Gorakhprasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
3. D.A. Murray: Differential Equations, Tata McGraw Hills
4. Frank Ayres: Theory and problems on Differential Equations, McGraw Hill Book Co., New York.

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019

Online Resources:

1. <https://www.classcentral.com/subject/math>
2. https://youtu.be/BnE_MJaU8B.
3. https://www.youtube.com/watch?v=L6_c6qvlB8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL

Practical / Activities:

1. Assignment
2. Quiz/unit test

Teaching Examination Scheme :

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
0	0	2	00	00	50	50





Content

Unit	Description in detail	Credit	Weightage
1	Application of Reduction formula for integration.	1	50%
	Application of rectification by using integration.		
	Application of surface revolution using integration.		
	Application of volume revolution.		
2	Application of De' Morve's theorem.	1	50%
	Application of roots of complex number.		
	Application of $\sin n\theta, \cos n\theta, n \in N$ in terms of $\sin \theta, \cos \theta$.		
	Application of $\sin n\theta, \cos n\theta$ and $\tan n\theta$ in terms of power of $\sin \theta, \cos \theta$ and $\tan \theta$		
3	Application of linear differential equation $dy/dx + Py = Q$, where P and Q are function of x . And Application of Bernoulli's differential equation.	1	50 %
	Application of differential equation in first order and higher degree solvable for x, y and p , Where $P = dy/dx$		
	Application of Clairaut's differential equation.		
	Application of linear differential equation with constant coefficients.		
4	Application of comparison test for a given sequence.	1	50 %
	Application of root test for a given sequence.		
	Application of ratio test for a given sequence.		

Reference Books:

1. Shantinayaran: Integral Calculus, S. Chand and Co., New Delhi.
2. Gorakhprasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.



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3. D.A. Murray: Differential Equations, Tata McGraw Hills.
4. Frank Ayres: Theory and problems on Differential Equations, McGraw Hill Book Co., New York.
5. Complex Analysis, by J.V.DESHPANDE, Tata Mc GRAW – Hill Publishing Co. Ltd. New Delhi

Suggested Readings:

1. James Stewart: “Calculus” Cengage publications, 7th edition, 4th Reprint 2019
2. Integral Calculus Differential Equations, Dipak Chatterjee, Tata McGraw-Hill, 1999

Online Resources:

1. <https://www.classcentral.com/subject/math>
2. <https://www.khanacademy.org/math/integral-calculus/ic-diff-eq>

Practical / Activities:

1. Practice

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	1	2				1		3	
CO2	2	3	2		1		1				2
CO3	3	2				1	1			2	
CO4	3	3	1		1			1			2





GOKUL GLOBAL UNIVERSITY, SIDHPUR					
Programme code:		BMAT	Programme Name :		B.Sc. Mathematics
Course Code		BMAT201USE	Semester :		II
Business Mathematics – II					
Course type :		Elective Course	Total Credit :		02
Teaching time (hours)		Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)	
30	----	15	35	50	

Course Objective:

- (a) Educate learners on how to use mathematical techniques in solving problems.
- (b) Educate the learners on how to integrate mathematical models in business.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understanding the application of Integral Calculus.
CO2	find indefinite integration by using direct formulae
CO3	Know about the Permutations and Combinations.





Unit	Content	Hrs.	Weightage
1	Integration: (Only examples)	15	50%
	Indefinite Integral: Definition, Working rules of integration, integration of x^n, a^n, e^x ; integration of $\frac{1}{x^2 \pm a^2}, \frac{1}{\sqrt{x^2 \pm a^2}}, \frac{1}{\sqrt{a^2 - x^2}}, \frac{1}{ x \sqrt{x^2 - a^2}}$ Integration of trigonometric functions, integration by method of substitution Some standard results: $\int [f(x)]^n f'(x) dx, \int \frac{f(x)}{f'(x)} dx, \int \frac{1}{ax^2 + bx + c} dx, \int \frac{1}{\sqrt{ax^2 + bx + c}} dx.$		
2	Permutations and Combinations: [only examples]	15	50%
	Fundamental rules of counting, Definition of Permutations and Permutation of n different things, Permutation of repeated things, Circular Permutation, Definition of Combination standard results and examples.		

List of References:

1. Business Mathematics by D. C. Sancheti & V. K. Kapoor, Sultan Chad & Sons Publication, New Delhi.
2. Business Mathematics by B. S. Shah Prakashsan, Ahmedabad.
3. Any Advance Calculus books used in Science Stream.

Suggested Readings:

1. Mathematics for Business careers by Jack Cain, Robert A. Carman, 2001

Online Resources:

1. <http://www.udemy.com>
2. <https://onlinecourses.swayam2.ac.in>

Practical / Activities:

1. Quiz / Assignment





Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3		2				1		3	
CO2	3	2	2		1	1	1		1		2
CO3	2	3	2		1					3	





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code : BMAT		Programme Name : B.Sc. Mathematics		
Course Code BMAT301UDSC		Semester : III		
Linear Algebra And Calculus				
Course type : Discipline Specific Course		Total Credit : 03		
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- Construct mathematical expressions and graphs involving functions and their derivatives.
- Write logical progressions of precise statements to justify and communicate mathematical reasoning.
- Compute mathematical quantities using differential calculus and interpret their meaning

Course Outcomes: At the end of the course, students shall be able to

CO1	Linear Algebra emphasizes the concept of vector spaces and linear transformations which are essential in simplifying various scientific problems.
CO2	It aims at inculcating problem solving skills within students to enable them compute large linear systems.
CO3	Vector calculus motivates the study of vector differentiation and integration in two and three dimensional spaces.
CO4	Understand the combination of two important aspects of modern mathematics via Linear Algebra and Vector Calculus.





Unit	Content	Credit	Weightage
1	Vector Space And Linear Transformation: Vector spaces, Subspaces, Span of a set, More about subspaces, Linear dependence and Independence, Dimension and Basis. Definition and examples of linear transformation, Range and kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Consequences of a Rank-nullity theorem, The space $L(U,V)$, Composition of a linear map, Operator equations.	1	33%
2	Limit , Continuity And Partial Derivatives: Function of severable variables, their limits and continuity, Partial derivatives, Differentiability and Differential, Conditions for commutativity of independent variables in higher ordered derivatives, Derivatives of implicit functions, Schwarz theorem	1	33%
3	Application Of Partial Derivatives: Euler's theorem on homogeneous function, Young's theorem, Extreme of function of severable variables, Application of Lagrange's method of undetermined multiplies, Tailor and Maclaurin's expansion for function of two variables, Tangent line and normal plane to twisted curves, Tangent plane and normal to surfaces.	1	34%

Reference Books:

1. 'Differential Calculus' by Shantinakaran, S. Chand, New Delhi
2. 'An Introduction to Linear Algebra, by V. Krishnamurthy, V P Mainra, J L Arora, Affiliated East-west Press Pvt Ltd., New Delhi
3. Advanced Calculus, R C Buck, Mac Millan
4. Kalan Shashtra Part I, D H Pandya and N D Suthar, University Granth Nirman Board (Gujarati)
5. Kalan Shashtra Part II, A M Vaudya and V H Pandya, University Granth Nirman Board
6. Linear Algebra Problem Book, P R Holmos, Cambridge University Press
7. Topics in Algebra, I N Herstein, Wiley Eastern Ltd.
8. Linear Algebra, Gupta K P, Pragati Prakashan, Meerut

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.





Online Resources:

1. https://www.youtube.com/watch?v=L6_c6qv1B8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL
2. <https://www.classcentral.com/subject/maths>
3. https://youtu.be/BnE_MJaU8B.

Practical / Activities:

1. Assignment
2. Quiz/ unit test

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
0	0	6	Mid	CE	70	100
			20	10		

Content

Unit	Description in detail	Credit	Weightage
I	Applications of Vector Space	3	50%
	Applications of Subspaces		
	Applications of Basis		
	To Expand linearly independent set to a basis of a vector space		
	Verification on Dimension theorem		
	Verifications on Linear transformation		
	Verifications on Rank-Nullity theorem		
	To find the inverse of a Linear transformations		
	To find composition of linear maps		





	Application of Limit and Continuity (Two Practical)		
	Application of Partial Derivatives (Two Practical)		
	Application of Lagrange’s method of undermined multiplies		
	Application of Euler's theorem		
	Application of Tailor’s and Maclaurin’s theorems		
II	Application of Gregory-Newton forward formula		50%
	Application of Gregory-Newton backward formula		
	Application of Factorial polynomials		
	Applications of Newton’s divided difference formula		
	Application of Lagrange’s interpolation formula for unequal intervals		
	Application of Gauss forward interpolation formula		
	Application of Gauss backward interpolation formula		
	Application of Stirling interpolation formula		
	Application of Bessel’s interpolation formula		
	Application of Numerical differentiation		
	Application of Trapezoidal rule		
	Application of Simpson’s 1/3 rule		
	Application of Simpson’s 3/8 rule		
	Application of Picard’s method		
Application of Taylor’s method			
Application of Euler’s method & Modified Euler’s method			

Reference Books:

1. Linear Algebra, Gupta K P, Pragati Prakashan, Meerut
2. Differential Calculus’ by Shantinakaran, S. Chand , New Delhi
3. Linear Algebra Problem Book, P R Holmos, Cambridge University Press

Suggested Readings:

1. James Stewart: “Calculus” Cengage publications, 7th edition, 4th Reprint 2019
2. E. Kreyszig: “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Ed. (Reprint), 2016

Online Resources:





1. <https://www.classcentral.com/subject/maths>
2. <https://www.youtube.com/watch?v=WX6O9TiFYsA&list=PLU6SqDYcYsfIJR18mo2Rv1MpdvmVD0YyI>
3. https://www.youtube.com/watch?v=L6_c6qv1B8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL

Practical / Activities:

1. Practices

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	2		2		2		3	
CO2	2	3			1		1				2
CO3	2	2	1	2	1					2	
CO4	3	3	1		1		1	1			2





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT302UDSC	Semester :	III	
Numerical Analysis				
Course type :	Discipline Specific Course	Total Credit :	03	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

The objective of the course is

- To develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems on the computer. Basic concepts: round-off errors, floating point arithmetic, Convergence. Bisection method, fixed-point iteration, Newton's method.
- An introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering.

Course Outcomes: At the end of the course, students shall be able to

CO1	The course will cover the classical fundamental topics in numerical methods such as, approximation, numerical integration, and numerical linear algebra, solution of nonlinear algebraic systems and solution of ordinary and partial differential equations.
CO2	Understand the difference operators and the use of interpolation
CO3	Code a numerical method in a modern computer language.
CO4	Evaluate a derivative at a value using an appropriate numerical method





Unit	Content	Credit	Weight
1	<u>Finite Differences table and theory of interpolation:</u> Ascending and Descending differences , Symbolic operators Difference of polynomial, Factorial polynomials, Gregory- Newton's forward and backward interpolation formula	1	33%
2	<u>Divided Differences:</u> Newton's divide difference interpolation formula, Lagrange's interpolation formula for equal and unequal intervals. <u>Central Differences Interpolation Formula:</u> Gauss forward and backward interpolation formula, Stirling interpolation formula, Bessel's interpolation formula.	1	33%
3	<u>Numerical Differentiation and Integration & Numerical Solution of ordinary differentiation equation:</u> Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Picard's method, Taylor's method, Euler's Method, Modified Euler's Method	1	34%

Reference Books:

1. Numerical Analysis by Kunz, McGraw Hill
2. Numerical Analysis by R. Gupta, Anmol Pub. Pvt.Ltd, New Delhi.
3. Numerical Analysis P. N. Chatterjee Prakashanmandir, Meerut.
4. Methods in Numerical Analysis K. W. Nelson Mac-Millan
5. Numerical Methods Dr. V. N. Vedomurthy, Vikas Publishing House Pvt. Ltd .
6. Numerical Methods in Engineering and Science, Dr. B. S. Grewal, Khanna Pub.

Suggested Readings:

1. Numerical Analysis by Richard L. Burden, J. Douglas Faires
2. Numerical Mathematics and Computing by E. Ward Cheney and David R. Kincaid

Online Resources:

1. <https://www.vedantu.com>
2. <https://ocw.mit.edu>

Practical / Activities:





1. Quiz/unit test
2. Assignment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2			2				3	
CO2	2	3		2	1		1				2
CO3	3	2		1		1		1		2	
CO4	2	3	1			1		1			1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code:	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT301USE	Semester :	III	
Business Mathematics – III				
Course type :	Elective Course	Total Credit :	02	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	----	15	35	50

Course Objective:

- (a) Reconcile and analyze various banking statements and services.
- (b) Solve a variety of interest formulas and calculate payroll.
- (c) Utilize correctly the mathematics of buying and selling.
- (d) Utilize calculations to analyze investments, business and consumer loans, and charge accounts.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the importance of Leaders and Leadership in the context of Business Organizations.
CO2	Know about the Permutations and Combinations.
CO3	Understand the important role Mathematics plays in all facets of the business world





Unit	Content	Credit	Weight
1	Logic and Set Theory: [only examples]	1	50%
	Logic: Logical Statements, Truth table, Negation, Compound statements, Tautologies and Contradiction, Negation of Compound statements, Propositions, Conditional and Biconditional statements. Set Theory: Definition and methods of sets, types of sets, Venn diagrams, Operations on sets, De-Morgan's law, Finite and infinite sets.		
2	Transportation Problem:	1	50%
	Meaning, Definition, Uses and Mathematical form of the Transportation Problem, Obtaining the initial feasible solution by North-West corner rule, Least cost method and Vogel's approximation methods.		

List of References:

1. Business Mathematics. By D. C. Sancheti & V. K. Kapoor, Sultan Chad & Sons Publication, New Delhi.
2. Business Mathematics. By. B. S. Shah Prakashsan, Ahmedabad.
3. Operations Research, By. J. K. Sharma. Macmillan Publishers India Ltd.

Reference Books:

1. Business mathematics. By D. C. Sancheti & V. K. Kapoor, Sultan Chad & sons Publication.
2. Business mathematics. By B S. Shah Prakashan, Ahmedabad.

Suggested Readings:

1. Operation research, by J. K. Sharma. Macmillan Publishers India Ltd.

Online Resources:

1. Byju's: <https://byjus.com/maths/bussiness-mathematics/>

Practical / Activities:

3. MCQs Quiz
4. To prepare drama on Business.





5. Play math tic-tac-toe
6. Roll into a Subtraction Dice game

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	2			1	1		3	
CO2	2	3			1		1				2
CO3	3	3		2		1		1		1	





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :		BMAT	Programme Name : B.Sc. Mathematics	
Course Code		BMAT401UDSC	Semester : IV	
Advanced Calculus				
Course type :		Discipline Specific Course	Total Credit : 03	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- (a) The course provides the students with the basic mathematical skills necessary to understand central analytical methods in economic theory.
- (b) The main part of the course covers mathematical analysis with multivariable functions, with applications for theories of consumption and production.
- (c) To provide the student with the skills of vector calculus operations which are needed for further study in mathematics

Course Outcomes: At the end of the course, students shall be able to

CO1	Perform the vector calculus operations by applying addition, subtraction, scalar multiplication, dot product, and cross product.
CO2	Take derivatives of multivariable functions by using appropriate rules.
CO3	Work with power series by applying the iterated derivatives.
CO4	Students will be able to perform vector calculus operations by partial derivatives, and matrix partial derivatives.
CO5	Do double and triple integrals by applying appropriate methods and rules. Students will be able to differentiate vectors to understand gradient, divergence and curl by using the appropriate rules.





Unit	Content	Credit	Weight
1	Curvature & Radius Of Curvature: Curvature of Plane curve, Radius of curvature of plane curve, Singular point of plane curve, Point of inflexion for plane curve. Improper Integral: Beta function and Gamma function, Convergence of Beta function and Gamma function, Relation between them, Its Simple properties and applications, Several forms of Beta function.	1	33%
2	Multiple Integral: Double Integral, Integral on non-rectangle regions, transformation to polar coordinate, Change of the order of integration, Triple integration and transformation to polar and cylindrical co – ordinate.	1	33%
3	Vector Analysis, Line & Surface Integral: Gradient of scalar function, Divergence and Curl of a vector function, Line integral, Surface Integral, Green's theorem, Stoke's and Gauss's Theorem.	1	34%

Reference Books:

1. Integral Calculus, Shantinakaran S. Chand, New Delhi (Course Book)
2. Advanced Calculus, D V Widder , Prentice Hall , New Delhi
3. Advanced Calculus Vol : I & II, T M Apostol, Blaisdoll
4. Advanced Calculus, R C Buck, MacMillan.
5. Kalan Shashtra Part I , D H Pandya and N D Suthar, University Granth Nirman Board (Gujarati)
6. Kalan Shashtra Part II, A M Vaudya and V H Pandya, University Granth Nirman Board (Gujarati)

Suggested Readings:

1. Advanced Calculus Lynn H. Loomis and Shlomo Strenberg, Harvard University
2. Kalan Shashtra Part II, A M Vaudya and V H Pandya, University Granth Nirman Board (Gujarati)

Online Resources:

1. <https://www.youtube.com/watch?v=4QFsiXfgbzM&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5>





2. <https://www.youtube.com/watch?v=9sLsX9DV5Fs&list=PLU6SqDYcYsfIvbXltebRgBfmgxRiP-gTJ>

Practical / Activities:

7. Assignment
8. Quiz

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3	0	0	Mid	CE	70	100
			20	10		

Content

Unit	Description in detail	Credit	Weightage
I	Application of Radius of curvature of plane curve (Three Practicals)	03	50 %
	Application of Beta function		
	Application of Gamma function		
	Application of double Integration		
	Application of change of order of Integration		
	Application of triple Integration		
	Application of Line integral		
	Application of Surface Integral		
	Application of Green's Theorem		
	Application of Stokes' theorem		
	Applications of a linear transformation associated with given matrix	03	50 %
	Applications of a matrix associated with linear transformation		
	To find kernel & Range of Matrices		
	Verifications on Rank-Nullity theorem on matrices		





II	Application of solution of system of linear equations (Two Practicals)		
	Application of Linear functional		
	Application of Adjoint of a linear Operator		
	Application of a Dual Space		
	Application to verify inner product space		
	Application on Gram-Schmidt orthogonalization process		
	Application of Cayley – Hamilton theorem		
	Application of Eigen value and Eigen vectors of a linear transformation		
	Application of minimal polynomial deduction		

Reference Books:

1. Linear Algebra, Ramchandra Rao, P. Bhimasankar, Tata Mac Graw Hill.
2. Topics in Algebra, I N Herstein, Wiley Eastern Ltd
3. An Introduction to Linear Algebra' by V. Krishnamurthy, V P Mainra, J L Arora, Affiliated East-west Press Pvt Ltd., New Delhi

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019

Online Resources:

1. <https://www.classcentral.com/subject/math>
2. https://youtu.be/BnE_MJaU8B.

Practical / Activities:

1. Practices

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	1	2		1	2		3	
CO2	2	3			1	1					2
CO3	3	2	1				1			2	
CO4	2	3	1		1			1			1





CO5	3	2		1					1	2
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GOKUL GLOBAL UNIVERSITY, SIDHPUR					
Programme code :		BMAT	Programme Name :		B.Sc. Mathematics
Course Code		BMAT402UDSC	Semester :		IV
Advanced Linear Algebra					
Course type :		Discipline Specific Course	Total Credit :		03
Teaching time (hours)		Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)	
45	----	30	70	100	

Course Objective:

- Construct mathematical expressions and graphs involving functions and their derivatives.
- Compute mathematical quantities using differential calculus and interpret their meaning.
- Write logical progressions of precise statements to justify and communicate mathematical reasoning

Course Outcomes: At the end of the course, students shall be able to

CO1	Solve an algebraic or transcendental equation using an appropriate numerical method.
CO2	Calculate a definite integral using an appropriate numerical method.
CO3	Approximate a function using an appropriate numerical method.
CO4	Evaluate a derivative at a value using an appropriate numerical method.





Unit	Content	Credit	Weight
1	Matrices of a Linear Transformation: Definition of a Matrix of a linear transformation, Linear Transformation associated with a matrix, the dimension of $L(U,V)$ and its determination, Rank and Nullity of a Matrix, invertibility of system of linear equations.	1	33%
2	Linear Functional And Duality: Definition of linear functional and its examples, Definition of Dual space and Dual basis and its examples, Adjoint of a linear operator, its properties and examples. Inner Product Space: Definition of inner product space, Norm, Orthogonality, Schwarz's & Triangular inequality, Parallelogram law, Orthonormal basis, Gram-Schmidt Orthogonalization Process (Without proof) and its examples	1	33%
3	Eigen Values And Eigen Vectors: Eigen values and Eigen vectors of a linear transformation, Characteristic polynomial, Cayley – Hamilton theorem, Finding inverse of a matrix using Cayley – Hamilton theorem, minimal polynomial deductions.	1	34%

Reference Books:

1. An Introduction to Linear Algebra' by V. Krishnamurthy, V P Mainra, J L Arora, Affiliated East-west Press Pvt Ltd., New Delhi
2. Linear Algebra, Ramchandra Rao, P. Bhimasankar, Tata Mac Graw Hill.
3. Topics in Algebra, I N Herstein, Wiley Eastern Ltd.
4. Linear Algebra, S K Berberion, Oxford University Press.
5. Linear Algebra Problem Book, P R Holmos, Cambridge University Press.
6. Linear Algebra, Sharma and Vashishtha, Krishna Prakashan, Meerut.

Suggested Readings:

1. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019

Online Resources:

1. https://youtu.be/BnE_MJaU8B.





2. <https://www.classcentral.com/subject/math>s
3. https://www.youtube.com/watch?v=L6_c6qv1B8I&list=PLzJaFd3A7DZuyLLbmVpb9e9VLf3Q9cYBL

Practical / Activities:

1. Assignment
2. Quiz/unit test

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	2	2		2		1		3	
CO2	3	1	2		1		2				2
CO3	2	3		1		1			1	2	
CO4	3	2	1	1			1				1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code:	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT401USE	Semester :	IV	
Business Mathematics – IV				
Course type :	Elective Course	Total Credit :	02	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	----	15	35	50

Course Objective:

- Understanding the nature of problem to be studied and identifying the related area of knowledge.
- Reviewing literature to understand how others have approached or dealt with the problem.
- Collecting data in an organized and controlled manner so as to arrive at valid decisions.

Analyzing data appropriate to the problem

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of Laplace Transforms, Inverse Laplace Transform and its application.
CO2	Understand the important role Mathematics plays in all facets of the business world
CO3	Understand the different Determinants of Individual Behavior and how these can be used for the benefit of the Organization

Unit	Content	Credit	Weight
1	Laplace Transformation: (Only examples)	1	50%
	Laplace transform- Definition and its properties. Rules of manipulation. Laplace transform of derivatives and integrals.		
2	Inverse Laplace Transformation: (only examples)		





Properties of inverse Laplace transform. Convolution theorem. Solve Differential equation using Laplace Transforms	1	50%
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Reference Books:

- a) The Fourier Transforms and its applications, by Ronald Bracewell.
- b) Schaum’s outline of Fourier analysis with applications to Boundary value problems, by Murray Spiegel.

Suggested Readings:

- a) The Laplace Transform: Theory and applications, by Joel L. Schiff.
- b) Schaum’s outline of Laplace Transforms, by Murray Spiegel.

Online Resources:

- a) Business mathematics by Unacademy Learner App

Practical / Activities:

- a) Action Addition and Subtraction.
- b) Math Twister.
- c) Shape Scavenger Hunt.
- d) Guess My Number.
- e) Multiplication and Division Bingo.
- f) Sign My Sheet.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3		1	2		1			3	
CO2	2	3				1		1			2
CO3	3	2	2	1	1			1		1	





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :		BMAT	Programme Name : B.Sc. Mathematics	
Course Code		BMAT501DSC	Semester : V	
Group Theory – I				
Course type :		Discipline Specific Course	Total Credit : 03	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- Group theory is one of the great simplifying and unifying ideas in modern mathematics.
- It was understand the solutions to polynomial equation.
- Full significance as a mathematical formulation of symmetry been understood.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of group & a finite cyclic group.
CO2	Extend group structure to finite permutation groups.
CO3	Solve problem in group theory & prove new definitions and theorems.
CO4	Understand, formulate and use quantitative models arising in social science, business and other contexts

Unit	Content	Hrs.	Weightage
1	Groups and Subgroups: Definition and examples of a group including permutation groups and quaternion groups, Elementary properties of groups, Subgroups and examples of subgroups,	15	33%
2	Permutation Groups: Cycle notation for permutations, Properties of permutations, Even and odd permutations, Alternating groups; Properties of cosets, Lagrange's theorem and	15	33%





	consequences including Fermat's Little theorem; Normal subgroups, Factor groups, Cauchy's theorem for finite abelian groups.		
3	Cyclic Groups and Group Homomorphisms: Properties of cyclic groups, Classification of subgroups of cyclic groups. Generator of a cycle group. Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Cayley's theorem. Definition of an isomorphism of a group and its illustrations Properties of isomorphisms, Isomorphism of cyclic groups, First, Second and Third isomorphism theorems for groups.	15	34%

Reference Books:

1. Gallian, Joseph. A. (2013). Contemporary Abstract Algebra (8th ed.). Cengage Learning India Private Limited, Delhi. Fourth impression, 2015.
2. Topics in Algebra, I N Herstein, Wiley Eastern Ltd.
3. Artin, M., Algebra, Prentice Hall of India, 1991.
4. Jacobson, N., Basic Algebra, Vol. II, Hundastan Publ. Co., Delhi, 1984.
5. P. B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2/e), Cambridge University Press, South Indian Edition 2002.

Suggested Readings:

1. Topics in Algebra (I.N.HERSTEIN)

Online Resources:

1. https://youtu.be/BnE_MJaU8BQ
2. <https://youtu.be/ihQyz7bJcRE>
3. <https://youtu.be/Bfp6gejiybA>
4. <https://youtu.be/-h3Gswp6-no>

Practical / Activities:

1. Introduction to MATLAB/ PYTHON/ SCILA
2. Assignment/unit test

3. Teaching Examination Scheme :

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
0	0	6	Mid	CE		





			00	00	200	200
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Content

Unit	Description in detail	Credit	Weightage
PCMAT – 501	<p>Introduction to MATLAB/ PYTHON/ SCILAB :</p> <p>Starting and ending MATLAB session, MATLAB environment, MATLAB help, types of files, search path, some useful MATLAB commands, data types, constant and variables, operators, built in functions, assignment statement, and illustrative programs.</p> <p>Vectors and Matrices :</p> <p>Scalars and vectors, entering data in matrices, line continuation, matrix subscripts/indices, multidimensional matrices and arrays, matrix manipulations, generation of special matrices, useful commands, matrix and array operations, function with array inputs.</p>		
PCMAT – 502	<p>Polynomials :</p> <p>Entering a polynomial, polynomial evaluation, roots of a polynomial, polynomial operations - addition and subtraction, multiplication, division, formulation of polynomial equation, characteristic polynomial of a matrix, polynomial differentiation, integration, and curve fitting, evaluation of Polynomial with matrix arguments.</p>	6	100%
PCMAT – 503	<p>MATLAB/ PYTHON/ SCILAB Graphics :</p> <p>Two-dimensional plots, multiple plots, style options, legend command, subplots, specialized two dimensional plots, three-dimensional plots.</p>		
PCMAT – 504	<p>Symbolic Processing With MATLAB/ PYTHON/ SCILAB</p> <p>:Symbolic Expressions and Algebra, Algebraic and Transcendental Equations, Calculus, Symbolic Linear Algebra,</p> <p>Ordinary and partial differential equation, Symbolic Tutors.</p>		



Reference Books:

1. “MATLAB and its Applications in Engineering” Raj Kumar Bansal, Ashok KumarGoel, Manoj Kumar Sharma, Pearson.
2. Python Essential Reference (Developer’s Library), 4th Edition by David M. Beazley, Addison – Wesley Professional.
3. An introduction to Scilab - CSE, IIT Bombay

Suggested Readings:

1. “Essentials of MATLAB Programming”, 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
2. “MATLAB Demystified”, David McMahon, The McGraw-Hill Companies, (2007).
3. “MATLAB® for Engineers”, 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).

Online Resources:

1. <https://in.mathworks.com/videos/matlab-overview-61923.html>
2. https://www.youtube.com/watch?v=IuEOMyGuuIg&list=PLRWKj4sFG7-6_Xr9yqg6SMr_F80KdFVhN

Practical / Activities:

1. MATLAB Practices

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	2		2				3	
CO2	2	3	2		1		1	1			2
CO3	3	3		1		1				2	
CO4	3	2		1		1		1			1



GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code : BMAT		Programme Name : B.Sc. Mathematics		
Course Code BMAT502DSC		Semester : V		
Mathematical Analysis – I				
Course type : Discipline Specific Course		Total Credit : 03		
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- (a) To discuss important results on number system.
- (b) Increase Student's knowledge about topology, limit point, sequence, series and convergent series and power series.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of number system.
CO2	Develop an understanding of basic topology.
CO3	Gain knowledge about sequence and series.
CO4	To learn basic properties of real numbers and its subsets which is backbone of Real Analysis.

Unit	Content	Hrs.	Weightage
1	Number System: The real field to be developed by ordered set approach, Equivalence of this approach and Dedekind's approach, Extended real number system, The complex number system, Euclidean spaces..	15	33%





2	<u>Basic Topology:</u> Finite, Countable and Uncountable sets, Metric space, Neighborhoods in metric spaces, Limit point of a set, Open, Closed, Bounded, Compact, Perfect, Connected and Convex subsets of metric spaces	15	33%
3	<u>Sequences and Series:</u> Convergence sequence, Sub sequences, Cauchy sequences, Upper and lower limits, Special sequences and Series, Series of non negative terms, Roots and Ratio Test. Power Series with Real (Complex) terms, Interval (circle) of convergence and radius of convergence of a power series, Summation by parts, absolute convergence, addition and multiplication of series.	15	34%

Reference Books:

1. “Principles of Mathematical Analysis” by Walter Rudin, McGraw Hill (International Student Edition), 3rd Edition.
2. “A First Course in Mathematical Analysis” by D. Somasundaram & B. Choudhary, Narosa Publishing House
3. “Fundamentals of Mathematical Analysis” by G. Das & S. Pattnayak Tata Mcgraw Hill Pub.Co
4. “Fundamental of Real Analysis” by S. L. Gupta & Nisha Rani – Vikas Pub. House Pvt. Ltd. New Delhi-1974.

Suggested Readings:

1. Mathematical analysis by S.C. Malik and Savita Arora.

Online Resources:

1. https://youtu.be/BnE_MJaU8BQ
2. <https://youtu.be/ihQyz7bJcRE>
3. <https://youtu.be/Bfp6gejiybA>
4. <https://youtu.be/-h3Gswp6-no>

Practical / Activities:

1. MATLAB/ PYTHON/ SCILAB Graphics
2. Quiz/ Assignment/unit test

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes 1:-Less relevant, 2:- Mild relevant 3:- Highly relevant
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3		2			1			3	
CO2	3	2	2	1		1		1			2
CO3	3	3			1		1			2	
CO4	2	3	1		1						1

GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :	BMAT		Programme Name :	B.Sc. Mathematics
Course Code	BMAT503DSC		Semester :	V
Differential Equation				
Course type :	Discipline Specific Course		Total Credit :	03
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70 (Paper of 3 hrs)	100

Unit	Content	Hrs.	Weight
1	Formation of Differential Equations, Symbolic Operator, Method of finding C.F., Sybolic Operator $1/f(D)$, Method of finding P.I., Shorter method of finding P.I., To find P.I. when $X = e^{ax}$, where a is constant, To finding P.I. when $X = Cosax$ or $Sinax$, To find the value of $1/f(D).x^m$, where m is positive integer, To find the value of $1/f(D).(e^{ax}V)$, where a is constant and V is a function of x . To evaluate $1/f(D).(XV)$, where V is a function of x .	15	33%
2	Condition of Exactness of the linear differential equations, Solution of non-linear equations which are Exact, Equations of the form $y^{(n)} = f(x)$, Equations of the form $y^{(2)} = f(y)$, Equation do not contain y directly, Equation that do not contain x directly, Equation in which y appears in only two derivatives whose orders differ by two, Equation in which y appears in only two derivatives whose order differ by unity.	15	33%
3	Method of solving $y^{(2)} + Py^{(1)} + Qy = R$ when an integral included in the C.F. is known, Method of solving $y^{(2)} + Py^{(1)} + Qy = R$ by changing the dependent variable, $y^{(2)} + Py^{(1)} + Qy = R$ by changing the independent variable, Solution by factorization of the Operator, Method of variation of Parameters, Method of Undetermined Co-efficient.	15	34%



Course Objective:

- To discuss importance of differential equation.
- To increase knowledge about liner differential equation.

Course Outcomes: At the end of the course, students shall be able to

CO1	Will be able to explain the concept of differential equation.
CO2	Can solve the problems of linear differential equations.
CO3	Compute all the solutions of second and higher order linear differential equations with constant coefficients, linear equations with variable coefficients.
CO4	Solve simultaneous linear equations with constant coefficients and total differential equations.

Reference Books:

- Erwin Kreyszing, Advanced Engineering mathematics, By. John Wiley & Sons Inc. New York, 1999.
- D.A.Murray, Introductory course on Differential Equations, By. Orient Longman,(India), 1967.
- A.R.Forsyth, A Terastise on Differential Equations, Macmillan and Co.Ltd., London.
- Ian N. Sneddon, Elements of partial Differential Equations, McGraw-Hill Book Compony, 1998.

Suggested Readings:

- Ordinary and partial differential equation.
- Raisinghanian, M. D., Advanced Differential Equations, S. Chand & Co., 1995

Online Resources:

- <https://youtube.be/F9118vka9rM>
- Khan Academy -Differential Equation.

Practical / Activities:

- MCQs Quiz/ unit test
- To prepare assignment to find P.I.and C.F.





**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and
Program Specific Outcomes (PSOs):**

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3		2			1	1		3	
CO2	3	2	2	1		1		1			2
CO3	3	3			1		1			2	
CO4	2	3	1		1						1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :		BMAT	Programme Name : B.Sc. Mathematics	
Course Code		BMAT504DSC	Semester : V	
Operations Research – I				
Course type :		Discipline Specific Course	Total Credit : 03	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70 (Paper of 3 hrs)	100

Course Objective:

- (a) To discuss importance of differential equation.
- (b) To increase knowledge about liner differential equation.

Course Outcomes: At the end of the course, students shall be able to

CO1	Solve real world problems using different Mathematical technique.
CO2	Be able to build and solve Transportation Models and Assignment Models.
CO3	Define basic components of Network and find critical path
CO4	Define queue characteristics , transient and steady state

Unit	Content	Hrs.	Weightage
1	Introduction: Nature and scope of Operations Research. Linear programming: (a) LP Model and method of solution- Graphical method, Slack-Surplus and unrestricted variables, Simplex Algorithm, Simplex Method	15	33%
2	Artificial Slack variables, Two phase method, Big-M / Penalty method, Variation in simplex method solution- unbounded, infeasible solutions and concept of degeneracy	15	33%
3	(a) Duality Theory-The essence of duality theory, primal-dual relationships, Duality theorems, Dual simplex method. (b) Integer Programming- The need of integer solutions, The	15	34%





concept of the Cutting – Plane, Gomory’s Cutting Plane Algorithm		
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Reference Books:

1. Operations Research , by. J. K. Sharma. Macmillan Publishers India Ltd.
2. Operations Research by Nita Shah, Ravi Gor and Hardik Soni, Prentice Hall of India.
3. Operations Research (Principles and Practice) by Pradeep Prabhakar Pai, Oxford University Press.

Suggested Readings:

1. Ordinary and partial differential equation.
2. Raisinghania, M. D., Advanced Differential Equations, S. Chand & Co., 1995

Online Resources:

1. <https://youtube.be/F9118vka9rM>
2. Khan Academy -Differential Equation.

Practical / Activities:

1. MCQs Quiz/ unit test
2. To prepare assignment to find P.I.and C.F.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2	1			1				3
CO2	2	3			1	1		1		2	
CO3	3	2	1							2	
CO4	3	3			1		1				1





GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT501SE	Semester :	V	
Business Mathematics – V				
Course type :	Elective Course	Total Credit:	02	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	---	15	35	50

Course Objective:

- (a) This course provides complete skill to understand basic function of mathematics and their use in Business and Finance.
- (b) To discuss about basic concept of mathematics.

Course Outcomes: At the end of the course, students shall be able to

CO1	Calculating the degree of certainty of events in ideal conditions.
CO2	Solve Business and finance problems.
CO3	After completion of this course students will be able to

Unit	Content	Hrs.	Weightage
1	Probability: (Only examples)	15	50%
	Classical- Statistical (or Empirical)- Axiomatic (Modern) definition of probability, Definitions of event, equally likely, mutually exclusive and exhaustive events, Probability theorems, Statements of Baye's theorem and its examples, Conditional probability and its examples.		
2	Probability Distribution: (only examples)		





Definitions of a Random variable, Probability Distribution of a random variable, Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution and its examples.	15	50%
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List of References:

1. Business Statistics, by Bharat Jhunjunwala, S. Chand Prakashan.
2. Business Statistics, by R.S. Bhardwaj
3. Statistics (Chapter – 18 & 19) by, R.S.N.Pillai & V. Bagavathi, S. Chand & Company, New- Delhi

Suggested Readings:

1. Khan, S.M. (2005). A textbook of Business Mathematics

Online Resources:

1. <http://www.udemy.com>
2. <https://onlinecourses.swayam2.ac.in>

Practical / Activities:

1. Quiz /Assignment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	2	2		1		1			2
CO2	3	2	1		1		1			2	
CO3	3	3		1		1				2	2

GOKUL GLOBAL UNIVERSITY, SIDHPUR



**Faculty of Science
Gokul Science College**

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Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT601DSC	Semester :	VI	
Ring Theory				
Course type :	Discipline Specific Course	Total Credit :	03	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- Full significance as a mathematical formulation of symmetry been understood.
- It was understand the solutions to polynomial equation.
- Ring theory is one of the great simplifying and unifying ideas in modern mathematics.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of group & a finite cyclic group.
CO2	Extend group structure to finite permutation groups.
CO3	Solve problem in Ring theory & prove new definitions and theorems.
CO4	To study the Rings of polynomials and its factorization over a field.

Unit	Content	Hrs.	Weight
1	Definition of a Ring and illustrations, Properties of a Ring, Zero divisors and Integral domain, Characteristic of an Integral Ring, Solution of the equation $ax = b$ in a ring R , Subrings, Ideals, Quotient ring,	15	33%
2	Introduction of Polynomials, Integral Domain $D[x]$, Familiar form of Integral domain $D[x]$, Unique factorization of Polynomials, Solutions of a Polynomial Equation, Eisenstein Criterion for irreducibility	15	33%
3	Homomorphism: Definition and some examples, Kernel of homomorphism, Homomorphism of rings, Isomorphism of rings, Fundamental theorem on homomorphism, homomorphism and characteristic., Maximal Ideal, Prime Ideal.	15	34%





Reference Books:

1. Gallian, Joseph. A. (2013). Contemporary Abstract Algebra (8th ed.). Cengage Learning India Private Limited, Delhi. Fourth impression, 2015.
2. Topics in Algebra, I N Herstein, Wiley Eastern Ltd.
3. Artin, M., Algebra, Prentice Hall of India, 1991.
4. Jacobson, N., Basic Algebra, Vol. II, Hundastan Publ. Co., Delhi, 1984.
5. P. B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2/e), Cambridge University Press, South Indian Edition 2002

Suggested Readings:

1. Topics in Algebra (I.N.HERSTEIN)

Online Resources:

1. <https://youtu.be/-h3Gswp6-no>
2. <https://youtu.be/Bfp6gejiybA>
3. <https://youtu.be/ihQyz7bJcRE>

Practical / Activities:

1. Unit test/Quiz
2. Assignment

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
0	0	6	00	00	200	200

Content

Unit	Description in detail	Credit	Weightage
1	<u>Input-Output Statements in MATLAB/ PYTHON/ SCILAB.</u> Data input, interactive inputs, reading/storing file data, output commands, formatted input-output functions.	3	25 %
2	<u>Programming Techniques:</u> Loops, Branches control structures, MATLAB/ PYTHON/ SCILAB programming, function subprograms, types of		25%





	functions, function handles, errors and warnings, MATLAB/ PYTHON/ SCILAB debugger.		
3	<u>MATLAB/ PYTHON/ SCILAB Applications:</u> The content of this unit is to be covered from the list given in Appendix A.	3	25%
4	<u>Practical using MATLAB/ PYTHON/ SCILAB programming</u> List of practical is given in Appendix B.		25%

Appendix A:

Table A.1

Discrete Math\Number theoretic functions	
factor	Returns Prime factors.
factorial	Factorial function.
nchoosek	All combinations of N elements taken K at a time.
perms	All possible permutations.
gcd	Returns the greatest common divisor.
lcm	Returns the least common multiple.
primes	Generate list of prime numbers
isprime	Returns a logical array that is prime numbers.
rat, rats	Returns a rational fraction approximation.
mod	The mod function is useful for congruence relationships. Returns modulus after
rem	Rievtiusrionsn remainder after division.

Table A.2

Coordinate System Conversion





cart2sph	Transform Cartesian to spherical coordinates.
cart2pol	Transform Cartesian to polar coordinates.
pol2cart	Transform polar to Cartesian coordinates.
sph2cart	Transform spherical to Cartesian coordinates.

Table A.3

Interpolation Functions	
interp1	Linear and cubic – spline interpolations of a function of one variable.
interp2	Linear interpolation of a function of two variables.
spline	Cubic – spline interpolation.
unmkpp	Computes the coefficients of cubic-spline polynomials.

Table A.4

Numerical Integration Functions	
quad	Numerical integration with adaptive Simpson's rule.
quadl	Numerical integration with adaptive Lobatto quadrature.
trapz	Numerical integration with the trapezoidal rule.
quadv	Vectorized quadrature.
dblquad	Numerically evaluate double integral.
triplequad	Numerically evaluate triple integral.

Table A.5

Numerical Differentiation Functions	
--	--





diff(x)	Computes the difference between adjacent elements in the vector x.
polyder	Differentiates a polynomial, a polynomial product, or a polynomial quotient.

Table A.6

ODE Solvers	
ode23	Nonstiff, low-order solver.
ode45	Nonstiff, medium-order solver.
ode113	Nonstiff, variable-order solver.
ode23s	Stiff, low-order.
ode23t	Moderately stiff, trapezoidal rule solver.
ode23b	Stiff, low-order solver.
ode15s	Stiff, variable-order solver.
Odeset	Creates integrator options structure for ODE solvers.
Deval	Evaluate solution of differential equation problem
bvp4c	Solve boundary value problems for ODEs.

Table A.7

Optimization	
fminbnd	Finds minimum of single-variable function.
fzero	Finds zero of single-variable function.
fminsearch	Multidimensional unconstrained nonlinear minimization
lsqnonneg	Linear least squares with nonnegativity constraints





fminunc	Find minimum of unconstrained multivariable function
fmincon	Find minimum of constrained nonlinear multivariable function
linprog	Solve linear programming problems

Table A.8

Statistical Functions	
erf(x)	Computes the error function $erf(x)$.
mean	Calculates the average.
median	Calculates the median.
std	Calculates the standard deviation.
var	Calculates the variance.
corrcoef	Correlation coefficients.
cov	Covariance matrix.

Appendix B:

1. Numerical Methods Practical (Lab) using MATLAB/ PYTHON/ SCILAB programming
2. Calculus
3. Optimization
4. Problems related to programming given in text book.

Assignment: The work should involve programming using MATLAB/ PYTHON/ SCILAB. The student should submit the electronic copy of .m files or/and diary file showing the execution/output of Matlab/ Python/ Scilab session(s).

Reference Books:





1. “MATLAB and its Applications in Engineering” Raj Kumar Bansal, Ashok KumarGoel, Manoj Kumar Sharma, Pearson.
2. Python Essential Reference (Developer’s Library), 4th Edition by David M. Beazley, Addison – Wesley Professional.
3. An introduction to Scilab - CSE, IIT Bombay

Suggested Readings :

1. “Essentials of MATLAB Programming”, 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
2. “MATLAB Demystified”, David McMahon, The McGraw-Hill Companies, (2007).
3. “MATLAB® for Engineers”, 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).

Online Resources :

1. <https://in.mathworks.com/videos/matlab-overview-61923.html>
2. https://www.youtube.com/watch?v=IuEOMyGuuIg&list=PLRWKj4sFG7-6_Xr9yqg6SMr_F80KdFVhN

Practical / Activities :

1. Practices

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant									PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		
CO1	3	3	1	2			1				3
CO2	3	2			1			1		2	
CO3	2	3		1		1				2	
CO4	3	3	1				1	1			1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT602DSC	Semester :	VI	
Mathematical Analysis – II				
Course type :	Discipline Specific Course	Total Credit :	03	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- (a) Full significance as a mathematical formulation of symmetry been understood.
- (b) It was understand the solutions to polynomial equation.
- (c) Ring theory is one of the great simplifying and unifying ideas in modern mathematics

Course Outcomes: At the end of the course, students shall be able to

CO1	Define metric and metric space.
CO2	Develop an understanding of Riemann – Stieltje’s integral.
CO3	Gain knowledge about sequence and series of function.
CO4	To be able to check continuity of a function.

Unit	Content	Hrs.	Weight
1	Limits and Continuity: Limits and Continuity for a functions from a metric space into another metric space, continuity of a composite function, Structural properties of continuous functions from a metric space in to R_k , Continuity and Compactness, Continuity and connectedness, Discontinuities, Monotonic function, Discontinuities of a monotonic function, Infinite limits and limits at infinity. Differentiation: Derivatives of a real function, Continuity and differentiability, Structural properties of the class of differentiable functions, Mean value theorems, Continuity of derivatives, L’Hospital rule, Derivatives of higher order, Taylor’s theorem.	15	33%
2	The Riemann – Stieltje’s Integral: Riemann integral and Stieltje’s integral, properties of Riemann integral and Stieltje’s	15	33%





	integral, Integration and Differentiation, Integration of Vector Valued Functions, Rectifiable curves.		
3	Sequences and Series of functions: Sequences of functions, Limit of a Sequence of functions, Uniform convergence, tests for uniform convergence and continuity, Uniform convergence and differentiation.	15	34%

Reference Books:

1. Principles of Mathematical Analysis, Walter Rudin, McGraw Hill (International Student Edition), 3rd Edition.
2. A First Course in Mathematical Analysis, D. Somasundaram & B. Choudhary, Narosa Publishing House.
3. Fundamentals of Mathematical Analysis, G. Das & S. Pattnayak Tata Mcgraw Hill Pub.Co
4. Fundamental of Real Analysis, S. L. Gupta & Nisha Rani – Vikas Pub. House Pvt. Ltd. New Delhi-1974.
5. Principle of Real Analysis, S.C.Malik , Wiley Eastern Limited New Delhi, 1982.

Suggested Readings:

4. Topics in Algebra (I.N.HERSTEIN)

Online Resources:

3. <https://youtu.be/-h3Gswp6-no>
4. <https://youtu.be/Bfp6gejiybA>
5. <https://youtu.be/ihQyz7bJcRE>

Practical / Activities:

2. Unit test/Quiz
3. Assignment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	2				1			1	3
CO2	3	2	1		1			1		2	
CO3	2	3		1		1				1	2
CO4	3	3	1				1				1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :		BMAT	Programme Name : B.Sc. Mathematics	
Course Code		BMAT603DSC	Semester : VI	
Topology				
Course type :		Discipline Specific Course	Total Credit : 03	
Teaching time (hours)		Examination Marking scheme		
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	---	30	70	100

Course Objective:

- Topology has been used to study various biological systems including molecules and nanostructure (e.g., membranous objects).
- In particular, circuit topology and knot theory have been extensively applied to classify and compare the topology of folded proteins and nucleic acids.

Course Outcomes: At the end of the course, students shall be able to

CO1	Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
CO2	Demonstrate familiarity with a range of examples of these structures.
CO3	Prove basic results about completeness, compactness, connectedness and convergence within these structures.
CO4	The Definition and some examples, Elementary concepts, Open bases and Open sub bases, Weak topologies.

Unit	Content	Hrs.	Weight
1	Topology and Topological space, Neighbourhoods, Hausdorff space, Closure of a subset of a Topological space.	15	33%
2	Interior of a subset of Topological space, Boundary of a subset of a Topological space, Continuity of a function from Topological space to Topological space, Homeomorphism between two Topological spaces.	15	33%
3	Subspace of a Topological space, connectedness of a	15	34%





	Topological spaces, Some applications of connectedness, Components of a point of connected Topological space.		
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Reference Books:

1. Introduction to Topology and Modern Analysis, by. "G F Symmons", New York McGrawHill, 1963
2. General Topology by Kelly J L , NewYork, Van Nostrand 1955
3. Elementary topology by Beckett D W., new York Academic Press, 1967.

Suggested Readings:

- a) Elementary topology by Beckett D W., new York Academic Press, 1967.

Online Resources:

- a) <https://you.be/8xxi3ILFLBk>

Practical / Activities:

- a) **Picture frame puzzles**
- b) **Rope handcuffs**
- c) **Topological clothing:**
- d) **Unit test**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2			1	1			3	
CO2	3	3			1		1				2
CO3	2	3		1		1		1		2	
CO4	3	2	1				1				1





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme code :	BMAT	Programme Name :	B.Sc. Mathematics	
Course Code	BMAT604DSC	Semester :	VI	
Operations Research – II				
Course type :	Discipline Specific Course	Total Credit :	03	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
45	----	30	70	100

Course Objective:

- (a) This module aims to introduce students to use quantities methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.
- (b) To discuss about Transportation problem and method of solution for T.P., Sequencing problem and Game theory.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the concept of transportation models and assignment problem.
CO2	Develop an understanding of sequencing problems.
CO3	Gain knowledge about game theory and dominance principle.
CO4	This helps them to get optimum solutions within the given constraints to problems arising in industry.

Unit	Content	Hrs.	Weight
1	Transportation Problem: Introduction, general method of a T.P., unbounded T.P. NWCM, Least cost method, VAM methods to find the initial solution, Dual of a T.P. and MODI method, degeneracy in a T.P., variations in T.P. Maximization T.P. and Prohibited routes. Assignment Problem: General model of A.P. (A.P. as a special case of a T.P.) Hungarian Method of solving a A.P., variations in a A. P maximization, prohibited assignments	15	33%
2	Sequencing Problem: Methods of sequencing, Johnson’s Algorithm for a two machine problem, three machine problem and M-machine problem, Processing Two jobs through M-machines.	15	33%





3	Game Theory: Introduction, Two-person zero games, Minimax and Maximin principles, saddle point theorems, mixed strategies, method for solution of 2×2 game, dominance principles, solution of games without saddle points by using dominance and then mixed strategies, graphical method of solving 2×m and m×2 game, L.P. solution of games.	15	34%
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Reference Books:

1. Operations Research , by. J. K. Sharma. Macmillan Publishers India Ltd.
2. Operations Research by Nita Shah, Ravi Gor and Hardik Soni, Prentice Hall of India.
3. Operations Research(Principles and Practice) by Pradeep Prabhakar Pai, Oxford University Press

Suggested Readings:

1. Wayne L. Winston, Practical Management Science: spreadsheet modeling and applications
2. Taha, Hamdy, Operations Research, 7th edition, (USA: Macmillan Publishing Company), 2003

Online Resources:

1. https://www.youtube.com/results?search_query=sequencing+problem+in+operational+research
2. https://www.youtube.com/watch?v=8M0tQKZzdDY&list=PL23dd-8zssJDLv4Zc6975_FKKd4MXwsTC

Practical / Activities:

1. Unit test/Quiz
2. Assignment

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3		1		1		1		3	
CO2	2	3	1		1		1				2
CO3	3	2		1		1				2	
CO4	2	3	1				1				2





GOKUL GLOBAL UNIVERSITY, SIDHPUR					
Programme code :		BMAT	Programme Name :		B.Sc. Mathematics
Course Code		BMAT601SE	Semester :		VI
Business Mathematics – VII					
Course type :		Elective Course	Total Credit:		02
Teaching time (hours)		Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)	
30	----	15	35	50	

Course Objective:

- (a) It acts as a tool that helps in solving and controlling various business problems.
- (b) To understand linear programming problem
- (c) To discuss correlation and regression analysis.

Course Outcomes: At the end of the course, students shall be able to

CO1	Develop linear programming (LP) models for shortest path, maximum flow.
CO2	Analysis the general nonlinear programming problems.
CO3	Formulate the nonlinear programming models.

Unit	Content	Hrs.	Weight
1	LPP Formulation & Graphical Method: (Only examples)	15	50%
	Introduction, Structure of linear programming problems, Important terms used in L P Problems, Objective function, constraints, Solution, feasible solution, Basic solution, BFS, Non-degenerate B.F.S, Degenerate solution, Infeasible, Unbounded & Multiple optimal solution, Slack & Surplus variables, Artificial variable, Formulation of LPP & a solution by Graphical method.		
2	Correlation & Regression analysis: (Only examples)		





Definition of correlation, positive & negative correlation, Scatter diagram, Carl – Pearson’s coefficient of linear correlation, Properties of correlation coefficients and its examples, regression coefficient, properties of regression coefficient and its examples.	15	50%
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List of References:

1. Operation Research, by J. K. Sharma.
2. Business Statistics , by R. S. Bhadyaj
3. Business Statistics , by Bharat Jhnujhunwala

Suggested Readings:

1. Taha, Hamdy, Operations Research, 7th edition, (USA: Macmillan Publishing Company), 2003

Online Resources:

1. <http://www.udemy.com>
2. <https://onlinecourses.swayam2.ac.in>

Practical / Activities:

1. Quiz

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes	Program Outcomes										
	1:-Less relevant, 2:- Mild relevant 3:- Highly relevant										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	2		2		1				3
CO2	2	3		1		1	1	1		2	
CO3	3	3		1		1				2	





**GOKUL
GLOBAL
UNIVERSITY**

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Bachelor of Science

Physics

Under

Choice Based Credit System (CBCS)



Faculty of Science
Gokul Science College

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E- Mail : dean.fac.sci@gokuluniversity.ac.in, Website : www.gokuluniversity.ac.in





PO No.	Program Outcome Description
PO1	Foundational Knowledge: Graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical Skills: Students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical Thinking: Graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective Communication: Students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and Teamwork: Graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information Literacy: Students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical Awareness: Graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong Learning: Students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal Impact: Graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.

PSO No.	Program Specific Outcome Description
PSO1	Physical Understanding and Application: Graduates of the B.Sc. Physics program will possess a thorough understanding of the principles and theories of physics. They will apply this knowledge to analyse and solve physical problems, design experiments, and make scientific observations.
PSO2	Data Analysis and Modelling: Graduates will develop skills in data analysis, statistical methods, and mathematical modelling to interpret and predict physical phenomena. They





will apply these skills to address real-world challenges and contribute to advancements in scientific research.

Semester I

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	COTACT HRS/WK
			L	T	P		
THEORY							
1	BPHY101 UDSC	Mechanics and Basic Electronics (MAE)	4	0	0	4	4
2	MPHY101 USE	INSTRUMENTATION MEASUREMENT AND ANALYSIS	2	0	0	2	2
3	BMAT101 UDSC	DIFFERENTIAL CALCULUS	4	0	0	4	4
4	BCHE101 DSC	INORGANIC, ORGANIC, PHYSICAL CHEMISTRY & VOLUMETRIC-I	4	0	0	4	4
5	B101EG	Communication Skills	2	0	0	2	2
PRACTICALS							
1	BPHY101 UPRA	Practical Module-01	0	0	1	2	2
2	BMAT101 UPRA	MATHEMATICS PRACTICAL – I	0	0	2	2	4
3	BCHE101P RA	Practical Core Course- I	0	0	4	4	4
TOTAL			16	0	7	24	26

Semester II

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	COTACT HRS/WK
			L	T	P		
THEORY							





1	BPHY201 UDSC	Wave, Optics, Electronics & Semiconductor Device (WOES)	4	0	0	4	4
2	MPHY201 USE	ELECTRONIC CIRCUIT ELEMENTS AND ENERGY SOURCES	2	0	0	2	2
3	BMAT201 UDSC	INTEGRAL CALCULUS & DIFFERENTIAL EQUATION	4	0	0	4	4
4	BCHE201 DSC	INORGANIC, ORGANIC, PHYSICAL CHEMISTRY & VOLUMETRIC-II	4	0	0	4	4
5	B201EG	Disaster Management	2	0	0	2	2
PRACTICALS							
1	BPHY201 UPRA	Practical Module-01	0	0	1	2	2
2	BMAT201 UPRA	MATHEMATICS PRACTICAL – II	0	0	2	2	4
3	BCHE201P RA	Practical Core Course- II	0	0	4	4	4
TOTAL			16	0	7	24	26

Semester III

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	COTACT HRS/WK
			L	T	P		
THEORY							
1	BPHY301 UDSC	OPTICS, MODERN PHYSICS & LASER(OMPL)	3	0	0	3	3
2	BPHY302 UDSC	SOLID STATE, NUCLEAR & MATHEMATICAL PHYSICS(SSNM)	3	0	0	3	3
3	BPHY301 USE	Space Physics	2	0	0	2	2
4	BMAT301 UDSC/ BCHE301 DSC	LINEAR ALGEBRA AND CALCULUS / INORGANIC & ORGANIC CHEMISTRY-I	3	0	0	3	3





5	BMAT302 UDSC/ BCHE302 DSC	NUMERICAL ANALYSIS / PHYSICAL CHEMISTRY-I	3	0	0	3	3
6	B301EG	Personality Development	2	0	0	2	2
PRACTICALS							
1	BPHY301 UPRA	PHYSICS PRACTICAL-301	0	0	1	1.5	3
2	BPHY302 UPRA	PHYSICS PRACTICAL-302	0	0	1	1.5	3
3	BMAT301 UPRA	MATHEMATICS PRACTICAL -III	0	0	1	3	3
4	BCHE301P RA	Practical Core Course- II	0	0	6	6	6
TOTAL			16	0	9	28	31

Semester IV

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	COTACT HRS/WK
			L	T	P		
THEORY							
1	BPHY401 UDSC	ELECTROMAGNETISM, ELECTRONICS & PLASMA PHYSICS (EMEP)	3	0	0	3	3
2	BPHY402 UDSC	QUANTUM MECHANICS, SOLID STATE & THERMODYNAMICS(QM SST)	3	0	0	3	3
3	MPHY401 USE	VACUUM PUMPS, PRESSURE GUAGES AND INSTRUMENTS	2	0	0	2	2
4	BMAT401 UDSC/ BCHE401 DSC	ADVANCED CALCULUS / INORGANIC & ORGANIC CHEMISTRY-II	3	0	0	3	3





5	BMAT402 UDSC/ BCHE402 DSC	ADVANCED LINEAR ALGEBRA / PHYSICAL CHEMISTRY & SPECTROSCOPY	3	0	0	3	3
6	B401EG	Human Rights	2	0	0	2	2
PRACTICALS							
1	BPHY401 UPRA	PHYSICS PRACTICAL-401	0	0	1	1.5	3
2	BPHY402 UPRA	PHYSICS PRACTICAL-402	0	0	1	1.5	3
3	BMAT401 UPRA	MATHEMATICS PRACTICAL - IV	0	0	1	3	3
4	BCHE401P RA	Practical Core Course- II	0	0	6	6	6
TOTAL			16	0	9	28	31

Semester V

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	BPHY501DSC	MATHEMATICAL PHYSICS, CLASSICAL MECHANICS & QUANTUM MECHANICS(MCQM- 01)	3	0	0	3	3
2	BPHY502DSC	MOLECULAR SPECTRA, STATISTICAL MECHANICS & SOLID-STATE PHYSICS(MSSP)	3	0	0	3	3
3	BPHY503DSC	ELECTROMAGNETIS M AND PLASMA PHYSICS(EMPP)	3	0	0	3	3





4	BPHY504DSC	ELECTRONICS	3	0	0	3	3
5	MPHY501SE OR BPHY502SE	Instruments OR Remote Sensing and Transducers	2	0	0	2	2
6	B501EG	Environment and Sustainable Development	2	0	0	2	2
PRACTICALS							
1	BPHY501PRA	PHYSICS PRACTICAL-501	0	0	1	1.5	3
2	BPHY502PRA	PHYSICS PRACTICAL-502	0	0	1	1.5	3
3	BPHY503PRA	PHYSICS PRACTICAL-503	0	0	1	1.5	3
4	BPHY504PRA	PHYSICS PRACTICAL-504	0	0	1	1.5	3
TOTAL			16	0	4	22	28

Semester VI

S R. N O.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	COTACT HRS/WK
			L	T	P		
THEORY							
1	BPHY601DSC	Mathematical Physics, Classical Mechanics & Quantum Mechanics (MCQM-02)	3	0	0	3	3
2	BPHY602DSC	Nuclear Physics (NP)	3	0	0	3	3
3	BPHY603DSC	Statistical Mechanics, Solid State Physics & Optics (SSPO)	3	0	0	3	3
4	BPHY604DSC	Electronics & C- Programming	3	0	0	3	3
5	MPHY601SE OR BPHY602SE	Atmospheric Science OR Nanoscience & Nanotechnology	2	0	0	2	2
6	B601EG	Stress Management	2	0	0	2	2
PRACTICALS							





1	BPHY601PRA	PHYSICS PRACTICAL-601	0	0	1	1.5	3
2	BPHY602PRA	PHYSICS PRACTICAL-602	0	0	1	1.5	3
3	BPHY603PRA	PHYSICS PRACTICAL-603	0	0	1	1.5	3
4	BPHY604PRA	PHYSICS PRACTICAL-604	0	0	1	1.5	3
TOTAL			16	0	4	22	28

BPHY101UDSC: - MECHANICS AND BASIC ELECTRONICS(MAE)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	4	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Vectors algebra & Calculus Basic Electronics and Linear circuits, Laws of Motion & Dynamics of System of Particles and Elasticity, Oscillations, Gravitation. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of oscillations to standard differential equations. They will be able to explain various natural vibration phenomena.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments

Credits: - 04

Module No.	Contents	Teaching Hours.
	Vectors algebra & Calculus	





I	Vectors and Scalars, Addition of Vectors, Resolution of Vectors, Scalar and Vector Products, Triple Products of Vectors, Scalar Triple Products, Some Important Conclusions from Scalar Triple Product, Vector Triple Products, Differentiation of a Vector with Respect to time , Scalar and Vector Fields, Partial Differentiation and Gradient, Operation with ∇ , The rate of flow of a Vector Field, Vector Integration, Surface Integral, Gauss's Divergence Theorem, Stoke's Theorem, Derivation of Green's Theorem from Gauss Divergence Theorem	15
II	<p>Basic Electronics and Linear circuits</p> <p>Electronic components, Basic idea of Passive components and Active components, Source of Electric Power, Batteries, Concept of Voltage Sources, Ideal Voltage Source, Concept of Current Source, Practical Current Source, Conversion of Voltage Source into Current Source and vice versa, RC circuits analysis and time constant (Capacitor charging and discharging), RL circuits analysis (Growth and Decay of current), Ideal LC circuit, Series LCR circuit (for charge case)</p>	15
III	<p>Laws of Motion & Dynamics of System of Particles</p> <p>Frames of reference, Newton's law of motion, Kinetic energy, Work and Work-Energy theorem, Calculation of Work done, Conservative and Non-Conservative force (definition), Potential Energy and Conservation of Energy, Definition of Center of Mass, Center of mass of Two particle and several group of particles, Linear momentum and its Conservation Principle, Rocket Propulsion, Collisions, Inelastic Collisions, Elastic Collisions (one- and two-dimension explanation)</p>	15
IV	<p>Oscillations & Gravitation</p> <p>Simple Harmonic Motion, Equation for SHM and its Solutions, Terms Associated with SHM, SHM as a Projection of Circular Motion, Energy Conservation in SHM, Newton's law of Gravitation, Gravitation Potential Energy, Gravitation Potential, Gravitational Field, Calculation of Gravitational Potential and Field due to a point mass, kepler's Laws, Motion of Planets and Satellite in circular orbit, Geosynchronous orbits, Weightlessness, Escape velocity</p>	15

Reference Books:

- Concept of physics by H C Verma part 1 Publisher: Bharati Bhawan
- Electricity and Magnetism by K.K.Tewary Publisher: S.Chand & Company Ltd.





- Basic electronics and linear circuits by N N Bhargava, D C Kushreshtha, S C Gupta
Publisher: Technical Teachers Training Institutes Chandigarh
- Mechanics Berkeley Physics course Vol 1
- B.Sc. Practical physics By C.L.Arora Pub: S.chand.
- A text book of Practical Physics By Indu Prakash & Ramkrishna Pub: Kitab Mahal, New Delhi.

Suggested Readings:

- Lectures on physics, R.P.Feynman, Vol 1
- Physics – Resnick and Holiday
- Principles of electronics by V.K.Mehta, S.Chand
- Electronics Device and Circuits by Allen Mottershead Pub: PHI

Online Resources:

1. <https://www.makerspaces.com/basic-electronics/>
2. <https://www.electronics-tutorials.ws/>
3. https://www.electronics-notes.com/articles/basic_concepts/

BPHY101UPRA: - Practical Module-01

Credit: - 02

Practical / Activities:

1. To determine the Moment of Inertia of a Fly Wheel.
2. To determine 'g' by bar pendulum.
3. To determine the Young's Modulus of long wire by Searl's method.
4. To study of Charging and Discharging of Capacitor and RC time constant.
5. To determine Low resistance by Projection method.
6. Decay of Potential across condenser.
7. Verification of Steafan's law using AC source.
8. Damping coefficient, Relaxation and quality factor in the damped motion of a Simple Pendulum.



9. Study of Resonator.
10. Refractive index liquid using convex lens.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3	1	1			1			3	3
CO2	3	3	3			1		1			2	2
CO3	3	3	3		1			1			2	3

BPHY101USE: - INSTRUMENTATION MEASUREMENT AND ANALYSIS

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include instrumentation measurement and analysis. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of instruments to standard their uses and analysis. They will be able to explain various parts of the instruments.
CO2	Develop basic communication skills through working in groups, Apply the various procedures and techniques for the experiments



Credits: - 02

Module No.	Contents	Teaching Hours.
I	Vernier Calipers, Micrometer Screw, Spherometer Introduction, Theory, Figure, Description of the instrument, Detail study of Least count, Errors, Positive Error, Negative Error, Determination of Magnitude of Positive and Negative Errors. Introduction, Theory, Figure, Description of the instrument, Definition of pitch and its Determination, study of least count, Meaning of the Error and explanation of positive and negative Errors, Determination of positive and Negative Errors, Method of taking observation with the help of micrometer screw. Introduction, Theory, Figure, Description of the instrument, to determine the pitch of the screw, To Determine the Least count of the Spherometer, Zero Error, Derivation of Formula for the Radius of Curvature Of Curved Surface.	15
	Wheastone Bridge, Post-Office box, Construction of Galvanometer, Spectrometer Introduction, Theory with Figure, The Figure of Meter Bridge used in Laboratory, Construction of Meter Bridge, Introduction, Theory, Circuit Diagram, Circuit Diagram, explanation of working with necessary formula. Introduction, Theory, Sensitivity and Figure of merit of Galvanometer. Introduction, Construction and explanation of three main parts of spectrometer, Mercury Discharge lamp, Sodium Discharge lamp, the adjustment, levelling and the method of recording the observation of spectrometer.	

Reference Books:

- Experimental book for Physics.
- A course in Electrical And Electronic Measurements and Instrumentation by A.K. Sawhney, Puneet Sawhney

Suggested Readings:

- A course in Electrical and Electronic Measurements and Instrumentation by J.B. Gupta
- Electronic instrumentation and measurements by David A bell

Online Resources:



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1. <https://www.makerspaces.com/basic-electronics/>
2. <https://www.electronics-tutorials.ws/>
3. https://www.electronics-notes.com/articles/basic_concepts/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3	2	1						3	2
CO2	3	3	3	2	1						3	2

BPHY201UDSC: - WAVE, OPTICS, ELECTROSTATICS & SEMICONDUCTOR DEVICE (WOES)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
4	0	4	20	10	70	100

Course Objective:

- The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Vectors algebra & Calculus Basic Electronics and Linear circuits, Laws of Motion & Dynamics of System of Particles and Elasticity, Oscillations, Gravitation. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of oscillations to standard differential equations. They will be able to explain various natural vibration phenomena
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments



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Credits: - 04

Module No.	Contents	Teaching Hours.
I	Waves Motion, Sound & Ultrasonic Waves	15
	Wave motion, Transverse Wave Travelling in String, Velocity of a Wave in a String, Interference and the principle of Superposition, Standing waves on a String, Normal Modes of a String, Laws of Transverse Vibrations of a String, Melde's Experiment. Speed of Sound Wave in a material medium, Speed of Sound in Gas-Newton's Formula and Laplace's Correction, Intensity and loudness of Sound Wave - Decibels, Beats, Musical Scale, Acoustics of Buildings, Application of Acoustic phenomena, Doppler Effect, Ultrasonic, Production of Ultrasonic Waves, Detection of Ultrasonic Waves, Applications of Ultrasonic waves	
II	Semiconductor Physics	15
	Semiconductor materials, Energy Bands in solid metals insulators and semiconductor, PN junction, Formation of PN junction, PN junction with Forward and Reverse biasing, V-I Characteristic of a PN junction diode, Zener Diode, Zener Breakdown, V-I Characteristic of a Zener diode, Zener Diode as Voltage Regulator Half-Wave Rectifier, Full-Wave Rectifier, Centre-tap Rectifier, Bridge Rectifier, Performance of Half-Wave & Full-Wave Rectifier Comparison of Rectifiers, Filter Circuit, Capacitor Filter, Inductor Filter, LC filter, π Filter,	
III	Thermodynamics & Electrostatics	15
	Second Law of Thermodynamics (2.8), Carnot's theorem (2.9), Thermodynamic Scale of temperature (2.10), Identity of Perfect Gas Scale and Absolute Scale (2.11), Thermodynamics of Refrigeration (4.2) - Entropy (2.13), Change of Entropy in a reversible process (2.14), change of entropy in an irreversible process (2.15), Principle of increase of entropy of degradation of energy (2.16), Formulation of the second law in term of entropy (2.17), Entropy and second law (2.18) - Third law of Thermodynamics (Nernst's heat theorem) (2.19) The Electric Field, Introduction, Coulomb's law, Continuous Charge Distribution, Electric Potential, Introduction to Potential, Comments on Potential, The Potential of a Localized charge distribution, Work and Energy in Electrostatics, the work done to move a charge, the energy of a point charge distribution, Current	





	and Current density, Conservation of charge, Continuity equation, ohm's law at a point, Wiedmann and franz law, the relaxation time	
IV	Wave Optics Electromagnetic nature of Light, Wave Front, Huygens Principle. Superposition of Waves, Conditions for Interference, Techniques of Obtaining Interference: Division of Amplitude and Division of Wave front, Young's Double Slit Experiment, Lloyd's Single Mirror- Determination of Wavelength of Light, Fresnel Biprism – Experiment Arrangement & Determination of Wavelength of Light, Interference in Thin Films, Types of thin film –Parallel and wedge-shaped films, Newton's Rings: Determination of Wavelength of Light & refractive index	15

Reference Books:

- Waves and Oscillation by N.Subrahmanym and Brij Lal Pub: Vikas Publising House Pvt. Ltd., New Delhi
- Elements of Electronics By Bagde & Singh Publisher : S.chand
- A Text Book of OPTICS By N.Subrahmanyam, Brijlal, M.N. Avadhanulu Publisher: S.chand.
- Introduction to Electrodynamics by David J. Griffiths Publisher: Prentice Hall India 3rd edition
- Electricity and Magnetism by K.K.Tiwari Pub: S.Chand & Company Ltd.
- Fundamentals of OPTICS By Gulati and Khanna Publisher: R.Chand

Suggested Readings:

- Physics – Resnick and Holiday
- Principles of electronics by V.K.Mehta, S.Chand
- Electronics Device and Circuits by Allen Mottershead Pub: PHI
- Heat and Thermodynamics by Zeemansky
- Heat and Thermodynamics by A.B. Gupta and H. P. Roy (New Central Book)

Online Resources:

1. <https://www.makerspaces.com/basic-electronics/>
2. <https://www.electronics-tutorials.ws/>
3. https://www.electronics-notes.com/articles/basic_concepts/





CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3	1	1		1				3	3
CO2	3	3	3			1	1				2	2
CO3	3	3	3		1		1	1			2	3

BPHY201UPRA: - Practical Module-02

Credit: - 02

Practical / Activities:

LIST OF EXPERIMENTS

- 1) To determine the unknown frequency of Tuning Fork By Melde' s Experiment.
- 2) To Verify the Laws of vibrating strings by Melde's Experiment.
- 3) To determine wavelength of light using Newton's Ring.
- 4) To study Half-Wave Rectifier.
- 5) To Study of a Transformer.
- 6) To study Characteristics of Photo diode.
- 7) Study of line spectra.
- 8) Determination of self-inductance 'L' of inductor.
- 9) Study of parallel resonance with frequency variation.
- 10) To study Bridge Rectifier
- 11) Find out Refractive index of prism using Spectrometer.
- 12) To study Zener diode Characteristics





BPHY201USE: - ELECTRONIC CIRCUIT ELEMENTS AND ENERGY SOURCES

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include instrumentation measurement and analysis. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of instruments to standard their uses and analysis. They will be able to explain various parts of the instruments.
CO2	Develop basic communication skills through working in groups, Apply the various procedures and techniques for the experiments

Credits: - 02

Module No.	Contents	Teaching Hours.
I	<p>PASSIVE CIRCUIT ELEMENT: RESISTOR, INDUCTOR, CAPACITOR</p> <p>Generals, Resistor type, Wire wound resistor, Carbon composition resistor, Carbon film resistor, Ceramic film resistor, Metal film resistor, Power resistor, value tolerance resistor, Variable resistor, Potentiometer, Rheostats, Fusible resistor, Resistor color, Resistor color bond, Resistor under 10 ohm, Resistor troubles, Checking resistor with ohmmeter. Inductor, comparison of different coils, Inductance of an Inductor, Another definition of Inductance, Mutual inductance, Co-efficient of coupling, variable inductors, inductor in series and parallel without M, series combination with m, Energy storage magnetic field, DC resistance of coils. Capacitor, Capacitor connect to battery, capacitance, factors controlling capacitance, type of capacitors, fixed capacitor,</p>	15





	variable capacitor, voltage rating of capacitor, leakage resistance, troubles capacitors, checking capacitor with ohmmeter.	
II	ENERGY SOURCES: CELLS AND BATTERY, TRANSFORMER.	15
	Primary and secondary cells and batteries, voltage and current o cell, cell life, different type of dry cell, carbon zinc cell, alkaline cell, manganese alkaline cell, Nickel-cadmium cell, mercury cell, silver oxide cell, lead acetate cell, Battery rating, Testing dry cell, Photoelectric cell, Solar cell. Transformer working, Transformer impedance, Can a Transformer operate on DC, RF shielding, Auto-Transformer	

Reference Books:

- Basic electronics by B. L. Tharaja, Pub. S. Chand & Company 3rd Edition.
- A course in Electrical And Electronic Measurements and Instrumentation by A.K. Sawhney, Puneet Sawhney

Suggested Readings:

- A course in Electrical And Electronic Measurements and Instrumentation by J.B. Gupta
- Electronic instrumentation and measurements by David A bell

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1. <https://www.makerspaces.com/basic-electronics/>
2. <https://www.electronics-tutorials.ws/>
3. https://www.electronics-notes.com/articles/basic_concepts/

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant										PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	3	3	3	2	1	1		1			3	2
CO2	3	3	3	2	1						3	2





BPHY301UDSC: - OPTICS, MODERN PHYSICS & LASER(OMPL)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Diffraction, Resolving power, Polarization, Laser, Modern Physics. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand different kind of diffraction types and its comparison between single slit and double slit grating and also understand resolving power of different optical instruments and its types.
CO2	The student understands about polarization, types of polarized light, its production method, refraction types, and about laser types, properties, applications.
CO3	In this section student understand about orbital and magnetic dipole moment, different conditions of it, different laws to support this theorem.

Credits: - 03

Module No.	Contents	Teaching Hours.
I	Diffraction & Resolving Power	15
	Distinction between Interference and diffraction (17.6), Fresnel and Fraunhofer types of diffraction (17.7), Fraunhofer diffraction at a double slit (18.4), Fraunhofer diffraction at double slit (Calculus method), (18.4.1), Distinct between single slit and double slit diffraction pattern (18.4.2), Fraunhofer diffraction at N slit (18.6 & 18.6.1), Plane diffraction grating (18.7), Theory of plane transmission grating (18.7.1), Dispersive power of Grating (18.7.7). Waves, Applications of Ultrasonic waves Resolving Power of Optical Instrument (19.5), Resolving Power of a telescope (19.7), Relation between magnifying power and	





	resolving power of a telescope (19.7.1), Resolving Power of a Plane transmission grating (19.12).	
II	Polarization & Laser Introduction (20.1), Polarization by double refraction (20.5.5), Double refraction (20.8.3), Huygens' explanation of double refraction (20.9 & 20.9.1), Types of polarized light, (20.15), Retarders or Wave plates (20.17), Quarter wave plate (20.17.1), Half wave plate (20.17.2), Production of Elliptically polarized light (20.18), Detection of Elliptically polarized light (20.18.1). Introduction (6.1), Properties of Lasers (6.2), Stimulated absorption, spontaneous emission and stimulated emission (6.3), Population inversion (6.5), Pumping (6.6), Main components of a laser (6.7), Nd:YAG Laser (6.8), Helium-Neon laser (6.9), CO ₂ laser (6.10), Semiconductor lasers (6.11), Applications of Laser (6.12 & 6.13)	15
III	Modern Physics Orbital and Magnetic Dipole Moment (4.1), Larmor Precession (4.2), Space quantization (4.3), Electron spin (4.4), Vector model of atom (4.5), Spectroscopic terms and their notations (4.6), Stern Gerlach Experiment (4.7), Pauli's Exclusion Principle (4.8). Zeeman Effect- Normal Zeeman Effect and anomalous Zeeman Effect (12.1), Explanation of Normal Zeeman Effect (12.2), Explanation of Anomalous Zeeman Effect (12.3), Paschen back effect (12.4).	15

Reference Books:

- Principles of Optics by B.K. Mathur
- Optics by Ajoy Ghatak
- Fundamentals of Optics by Jonkin's and White
- Engineering Physics by K. Rajgopal
- Atomic & Molecular spectra by Rajkumar Kedarnath Prakashan Meerut
- Engineering Physics by R.K Gaur and S.L. Gupta
- Concepts of Modern Physics by Arther Beiser.





Suggested Readings:

- A text book of OPTICS by Dr. N, Subrahmanyam, Brijlal, Dr, M,N, Avadhanulu - S.Chand
- A Text book of Light by D.N.Vasudeva - S. Chand & Co.

Online Resources:

1. <https://en.wikipedia.org/wiki/Diffraction>
2. <https://testbook.com/learn/physics-diffraction-of-light/>
3. <https://www.olympus-lifescience.com/en/microscope-resource/primer/lightandcolor/diffraction/>
4. <https://byjus.com/physics/resolving-power-of-microscopes-and-telescopes/>
5. <https://www.britannica.com/technology/resolving-power>
6. http://labman.phys.utk.edu/phys136core/modules/m9/resolving_power.html
7. <https://byjus.com/physics/polarization-of-light/>
8. <https://www.physicsclassroom.com/class/light/Lesson-1/Polarization>
9. [https://en.wikipedia.org/wiki/Polarization_\(waves\)](https://en.wikipedia.org/wiki/Polarization_(waves))
10. <https://www.geeksforgeeks.org/polarization-of-light-definition-types-methods-applications/>
11. <https://www.vedantu.com/physics/polarisation-of-light>
12. <https://www.edmundoptics.in/knowledge-center/application-notes/optics/introduction-to-polarization/>
13. <https://science.howstuffworks.com/laser-weapon.htm>
14. <https://www.ulsinc.com/learn>
15. <https://www.rp-photonics.com/lasers.html>
16. <https://openstax.org/books/university-physics-volume-3/pages/8-2-orbital-magnetic-dipole-moment-of-the-electron>
17. <https://opentextbc.ca/universityphysicsv3openstax/chapter/orbital-magnetic-dipole-moment-of-the-electron/>

BPHY301UPRA: - Practical Module-01

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Resonance pendulum. Determination of „l^o“, „r^o“ & „a^o“



- 2) Study of X-ray diffraction (Powder) Pattern.
- 3) Decay of Temperature when body is allowed to cool. (thermocouple)
- 4) To study elliptically polarized light using photocell and quarter wave plate.
- 5) To determine I using Hertzman formula
- 6) Activation energy of a semiconductor
- 7) Absorption co-efficient of liquid using photocell.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3	1		1		1			2	2
CO2	3	2	1	1	1			1			1	2
CO3	3	2	2						1		1	1

BPHY302UDSC: - SOLID STATE, NUCLEAR & MATHEMATICAL PHYSICS (SSNM)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include atomic cohesion and crystal binding, atomic spectra, elementary particles, detectors, radioactivity, Q-Equation, Fourier series and co-Ordinator transformation. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to



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CO1	The student will be able to understand cohesion of atom, different types of bond, different crystal structure, and some properties of acting on it and also learn about its related experimental model
CO2	In this unit student will learn about elementary classification of particle, types of detectors, about radioactivity, and about the Q-equation.
CO3	In this unit student will learn about Fourier series, application and different function of it, and also learn about co-ordinate transformation.

Credits: - 03

Module No.	Contents	Teaching Hours.
I	<p>Atomic Cohesion and Crystal Binding, Atomic Spectra:</p> <p>Cohesion of Atoms(2.1), Primary Bonds (2.2), The Covalent Bond (2.2.1), The Metallic Bond (2.2.2), The Ionic Bond (2.2.3), Mixed Bond (2.2.4), Secondary Bonds(2.3), The Vander wall's Bond (2.3.1), The Hydrogen Bond (2.3.2), The Cohesive Energy(2.4), Ionic Crystal (2.4.1), Noble Gas Crystal (2.4.2), Atomic Radi.Vs Lattice constants (2.5), Elastic constants of crystals (2.6), Elastic Stress (2.6.1), Elastic strain(2.6.2), Dilation(2.6.3), Elastic Compliance and Stiffness constant (2.7), Elastic Energy density (2.7.1), Application to Cubic crystal (2.7.2), Bulk Modulus and compressibility (2.7.3).</p> <p>Franck-Hertz experiment, Critical potentials Shortcomings of Bohr's Theory, Summerfield extension of Bohr theory</p>	15
II	<p>Elementary Particles, Detectors, Radioactivity & The Q-Equation</p> <p>Fundamental interactions in Nature (21.1), Dawn of elementary particle physics (21.2), Mediator of an interaction, (21.2.1), Pi-Mesons (21.2.2), Muons, Kaons and hyperons (21.2.3), Particles and antiparticles (21.3), Classifications of elementary particles (21.4)</p> <p>Introduction (1.1.1), Detectors for Nuclear Particles (1.1.3), (i) Proportional Counter (ii) Semiconductor detectors, (Review of Radioactive decay laws, half-life, mean life time etc.) Radioactive growth and decay (2.6) Ideal equilibrium (2.7) Transient equilibrium and secular equilibrium (2.8) Radioactive series (2.9)</p> <p>Introduction (3.1), Types of Nuclear Reactions (3.2), The Balance of Mass and Energy in Nuclear Reactions (3.3), The Q-Equation (3.4), Solution of the Q Equation (3.5).</p>	15





III	Fourier series & Co-ordinate Transformation	15
	Introduction (7.1), Periodic functions (7.2), Application of Fourier series (7.3), Average values of a function (7.4), Fourier Co-efficient (7.5), Dirichlet's conditions (7.6), Complex form of Fourier series (7.7), Parseval Theorem Curvilinear Coordinates (10.6), Scale factors and basis vectors for orthogonal systems (10.7)	

Reference Books:

- Mathematical method for physical sciences by M. L. Boss John Wiley Publication.
- Concepts of Modern Physics by Arther Beiser.
- Introduction to Solid State Physics by C. Kittel (John Willey)
- Fundamental of Solid-State Physics by Saxena, Gupta, Saxena (Pragati Prakashan)
- Solid State Physics by C. M. Kachhawa
- Engineering Physics by R.K Gaur and S.L. Gupta

Suggested Readings:

- Elements of Solid-State Physics. (2003) by J. P. Srivastava, PHI
- Nuclear Physics by S.B. Patel (New age International (p) Ltd. Publishers)
- Modern physics by G. Aruldas, P. Rajagopal

Online Resources:

1. http://www.vpscience.org/materials/US04CPHY22_UNIT4.pdf
2. <https://byjus.com/physics/atomic-spectra/>
3. <https://www.livescience.com/65427-fundamental-elementary-particles.html>
4. https://en.wikipedia.org/wiki/Particle_detector
5. <https://www.sciencedirect.com/topics/physics-and-astronomy/radioactivity#:~:text=Radioactivity%20is%20the%20phenomenon%20of, mass%20being%20converted%20to%20energy.>
6. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Equilibria/Chemical_Equilibria/The_Reaction_Quotient#:~:text=This%20means%20that%20in%20the,there%20would%20be%20at%20equilibrium.](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Equilibria/Chemical_Equilibria/The_Reaction_Quotient#:~:text=This%20means%20that%20in%20the,there%20would%20be%20at%20equilibrium.)





7. <https://byjus.com/maths/fourier-series/#:~:text=A%20Fourier%20series%20is%20an,the%20sine%20and%20cosine%20functions.>
8. <http://motion.cs.illinois.edu/RoboticSystems/CoordinateTransformations.html>
9. <https://www.continuummechanics.org/coordxforms.html>
10. <https://math.etsu.edu/multicalc/prealpha/chap3/chap3-1/printversion.pdf>

BPHY302UPRA: - Practical Module-02

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Study of B.G.: To determine current sensitivity, volt sensitivity, figure of merit and Rg of B.G.
- 2) High resistance by equal deflection method.
- 3) Low resistance by Carry foster bridg.
- 4) To determine low value of „C“ using Schering bridge.
- 5) Characteristics of UJT & Determination of RBB, VD & h
- 6) Characteristics of a Photodiode
- 7) To verify Demorgan’s Theorems using IC-7400.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3			1					3	3
CO2	3	2	1	1				1			1	2
CO3	3	2	2		1			1			1	1





BPHY301USE: - ASTRO/SPACE PHYSICS

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include astronomical background, description about sun and its radiation related phenomena, cosmic radiation, types, its effects. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand about sun, its radiation effect, different layers of atmospheres affected by radiation, and sunspot cycle.
CO2	The student understands about different type of cosmic radiations effect of geomagnetic field on cosmic rays, its time variation, its origin, basic facts and region of confinement.

Credits: - 02

Module No.	Contents	Teaching Hours.
I	Sun and Solar Radiation	15
	Introduction, Astronomical background, General description of the sun, Solar structure, Sun's outer layers, Composition, Visible features on the sun, More about sun's outer atmosphere, Temperature of the corona, Solar activity and Sunspot cycles	
II	Cosmic rays and High energy astrophysics	15
	An introduction to cosmic rays and high energy astrophysics: primary cosmic radiation, energy spectrum of primary cosmic rays, secondary cosmic rays, effect of geomagnetic field on cosmic rays, time variation of cosmic rays, photons in primary cosmic rays, origin of cosmic rays, basic facts about cosmic rays, region of confinement	

Reference Books:



- An Introductory Course on Space Science Earth's Environment by S.S.Degaonker
(Gujarat University Publication, Ahmedabad)

Suggested Readings:

- An Introductory Course on Space Science Earth's Environment by S.S.Degaonker
(Gujarat University Publication, Ahmedabad)

Online Resources:

1. <https://www.energy.gov/eere/solar/solar-radiation-basics#:~:text=Solar%20radiation%2C%20often%20called%20the,using%20a%20variety%20of%20technologies.>
2. <https://www.azom.com/article.aspx?ArticleID=16595>
3. <https://www.fondriest.com/environmental-measurements/parameters/weather/photosynthetically-active-radiation/>
4. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/solar-radiation>
5. <https://www.sciencedirect.com/topics/chemistry/solar-radiation>
6. <https://www.newport.com/t/introduction-to-solar-radiation>
7. <https://web.astro.princeton.edu/research/computational-astrophysics>
8. <https://www.frontiersin.org/articles/10.3389/fspas.2019.00023/full>
9. <https://www.sciencedirect.com/topics/physics-and-astronomy/high-energy-cosmic-radiation>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes												
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9				
CO1	3	2	1	1								2	1
CO2	3	2	1		1	1		1				1	2



**BPHY401UDSC: - ELECTROMAGNETISM, ELECTRONICS & PLASMA PHYSICS
(EMEP)**

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3	0	3	Mid	CE		
			20	10		

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Electrostatics in Dielectric, Magnetic Potentials, Magnetic Vector Potential, Magnetization, Transistors Biasing and Stabilization, Basic Transistor Amplifier and its parameters, different Solid-state Devices and Types of A.C. Bridges. Also, here students learn Digital electronic and they get Number systems like Decimal, Binary, Hexadecimal and Octal and its conversions, different type subtractor. They also introduce with concept of plasma. In Plasma, study on Composition and Characteristics of a Plasma.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to know different kind of Magnetization, transistor biasing and different types A.C Bridge.
CO2	They Develop their basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	They also develop their basics instrumental knowledge with experiment skill and active their digital electronic calculation skill. They also get plasma related knowledge.

Credits: - 03

Module No.	Contents	Teaching Hours.
	Electrostatics in Dielectric & Magneto statics	





I	<p>Gaseous Non-Polar Dielectrics (2.11), Gaseous Polar Dielectrics (2.12), Non- Polar Liquids (2.13), Solid Dielectrics-Electrets (2.14).</p> <p>The Magnetic Potentials (4.9- a & b), Magnetic Vector Potential due to Small Current Loop (4.12), An alternative method for finding the Vector Potential A and the Field B due to Current Loop (4.13), Magnetization (4.15), Magnetic Field Vector (4.16), Magnetic Susceptibility and Permeability (4.17), Boundary Conditions (4.18), Uniformly magnetized Sphere in External Magnetic Field (4.19), A Comparison of Static Electric and Magnetic Fields (4.20).</p>	15
II	<p>Transistors Biasing and Stabilization, Basic Transistor Amplifier, Solid state Devices & A.C. Bridges</p> <p>Bias Stabilization (Operating point stabilization) (8.7, 8.7.1 & 8.7.2), Stability factor (8.8), Stabilization by Collector Base Resistance (8.9) Stabilization by potential divider and Emitter resistor (8.10)</p> <p>Transistor as a four pole (9.2), h-parameters with h-parameters equivalent circuit (9.5 complete), Grounded Emitter Circuit - Mathematical analysis using h parameters only (9.6), Comparative Study of three types of Amplifiers (9.9).</p> <p>JFET (12.1 to 12.6), UJT (26.6, 26.6.1 to 26.6.3).</p> <p>A.C. Bridges (17.5), Maxwell Bridge (17.6.1), Schering Bridge.</p>	15
III	<p>Digital Electronics & The Basic concepts of Plasma</p> <p>Introduction (21.1), Number systems used in Digital Electronics (21.2), Decimal, Binary, Hexadecimal and Octal (21.2.1 to 21.2.4), Binary Codes-(A) BCD, (B) Gray, (C) Excess-3 Codes (21.4), Arithmetic Circuits – Exclusive - OR Gate (21.9), Applications of X-OR Gate: (i) Binary to Gray Code Converter (ii) A Parity Checker (iii) The Half Adder (iv) The Full Adder (v) Parallel Adder (vi)Half subtractor (vii)Full subtractor.</p> <p>Introduction (1.1), Composition and Characteristics of a Plasma (1.2), Collisions (1.3), Elastic collisions (1.3.1), Inelastic collisions (1.3.2), Surface Phenomena (1.4), Transport Phenomena (1.5), Diffusion and Mobility (1.6), Viscosity, Conductivity (1.7), Recombination (1.8), Ohm’s law (1.9), Gas Discharge (1.10), Composition of various natural and Man-made Plasma (1.11), Plasma diagnostics (1.12), Plasma waves and Instabilities Confinement of Plasma (1.13), Space Plasma (1.14).</p>	15





Reference Books:

- Electromagnetic by B.B. Laud, New Age Int. Publisher
- Hand book of Electronics by Gupta & Kumar 30th Revised Edition, 2002 Pragati Prakashan
- Electronics and Radio Engineering by M.L. Gupta (9th Edition-2002) D Raj & Sons
- Electricity and Magnetism by Maharajan and Rangwala, THM
- Electronic Devices and Circuits by A. Mottershead Prentice – Hall of India.
- Basic Electronics and Linear Circuits by N.N. Bhargava, D.C. Kulshreshtha, S.C. Gupta McGraw
- Electricity and Magnetism Berkeley Physics course Vol.-II by EDWARD M PURCELL.
- Integrated Electronics by Millman & Halkias.

Suggested Readings:

- Electricity and Magnetism By K.K. Tewari (S.Chand.& Company Ltd.)
- Elements of Plasma Physics by S.N. Goswami New Central book Agency (P) Ltd., Calcutta.
- Advanced Magneto hydrodynamics by J. P. Goedbloed; Rony Keppens; Stefaan Poedts.
- Plasma Physics An Introduction By Richard Fitzpatrick

Online Resources:

- <https://www.electronics-tutorials.ws/>
- www.youtube.com
- <https://www.britannica.com/science/plasma-state-of-matter/Plasma-oscillations-and-parameters>
- <http://silas.psfc.mit.edu/introplasma/>





BPHY401UPRA: - Practical Module-01

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

1. Coaxial Viscometer
2. To determine wave length of bright lines of mercury light using grating.
3. R.P. of Telescope
4. Searl's Goniometer. Determination of cardinal points and do
5. Kundt's tube. Determination of "y"
6. Diffraction by Adser 'A' Pattern
7. e/k by Power Transistor

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3		1						3	2
CO2	2	2	1	1				1			2	1
CO3	2	1	1			1					1	1

BPHY402UDSC: - QUANTUM MECHANICS, SOLID STATE & THERMODYNAMICS (QMSST)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100





Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected topics of physics. The topics include Schrodinger Equations, The operator correspondence and the Schrodinger equation for a particle subject to forces , Normalization and Probability Interpretation, Non-Normalizable Wave functions and Box Normalization, Conservation of Probability, Crystal Structure, Some importance crystal structure, Face Centered Cubic Structure, Wigner-Seitz Cells, Miller Indices , Newtonian Relativity, Relativity of Simultaneity, Heat and Thermodynamics, The Helmholtz and Gibb's function, Maxwell's Distribution Law of Velocities Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Schrodinger Equation. They will be able to explain various Normalization and Probability.
CO2	Develop basic structure knowing skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	They learn different types of Relativity concept, Thermodynamics.

Credits: - 03

Module No.	Contents	Teaching Hours.
I	Schrodinger Equations, Physical Interpretation and Condition on 'ψ', & Stationary States and Energy Spectra A free particle in one dimension (2.1), Generalization to three dimensions (2.2), The operator correspondence and the Schrodinger equation for a particle subject to forces (2.3), Normalization and Probability Interpretation (2.4), Non-Normalizable Wave functions and Box Normalization (2.5). Conservation of Probability (2.6), Expectation values, Ehrenfest's Theorem (2.7), Admissibility Condition on the Wave function (2.8) Stationary states: The time Independent Schrödinger Equation (2.9), A particle in a square well potential (2.10), Bound States in a square well ($E > 0$) (2.11), The square well: non-localized states ($E > 0$) (2.12).	15
	Crystal Structure & Special Theory of Relativity Structure, Translational Symmetry, Space, Unit Cell and Primitive Cell, Symmetry Elements in Crystals, The Seven crystal Systems, Coordination Number, some importance crystal structure, Simple	





II	Cubic Structure, Body Centered Cubic Structure, Face Centered Cubic Structure, Wigner-Seitz Cells, Miller Indices, The spacing of a set of crystal planes Newtonian Relativity (14.1), Michelson-Morley experiment (14.2), Special theory of relativity (14.3), Lorentz Transformation (14.4), Consequences of Lorentz Transformation (14.5) - (a) Relativity of Simultaneity (b) the Lorentz-Fitz Gerald length Contraction (c) Time Dilation, Addition of Velocities (14.6), Mass-energy relation (14.8), Space time (14.9), Compton scattering (14.11).	
III	Heat and Thermodynamics & Kinetic Theory of Gases Characteristic functions, Enthalpy, The Helmholtz and Gibbs function, Two Mathematical Theorems, Maxwell's equations, The T-ds equations, Energy equation, The Thermal Expansivity, Compressibility, Joule-Kelvin effect (Porous plug Experiment), Liquefaction of Gases by Joule-Kelvin effect Maxwell's Distribution Law of Velocities, Deduction of Maxwell-Boltzmann law, Determination of the values of constants 'a' and 'b', Experimental Test of Maxwell's Law	15

Reference Books:

- Elements of Solid State Physics. (2003) by J. P. Srivastava, PHI
- Nuclear Physics by S.B. Patel (New age International (p) Ltd. Publishers)
- Mathematical method for physical sciences by M. L. Boss John Wiley Publication.
- Concepts of Modern Physics by Arthur Beiser.
- Introduction to Solid State Physics By C. Kittel (John Wiley)
- Fundamental of Solid State Physics By Saxena, Gupta, Saxena (Pragati Prakashan)
- Solid State Physics by C. M. Kachhawa
- Engineering Physics by R.K Gaur and S.L. Gupta

Suggested Readings:

- Modern physics by G. Aruldas, P. Rajagopal
- Nuclear Physics in a Nutshell by Carlos A. Bertulani
- Nuclear Physics: Principles and Applications by John Lilley





- Fundamentals of Physics (Mechanics, Relativity, and Thermodynamics) by R.

Shankar

- Heat and Thermodynamics by Pramila Shukla , Shefali Kanwar & Shivani
- An Introduction to the Kinetic Theory of Gases by James Jeans.

Online Resources:

- www.youtube.com
- <https://en.wikipedia.org/>
- <https://galileo.phys.virginia.edu/classes/252/home.html>

BPHY402UPRA: - Practical Module-02

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Absolute value of capacity using B.G. or S.G.
- 2) Low resistance by method of Projection
- 3) Comparison of capacity (C1/C2) by Desauty method
- 4) To determine self-inductance by Anderson Bridge
- 5) Characteristics of a C.B. Transistor (PNP)
- 6) Characteristics of JFET & Determination of μ , r_d , g_m
- 7) Construction of AND, OR, NOT Gates using NAND & NOR Universal gates.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	3		1						2	3
CO2	2	1	2	1		1		1			1	2
CO3	1	2	1								2	2



BPHY401USE: - Vacuum Pumps, Pressure Gauges and Instruments

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	00	10	05	35	50

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include different **Vacuum Pumps like** Rotary Oil Pumps, Molecular Pump, Diffusion Pump, and Pressure gauges like McLeod gauge, Pirani gauge, Thermocouple gauge, Ionization gauge. Errors of observations, Types of errors- Normal law of errors, Average, standard and probable errors, Percentage error. How Travelling Microscope works.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand Exhaust Pumps and their characteristics, Different types of pumps and Pressure gauges, Different types of measurements errors. Learn the different Travelling Microscope working process and how its Different eyepiece use full.
CO2	They Develop their skills through working in groups in performing the Instruments and by interpreting the results, They also develops their working Instruments knowledge, find the error of instruments and resolved the instruments measurements error.

Credits: - 02

Module No.	Contents	Teaching Hours.
I	Vacuum Pumps, Pressure Gauges & Errors in measurement	15
	Exhaust Pumps and their characteristics, Rotary Oil Pumps, Molecular Pump, Diffusion Pump, Other methods of producing Low Pressures, Pressure gauges- McLeod gauge, Pirani gauge, Thermocouple gauge, Ionization gauge Errors of observations, Types of errors, Normal law of errors, Average, standard and probable errors, Percentage error	
II	Optical Instruments	15
	Travelling Microscope, Cathetometer and Optical bench	



	Objective and Eyepiece, Kellner's Eyepiece, Huygens Eyepiece, Ramsden Eyepiece, Comparison of Ramsden Eyepiece and Huygens Eyepiece, Gauss Eyepiece, Telescopes, Refracting Astronomical Telescope, Reflecting Telescope, Newton's Telescope, Other reflecting Telescope	
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Reference Books:

- An advanced Course in Practical Physics by D. Chattopadhyay, P.C. Rakshit, B.SAHA, New Central Book Ltd.
- A text book of OPTICS by Dr. N. Subrahmanyam, Brijlal, Dr. M.N. Avadhanulu-S.Chand
- Mechanics by D.S. Mathur, S.Chand.

Suggested Readings:

- Handbook of *vacuum* science and technology / Dorothy M. Hoffman,. Bawa Singh, John H. Thomas
- Handbook of Measurement Error Models By [Grace Y. Yi](#), [Aurore Delaigle](#), [Paul Gustafson](#)
- Fundamentals and Basic Optical Instruments By [Daniel Malacara Hernández](#)
- Basic Optics and Optical Instruments: Revised Edition by Fred A. Carson

Online Resources:

- www.youtube.com
- <https://www.vacuumscienceworld.com/blog/vacuum-pressure-measurement>
- <https://www.tutorialspoint.com/>
- <https://en.wikipedia.org>
- <http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/opinst.html>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3	1				1			2	3
CO2	3	3	3		1	1					1	3





**BPHY501DSC: - MATHEMATICAL PHYSICS, CLASSICAL MECHANICS &
QUANTUM MECHANICS(MCQM-01)**

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Differential equations, 2nd order differential equations, lagrangian formulation, motion of a rigid body, general formalism of wave mechanics. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand different kind of differential equations, a method of separation in different coordinates, Laplacian equation in different coordinates and 2 nd order differential equation in regular singular point.
CO2	The student understands about different types of lagrangian formulation for holonomic, non-holonomic constrain D'Alembert's principal, Rayleigh's dissipation function and Euler's theorem.
CO3	In this section student understand about Schrodinger equation and probability interaction, fundamental postulate of wave mechanics, different types of operators there eigen value problem, eigen value functions, uncertainty principal and evolution of system with time constant of the motion.

Credit: -03

Unit	Content	Credit	Weightage
I	Differential Equations	1	34 %
	Some partial differential Equations Physics (2.1), The method of separation of variables (2.2A), Separation of Helmholtz equation in Cartesian Coordinates (2.2B), Separation of Helmholtz equation in spherical polar Coordinates (2.2C), separation of Helmholtz equation in cylindrical coordinates (2.2D), Laplace's equation in various coordinate systems (2.2E).		





	2nd order differential equations		
	Ordinary and singular points (3.1), Series solution around and ordinary point (3.2), Series Solution around a regular singular point (The method of Frobenius) (3.3).		
II	Lagrangian Formulation	1	33 %
	Introduction, Constraints, holonomic and non-holonomic constraints, scleronomous and rheonomous constraints (8.1), generalized coordinates(8.2), D'Alembert's principle(8.3), Lagrange's equations(8.4), a general expression for kinetic energy(8.5), Symmetries and the laws of conservation(8.6), Cyclic or ignorable coordinates (including illustrations)(8.7), Velocity dependent potential of electromagnetic field(8.8), Rayleigh's dissipation function(8.9).		
	Motion of a rigid body:		
	Introduction, Euler's theorem (10.1), Angular momentum and kinetic energy (10.2), The inertia tensor (10.3), Euler's equations of motion (10.4)		
III	General formalism of Wave Mechanics	1	33 %
	The Schrodinger equation and Probability interaction for N- particle system(3.1), The fundamental postulates of wave mechanics(3.2), Adjoint of an operator and self Adjointness(3.3), The Eigen value problem(3.4), Degeneracy(3.5), Eigen values and Eigen functions of self-adjoint operators(3.6), The Dirac delta function(3.7), Observables, completeness and normalization of Eigen functions(3.8), Closer, physical interpretation of Eigen values, Eigen function and expansion coefficients(3.9), Momentum Eigen functions : wave functions in momentum space(3.10), uncertainly Principle(3.11), States with minimum value for uncertainly product(3.12), commuting observable : Removal of degeneracy(3.13), Evolution of system with time Constants of the motion(3.14).		

Reference Books:

- Mathematical Physics by P. K. Chatopadhyay. Wiley East Ltd.
- Mathematical Physics by B.D.Gupta.
- Mathematical Physics by H.K.Dass.
- Introduction to classical mechanics by Takawale and Puranic. THM Publication.





- Classical Mechanics, by Goldstein. Narosa Publishing House, New Delhi.
- Classical Mechanics by Yasvant Waghmare.
- Classical Mechanics by N.C.Rana and P.S.Joag, THM Publication.
- A text book of Quantum Mechanics by P.M. Methews and K. Venkateshan, THM Publication.
- Quantum Mechanics by Ghatak and Loknathan, The Macmillan company of India Limited.
- Quantum Mechanics by John, L. Powell and B. Crasemann.
- Quantum Mechanics by Schiff.
- Quantum Mechanics by Fschwabi, Narosa Publishing House, New Delhi.

Suggested Readings:

- Mathematical Physics by P. K. Chatopadhyay. Wiley East Ltd.
- Mathematical Physics by B.D.Gupta.
- Mathematical Physics by H.K.Dass.
- A text book of Quantum Mechanics by P.M. Methews and K. Venkateshan, THM Publication.
- Quantum Mechanics by Ghatak and Loknathan, The Macmillan company of India Limited.

Online Resources:

1. <https://byjus.com/maths/differential-equation/>
2. https://en.wikipedia.org/wiki/Differential_equation
3. <https://www.cuemath.com/calculus/differential-equation/>
4. <https://www.cuemath.com/calculus/second-order-differential-equation/>
5. <https://www.mathsisfun.com/calculus/differential-equations-second-order.html>
6. <https://tutorial.math.lamar.edu/classes/de/introsecondorder.aspx>
7. https://en.wikipedia.org/wiki/Lagrangian_mechanics#:~:text=In%20physics%2C%20Lagrangian%20mechanics%20is,his%201788%20work%2C%20M%C3%A9canique%20analytique.
8. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Statistical_Mechanics/Advanced_Statistical_Mechanics/Classical_microstates%2C_Newtonian%](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Statistical_Mechanics/Advanced_Statistical_Mechanics/Classical_microstates%2C_Newtonian%)





[2C Lagrangian and Hamiltonian mechanics/The Lagrangian formulation of classical mechanics](#)

9. <http://www.unishivaji.ac.in/uploads/distedu/SIM2013/M.%20Sc.%20Maths%20Classifical%20Mechanics/Chapter%20I.pdf>
10. <https://brilliant.org/wiki/lagrangian-formulation-of-mechanics/>
11. https://www.brown.edu/Departments/Engineering/Courses/En4/notes_old/RigidKinematics/rigkin.htm#:~:text=Characteristics%20of%20rigid%20body%20motion,a%20rotation%20about%20the%20point.
12. <https://www.geeksforgeeks.org/motion-of-a-rigid-body/>
13. <https://byjus.com/physics/rigid-body-and-rigid-body-dynamics/>
14. https://nios.ac.in/media/documents/SrSec312NEW/312_Physics_Eng/312_Physics_Eng_Lesson7.pdf
15. https://qm1.quantumtinkerer.tudelft.nl/9_formalism/#:~:text=The%20formalism%20of%20quantum%20mechanics%20is%20built%20upon%20two%20fundamental,%20%20%7C%CE%A8%E2%9F%A9%E2%88%88H.
16. https://en.wikipedia.org/wiki/Mathematical_formulation_of_quantum_mechanics
17. <https://math.mit.edu/~dav/quantum.pdf>
18. <http://www.damtp.cam.ac.uk/user/tong/qm/qm3.pdf>

BPHY501PRA: - Practical Module-501

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Acceleration due to gravity (g) using Katter's pendulum (with movable and fixed knife edges)
- 2) Determination of Thermal conductivity 'K' of a rubber tube.
- 3) Study of thermocouple
- 4) Velocity of sound in air using CRO
- 5) G.M. Counter (Plateau Characteristics)



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CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3			1					3	2
CO2	2	3	3		1			1			2	1
CO3	2	1	2	1							2	1

BPHY502DSC: - MOLECULAR SPECTRA, STATISTICAL MECHANICS & SOLID-STATE PHYSICS(MSSP)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include molecular spectra and statistical mechanics of solid-state physics. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of molecular spectra and statistical. They will be able to explain various solid-state physics.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments

CREDIT: - 03

Unit	Content	Credit	Weightage
I	MOLECULAR SPECTRA	1	33 %





	<p>Pure Rotational and Vibrational - Rotational Spectra : Types of Molecular Spectra(17.2), Salient Features of Rotational Spectra(18.1), Molecular requirement for Rotational Spectra(18.2), Experimental Arrangement(18.3), The molecule as a rigid rotator: Explanation of rotational spectra(18.4), The Non-rigid Rotator(18.5), The Isotope Effect(18.6), Salient Features of Vibrational-Rotational Spectra(19.1), The Molecule as a Harmonic Oscillator(19.2).</p> <p>Raman and Electronic Spectra : Nature of the Raman Effect(20.1), Experimental Arrangement for Raman Spectra(20.2), Classical Theory of Raman Effect(20.3), Quantum theory of Raman Effect(20.4), Raman Spectra and Molecular Structure(20.5), Infra-red Spectra Versus Raman Spectra(20.6), Salient Features of Molecular Electronic Spectra(21.1), Formation of Electronic Spectra(21.2).</p>		
II	<p>STATISTICAL MECHANICS :</p> <p>Some Application of Statistical Mechanics : Thermodynamics(6.3), Reversible and Irreversible processes(6.3.1), The Laws of Thermodynamics(6.3.2) ((i) Zero (ii) First Law (iii) Second Law), Statistical interpretation of the basics thermodynamic variables(6.4, 6.4.1 to 6.4.8), Thermodynamic functions in terms of grand partition function(6.7), Ideal gas(6.8), Gibbs's Paradox Inclusive Sackur-Tetrode equation(6.9), The equipartition theorem(6.10).</p> <p>Bose Einstein and Fermi Dirac Distributions : Symmetry of wave functions(8.1), the Quantum Distribution functions(8.2), the Boltzmann limit of Boson and Fermions Gases(8.3), Evaluation of the Partition function(8.4), Partition function for Diatomic Molecules(8.5) ((a) translation partition function (b) rotational partition function (c) vibration partition function (d)electronic partition function), Equation of state for an Ideal gas(8.6), The quantum mechanical Paramagnetic susceptibility(8.7), problems</p>	1	34 %
III	<p>SOLID STATE PHYSICS :</p> <p>Free Electron Theory of Metal : Thermal conductivity of metals(6.1.2), The F.D. distribution function(6.3), The Sommerfield Model(6.4), Density of states(6.4.1), The free electron gas at 0° K(6.4.2), Energy of electron at 0° K(6.4.2), The electron heat capacity(6.5), The Sommerfield Theory of conduction in metals(6.6), The Hall coefficient(6.6.1).</p> <p>Application to Plasmons, Polaritons and Polarons : (Note: Qualitative description of dielectric constant should be given equation 10.45 to 10.49)Application to Plasma(10.7), Plasma oscillations(10.7.1), Transverse optical mode in plasma(10.7.2), Application to optical phonon modes in ionic crystals(10.8), The longitudinal optical mode(10.8.1), Transverse optical mode(10.8.2), The interaction of electromagnetic waves with optical modes(10.9).</p>	1	33 %



Reference Books:

- Atomic and Molecular Spectra : Laser by Rajkumar, Kedar Nath & Ram Nath
- Fundamentals of Statistical Mechanics by B. B. Laud. New Age International Publisher
- Elements of Solid State Physics by J.P. Srivastava, PHI New Delhi 2003

Suggested Readings:

- Statistical Mechanics and Properties of Matter by E.S.R.Gopa 2. Solid State Physics by A. J. Dekker.
- Introduction to Solid State Physics by C. Kittel. 7th Edition, John Wiley and Sons
- Molecular spectroscopy by Herz-Berg.
- Molecular spectroscopy by Banewell.

Online Resources:

1. https://www.smvdu.ac.in/images/stories/pdf/Academics/M.Sc_Physics/Final_Syllabus%20for%20all%20MSc%20Physics%20Programme%20at%20SoP.pdf
2. <https://www.sxccal.edu/wp-content/uploads/2022/06/Solid-State-Physics-and-Atomic-and-Molecular-Physics.pdf>
3. www.wikipedia.com
4. [Swayam portal](#)

BPHY502PRA: - Practical Module-502

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Refractive index ' μ ' by total internal Reflection method using Gauss eye piece
- 2) Resolving power of grating
- 3) To study absorption spectra of Iodine gas molecule
- 4) Newton's Ring (determination of R)
- 5) To study absorption spectra of liquid (KMnO₄)



CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	2		1			1			2	3
CO2	3	2	2	1	1						3	2
CO3	3	2	1			1					2	1

BPHY503DSC: - ELECTROMAGNETISM AND PLASMA PHYSICS(EMPP)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- Electromagnetism extends our understanding beyond classical mechanics because it introduces the concept of charge – a property we can observe in macroscopic objects and the smallest building blocks of matter.
- Electromagnetism is the invisible hand that allows charged objects to interact with each other.

Course Outcomes: At the end of the course, students shall be able to

CO1	Electromagnetism has important scientific and technological applications.
CO2	It is used in many electrical appliances to generate desired magnetic fields.
CO3	It is even used in a electric generator to produce magnetic fields for electromagnetic induction to occur.



Credit: - 03

Unit	Content	Credit	Weightage
I	<p>Boundary Value Problems in Electrostatic Fields: Special Techniques</p> <p>Laplace's Equation(3.1), Introduction(3.1.1), Laplace's Equation in one dimensions(3.1.2), Laplace's Equation in two dimensions(3.1.3), Laplace's Equation in three dimensions(3.1.4), Boundary conditions and Uniqueness theorems(3.1.5), The method of images(3.2), The classic image problem(3.2.1), Induced surface charge(3.2.2), Force and energy(3.2.3), other image problems(3.2.4), Separation of variables(3.3), Cartesian Coordinates(3.3.1), Spherical coordinates(3.3.2), Multipole Expansion(3.4), Approximate Potential at large distances(3.4.1), The monopole and dipole terms(3.4.2), Origin of Coordinates in Multipole Expansions(3.4.3).</p>	15	33%
II	<p>ELECTROMAGNETICS</p> <p>Electromagnetic Induction</p> <p>Faraday's law (7.2.1), The Induced Electric Field(7.2.2), Maxwell's Equation : Electrodynamics before Maxwell(7.3.1), How Maxwell fixed Ampere's Law(7.3.2), Maxwell's Equations(7.3.3), The Potential Formulation : Scalar and Vector Potentials(10.1.1), Gauge Transformations(10.1.2), Coulomb Gauge and Lorentz Gauge(10.1.3)</p> <p>Electromagnetic Waves</p> <p>Electromagnetic Waves in Vacuum: The Wave equation for E and B(9.2.1), Energy and Momentum in Electromagnetic Waves(9.2.3), Electromagnetic Waves in Matter: Propagation in Linear Media(9.3.1), Electromagnetic Waves in conductors(9.4.1), And The frequency dependence of permittivity(9.4.3).</p>	15	33%
III	<p>PLASMA PHYSICS</p> <p>Characteristics of a Plasma in a Magnetic field</p> <p>Description of plasma as a gas mixture(3.1), Properties of plasma in magnetic field(3.2), Force on plasma in magnetic field(3.3), Current in Magnetised Plasma(3.4), Diffusion in a Magnetic field(3.5), Collisions in fully ionized magneto-plasma(3.6), Pinch Effect(3.7), Oscillations and waves in the plasma(3.8), Plasma frequency(3.8.1), Maxwell's equation in a homogenous plasma(3.8.2), Electromagnetic or Transverse Oscillations(3.8.3), Electrostatic or Longitudinal oscillations(3.8.4), Oscillations of the plasma(3.8.5), Hydromagnetic waves(3.8.6), Resonances and cut-offs or reflection points(3.8.7).</p>	15	34%





Applications of Plasma		
Controlled Thermonuclear Reactions (7.1), Lawson criterion (7.1.1), The Coulomb Barrier (7.1.2), Heating and Confinement of the Plasma (7.1.3), Radiation loss of energy (7.1.4), Magnetohydrodynamic conversion of energy (7.2), Plasma propulsion (7.3), Other plasma devices (7.4).		

Reference Books:

- Introduction to Electrodynamics by David J. Griffiths. 3rd Edition Pearson Education Asia.
- Electromagnetics by B. B. Laud, 2nd Edition, Wiley Eastern Ltd.
- Elements of Plasma Physics by S. N. Goswami New Central Book Agency (P). Ltd. Calcutta.

Suggested Readings:

- Introduction to Plasma Physics by F.F.Chen. Plenum Press.
- Plasma Physics by S. N. Sen., Pragati Prakashan, Meerut

Online Resources:

- <https://youtu.be/7cuuCj1btcU>
- <https://youtu.be/YounWzEh0LA>

BPHY503PRA: - Practical Module-503

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- Comparison of capacity (C1/C2) using method of mixture
- Measurement of frequency f and phase difference ' θ ' of a.c. wave using CRO
- Calibration of magnetic field
- Determination of M and H using Deflection and Vibrational Magnetometer



5) e/m Thomson method

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	2			1		1			1	3
CO2	3	2	2	1		1		1			2	2
CO3	1	3	1		1						3	2

BPHY504DSC: - ELECTRONICS

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Principle of duality, different type of bridge, Karnaugh Maps and its Don't Care Conditions, Multiplexer, Demultiplexer, Basic Transistor Amplifiers, Multistage Amplifiers, Principle of Feedback Amplifiers & its Feedback, some Transistor Oscillators.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to know the principal of Duality, different types of Bridge Networks, The Reciprocity theorem, The compensation theorem, Karnaugh Maps, Don't Care Conditions, BCD-to-7 Segment Decoder, Digital Comparator, Multiplexer, Demultiplexer. They will have knowledge about Basic Transistor Amplifier like Current and Voltage amplifiers, Common Emitter Amplifiers with Emitter Resistor, Effect of An Emitter Bypass Capacitor in low frequency Response, also learn the different types of Multistage Amplifiers, Principle of Feedback Amplifiers, Advantages of Negative Feedback, Reasons for Negative Feedback, get knowledge about Transistor Oscillators like Tuned Collector Oscillators, Hartley Oscillator,
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	Colpitt's Oscillators , Phase Shift oscillator, R-C- Oscillator, Wien Bridge Oscillator, Crystal Oscillator.
CO2	They develop their basic communication & Computer coding skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	They also develop their basics instrumental knowledge with experiment skill and active their digital electronic calculation skill. They also get plasma related knowledge.

Credit: - 03

Unit	Content	Credit	Weightage
I	1.1. Network Transformations	1	33 %
	Principle of duality(1.3), Reduction of Complicated network(1.4), Conversions between T and π sections(1.5), The bridged-T network(1.6), The Lattice Network(1.7), The Reciprocity theorem(1.9), The compensation theorem(1.12), Driving point impedance, transfer impedance(1.14), The parallel-T network(1.17).		
	1.2. Digital Electronics		
	Simplification using Karnaugh Maps, Don't Care Conditions, BCD-to-7 Segment Decoder, Digital Comparator, Multiplexer, Demultiplexer.		
II	2.1. Basic Transistor Amplifiers	1	34 %
	Current and Voltage amplifiers(9.10), Common Emitter Amplifiers with Emitter Resistor(9.11), Simplified Common Emitter Hybrid Model(9.12), Effect of An Emitter Bypass Capacitor in low frequency Response(9.13).		
	2.2. Multistage Amplifiers		
	Multistage Transistor Amplifiers(10.1), R-C- coupled Amplifiers(10.2), Transformer Coupled Amplifiers(10.3) and Direct coupled Amplifiers(10.4), Effect of cascading on Band width(10.5).		
III	3.1. Feedback Amplifier	1	33%
	Feedback(11.1), Principle of Feedback Amplifiers(11.2), Advantages of Negative Feedback(11.3), Reasons for Negative Feedback(11.4).		
	3.2. Transistor Oscillators (Sinusoidal)		





Tuned Collector Oscillators(14.1), Hartley Oscillator(14.4), Colpitt's Oscillators (Circuit operation and alternative treatment only)(14.5), Phase Shift oscillator(14.6), R-C- Oscillator(14.6.1), Wien Bridge Oscillator(14.6.2), Crystal Oscillator(14.7).		
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Reference Books:

- Networks, Lines and Fields by J. D.Ryder. Prentice Hall.
- Hand Book of Electronics by Gupta and Kumar. 30th revised Edition 2002.

Suggested Readings:

- Fundamentals of electronics. Book 2, Amplifiers, analysis and design, Thomas F. Schubert, Jr. and Ernest M. Kim.
- "Transistor Theory and Circuits Made Simple" by Harvey Pollack
- Evaluating Feedback in Amplifiers and Oscillators: Theory, Design and Analogue Applications: No. 4 (Communications Systems, Techniques & Applications S.)

Online Resources:

- <https://www.allaboutcircuits.com/textbook/semiconductors/chpt-4/feedback/>
- <https://www.electronics-tutorials.ws/>
- www.youtube.com
- <https://www.allaboutcircuits.com/textbook/semiconductors/chpt-4/feedback/>

BPHY504PRA: - Practical Module-504

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) A study of transistorized Hartley Oscillator using CRO/Wave meter
- 2) I/P and O/P impedance of a R-C CE amplifier at different frequency using VTVM/CRO





- 3) A study of Transformer coupled Amplifier using VTVM/CRO (voltage gain frequency response and band width)
- 4) Diac characteristics
- 5) Characteristic of SCR

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	2	1	1		1		1			2	3
CO2	2	3	2		1						1	3
CO3	1	2	3	1		1					2	3

BPHY501SE: - INSTRUMENTS

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics Michelson's interferometer, babinet compensator its construction, principal, working, uses, applications, then learn about C.R.O and G.M. Counter. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand about Michelson's interferometer, babinet compensator its construction, principal, working, uses, applications.
CO2	The student understands about C.R.O. its uses and about G.M. counter principal, working, construction, applications, advantages and limitations.





Credit: - 2

Unit	Content	Credit	Weightage
I	Michelson's Interferometer	1	50 %
	Principle(15.7), Construction, Working, Circular fringes ,Localized fringes, White light fringes, Visibility of fringes(15.7.1 to 15.7.7), Applications of Michelson Interferometer(15.8),Measurement of wavelength, Determination of difference in the wavelengths of two waves, Thickness of a thin transparent sheet, Determination of the refractive index(15.8.1 to 15.8.4).		
	Babinet Compensator		
	Construction(20.21.1), Production of polarized light(20.21.2), analysis of elliptically polarized light(20.21.3).		
II	C.R.O.	1	50 %
	CR Tube(3.5), Electrostatic Deflection Sensitivity(3.5.1), Magnetic Deflection Sensitivity(3.5.2), CRT connections(3.5.3), Uses of C.R.O(3.5.4).		
	G. M. Counter		
Principle, Construction, Working, Dead time, recovery time, True counting rate, Efficiency of counting, Quenching of G M counter, Operation and testing of G.M. counter, Plateau, Applications of GMC, Advantages and limitations of GMC.			

Reference Books:

- A textbook of Optics by Dr. N. Subrahmanyam, Brijlal and Dr. M.N. Avadhanulu, S. Chand & Co. (for M.I and B.C.)
- Hand Book of Electronics by Gupta and Kumar. 30th revised Edition 2002. (For CRO)
- Refresher Course in Physics Vol-III, S. Chand & Co. Ltd. (7 th edition-2006) (for GMC, Ch-28)6. Space Plasma Physics, A C Das Narosa Pub

Suggested Readings:

- A textbook of Optics by Dr. N. Subrahmanyam, Brijlal and Dr. M.N. Avadhanulu, S. Chand & Co. (for M.I and B.C.)





Online Resources:

1. https://en.wikipedia.org/wiki/Michelson_interferometer
2. https://www.niser.ac.in/sps/sites/default/files/basic_page/Michelson%20Interferometer_P744%20-%20Optics.pdf
3. https://www.rp-photonics.com/babinet_soleil_compensators.html
4. https://www.holmarc.com/babinet_compensator.php
5. <https://www.elprocus.com/cro-cathode-ray-oscilloscope-working-and-application/>
6. https://en.wikipedia.org/wiki/Geiger_counter
7. <https://byjus.com/physics/geiger-counter/>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant										PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	2	2	1	1		1		1			2	3
CO2	2	2	2	1	1	1		1			1	3

BPHY601DSC: - MATHEMATICAL PHYSICS, CLASSICAL MECHANICS & QUANTUM MECHANICS(MCQM-02)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include some special functions in physics, variational principle: Lagrange's and Hamiltonian equations, exactly soluble eigen value problems. Some industry relevant topics are also covered under which basic concepts are taught.





Course Outcomes: At the end of the course, students shall be able to

CO1	The student will learn about Legendre differential equation, its generating functions, Rodriguez's formula, Hermite differential equation, its generating function, its recurrence formula, and Rodriguez's formula.
CO2	The student learns about different types of lagrangian formulation in advance, Hamiltonian equation of motion, its application, phase space, configuration space, some techniques of calculus of variation, application of variational principle.
CO3	In this section student will learn about simple harmonic oscillator, Schrodinger equation and energy eigenvalues, energy eigenfunctions, property of stationary state, abstract operator method, coherent state, angular momentum operator, eigenvalue equation for L^2 spherical harmonics, physical interpretation, parity, angular momentum in stationary states of systems with spherical symmetry.

Credit: - 03

Unit	Content	Credit	Weightage
I	Some special functions in Physics	1	33 %
	Legendre differential equation(6.1), Generating Function of Legendre Polynomial(6.2), Rodriguez's formula for Legendre Polynomial(6.3), Orthogonal properties of Legendre Polynomial(6.4), Hermite differential equation and Hermite Polynomial(6.11), Generating function of Hermite Polynomial(6.12), Recurrence formula for Hermite Polynomial(6.13), Rodriguez's formula for Hermite Polynomial(6.14).		
II	Variational principle : Lagrange's and Hamiltons equations	1	34 %
	Configuration space(11.1), Some techniques of calculus of variation(11.2), Applications of the Variational principle(11.3), Hamilton's principle(11.4). Equivalence of Lagrange's and Newton's equations(11.5), Advantages of the Lagrangian formulation-Electromechanical analogies(11.6), Lagrange's undetermined multipliers(11.7), Lagrange's equation for non-holonomic system(11.8), Application of the Lagrangian method of undetermined multipliers(11.9), Hamilton's equations of motion(11.10), Some applications of the Hamiltonian formulation(11.11), Phase space(11.12), Comments on the Hamiltonian formulation(11.13).		
III	Exactly soluble Eigenvalue problems	1	33 %
	Introduction, the simple harmonic oscillator, the Schrödinger equation and energy eigenvalues(4.1), the energy		



<p>eigenfunctions(4.2), properties of stationary states(4.3), the abstract operator method(4.4), Coherent states(4.5), the angular momentum operators(4.6), the eigenvalue equation for L^2, separation of variables(4.7), admissibility conditions on solutions, eigenvalues(4.8), the eigenfunctions, Spherical harmonics(4.9), Physical interpretation(4.10), Parity(4.11), Angular momentum in stationary states of systems with spherical symmetry(4.12)</p>		
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Reference Books:

- Mathematical Physics by P. K. Chatopadhyay. Wiley East Ltd.
- Mathematical Methods for Physicists by G. Arfken, Academic Press
- Mathematical Methods in the Physical Sciences by Mary L. Boas, Wiley India Pvt. Ltd.
- Introduction to classical mechanics by Takawale and Puranic. THM Publication.
- Classical Mechanics, by Goldstein. Narosa Publishing House, New Delhi.
- Classical Mechanics by Yasvant Waghmare.
- Classical Mechanics by N.C.Rana and P.S.Joag, THM Publication.
- Quantum Mechanics by Satya Prakash, Pragati Prakashan (Reprint-2008)
- A text book of Quantum Mechanics by P.M. Methews and K. Venkateshan, THM Publication.
- Quantum Mechanics by Ghatak and Loknathan, The Macmillan company of India Limited.
- Quantum Mechanics by John, L. Powell and B. Crasemann.
- Quantum Mechanics by Schiff.
- Quantum Mechanics by Fschwabi, Narosa Publishing House, New Delhi.

Suggested Readings:

- Mathematical Physics by P. K. Chatopadhyay. Wiley East Ltd.
- Mathematical Physics by B.D.Gupta.
- Mathematical Physics by H.K.Dass.
- A text book of Quantum Mechanics by P.M. Methews and K. Venkateshan, THM Publication.





- Quantum Mechanics by Ghatak and Loknathan, The Macmillan company of India Limited.

Online Resources:

1. <https://byjus.com/maths/differential-equation/>
2. https://en.wikipedia.org/wiki/Differential_equation
3. <https://www.cuemath.com/calculus/differential-equation/>
4. <https://www.cuemath.com/calculus/second-order-differential-equation/>
5. <https://www.mathsisfun.com/calculus/differential-equations-second-order.html>
6. <https://tutorial.math.lamar.edu/classes/de/introsecondorder.aspx>
7. https://en.wikipedia.org/wiki/Lagrangian_mechanics#:~:text=In%20physics%2C%20Lagrangian%20mechanics%20is, his%201788%20work%2C%20M%C3%A9canique%20analytique.
8. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Statistical_Mechanics/Advanced_Statistical_Mechanics/Classical_microstates%2C_Newtonian%2C_Lagrangian_and_Hamiltonian_mechanics/The_Lagrangian_formulation_of_classical_mechanics](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Statistical_Mechanics/Advanced_Statistical_Mechanics/Classical_microstates%2C_Newtonian%2C_Lagrangian_and_Hamiltonian_mechanics/The_Lagrangian_formulation_of_classical_mechanics)
9. <http://www.unishivaji.ac.in/uploads/distedu/SIM2013/M.%20Sc.%20Maths%20Classifical%20Mechanics/Chapter%20I.pdf>
10. <https://brilliant.org/wiki/lagrangian-formulation-of-mechanics/>
11. https://www.brown.edu/Departments/Engineering/Courses/En4/notes_old/RigidKinematics/rigkin.htm#:~:text=Characteristics%20of%20rigid%20body%20motion,a%20rotation%20about%20the%20point.
12. <https://www.geeksforgeeks.org/motion-of-a-rigid-body/>
13. <https://byjus.com/physics/rigid-body-and-rigid-body-dynamics/>
14. https://nios.ac.in/media/documents/SrSec312NEW/312_Physics_Eng/312_Physics_Eng_Lesson7.pdf
15. https://qm1.quantumtinkerer.tudelft.nl/9_formalism/#:~:text=The%20formalism%20of%20quantum%20mechanics%20is%20built%20upon%20two%20fundamental,%2C%20%7C%CE%A8%E2%9F%A9%E2%88%88H.
16. https://en.wikipedia.org/wiki/Mathematical_formulation_of_quantum_mechanics
17. <https://math.mit.edu/~dav/quantum.pdf>
18. <http://www.damtp.cam.ac.uk/user/tong/qm/qm3.pdf>





BPHY601PRA: - Practical Module-601

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Young modulus 'y' by Koenig method.
- 2) Optical Lever
- 3) Viscosity by Log decrement
- 4) I-V Characteristic of solar cell and determination of F.F, V.F.& n.
- 5) G.M. Counter (Comparison of Intensities)

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes												
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9				
CO1	3	2	2	1								3	2
CO2	3	2	1		1			1				2	1
CO3	2	3	2	1		1						2	3

BPHY602DSC: - NUCLEAR PHYSICS(NP)

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- (i) The objective of the course to impart o impart knowledge about basic nuclear physics properties and nuclear models for understanding of related reaction dynamics. Some industry relevant topics are also covered under which basic concepts are taught.





Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate the beta decays. They will be able to explain various reaction equations and related Q values and energy of beta particles.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments

Credit: 03

Unit	Content	Credit	Weightage
I	Alpha Rays: Spectra and Decay, Beta Rays: Spectra and Decay Range of alpha particles (4.II.1), Disintegration energy of the spontaneous alpha decay (4.II.2), Alpha decay paradox - barrier penetration (4.II.3).	1	33 %
	Introduction(4.III.1), Continuous Beta ray spectrum - difficulties encountered to understand it(4.III.2), Pauli's Neutrino Hypothesis(4.III.3), Fermi's theory of Beta decay(4.III.4), the detection of neutrino(4.III.5), Parity non-conservation in Beta decay(4.III.6).		
II	Gamma-Ray Emission , The liquid drop model of the nucleus Introduction (4.IV.1), Gamma-ray emission – selection rules (4.IV.2), Internal conversion (4.IV.3), Nuclear isomerism (4.IV.4)	1	34 %
	Introduction(5.1), Binding energies of nuclei : plot of B/A against A(5.2), Weizsacher's semi empirical mass formula Mass parabolas(5.3): prediction of stability against Beta decay for members of an isobaric family(5.4), Stability limits against spontaneous fission(5.5), Barrier penetration - decay probabilities for spontaneous fission(5.6), Nucleon emission(5.7).		
III	Nuclear Energy, Elementary Particles Introduction(6.1), Neutron Induced Fission(6.2), Asymmetrical Fission-Mass Yield(6.3), Emission of Delayed Neutrons by Fission Fragments(6.4), Energy Released in the Fission of U^{235} (6.5), Fission of Lighter Nuclei(6.6), Fission Chain Reaction(6.7), neutron cycle in a Thermal Nuclear Reactor(6.8), Nuclear Reactors(6.9).	1	33 %





Leptons (14.4), Hadrons(14.5), Elementary particle quantum numbers(14.6), Isospin(14.7), Symmetries and- conservation principles(14.8), Quarks(14.9), fundamental Interactions(14.10).		
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Reference Books:

- Nuclear Physics by S. B. Patel, Willey Eastern Ltd.
- Concept of Modern Physics by A.Beiser, 5th edition, McGraw-Hill.
- Introduction to Nuclear Physics by H.Enge, Addison Wesley

Suggested Readings:

- Nuclear Physics by D. C. Tayal, Himalaya Publisher
- Nuclear Physics by Irving Kaplan

Online Resources:

- https://www.smvdu.ac.in/images/stories/pdf/Academics/M.Sc_Physics/Final_Syllabus%20for%20all%20MSc%20Physics%20Programme%20at%20SoP.pdf
- <https://www.sxccal.edu/wp-content/uploads/2022/06/nuclear-physics.pdf>
- www.wikipedia.com
- [Swayam portal](#)

BPHY602PRA: - Practical Module-602

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- To determine air gap 't' between two plates of F.P. Etalon and determination of wavelength ' λ ' of monochromatic light
- Temperature of Flame
- Newton's Ring (Determination of Wave length of Light)
- To determine λ and $d\lambda$ of sodium light using Michelson interferometer
- Determination of wavelength of light by Lloyd's mirror.





CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	1	1		1			1			1	3
CO2	2	3	3	1		1					2	1
CO3	1	2	2		1			1			2	2

BPHY603DSC: - Statistical Mechanics, Solid State Physics, Optics

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

- The course aims to provide a formal understanding of the underlying energy distribution of systems containing many particles.
- The consequences of the distribution are related to classical descriptions of thermodynamics and the behavior of electrons in solids.

Course Outcomes: At the end of the course, students shall be able to

CO1	Apply the definitions and results of statistical mechanics to deduce physical properties of the systems studied in the lectures and other systems of similar complexity, drawing in part on your knowledge of the microstates of simple systems from core courses in quantum mechanics and solid-state physics.
CO2	Calculate the density of states based on the Fermi statistics.
CO3	Understand the principles of superconductivity





Credit: - 04

Unit	Content	Credit	Weightage
I	Macroscopic and Microscopic states	15	33%
	Macroscopic States, Microscopic States, Phase Space, μ -Space, τ -Space, Postulate of equal a priori probability.		
	Statistical Ensembles		
	Micro canonical ensemble, Canonical ensemble, Alternative method for the derivation of canonical distribution, Mean value and Fluctuations, Grand Canonical Ensemble, Alternative derivation of Grand Canonical Distribution, Fluctuations in the number of particle of a system in a grand canonical ensemble, Reduction of a Gibb's distribution to Maxwell's and Boltzmann distribution, Barometric formula, Experimental verification of the Boltzmann's distribution		
II	Superconductivity Phenomena without observable Quantization, Zero resistance and persistent currents, Perfect Diamagnetisms : Meissner Effect, London Equation, Critical Field : Type I and Type II super conductors, BCS Theory : A qualitative approach, Cooper pair formation, BCS ground state, Important predictions of the BCS theory and comparison with experiments, Critical temperature, Ginzburg-Landau Theory, Magnetic flux Quantization, Coherence Length, Type-II superconductivity, Josephson tunneling, Applications.	15	34%
II	HOLOGRAPHY AND FIBER OPTICS	15	34%
	Holography		
	Introduction, Principle of Holography, Theory, Important properties of Hologram, Advances, Applications.		
	Fiber Optics Introduction, Optical Fiber, Critical angle of Propagation, Modes of Propagation, Acceptance angle, Fraction of refractive index, Numerical aperture, Types of optical fiber, Normalized frequency, Pulse dispersion, Attenuation, Application, Fiber optic Communication system, Advantages.		

Reference Books:

- a) Fundamentals of Statistical Mechanics by B. B. Laud. New Age International Publisher





- b) Statistical Mechanics and Properties of Matter by E.S.R.Gopa

Suggested Readings:

- a) Solid State Physics by Saxena. Pragati Prakashan.
b) Solid State Physics by C. M. Kachhawa

Online Resources:

- c) <https://youtu.be/afzahVskyeY>
d) <https://youtu.be/BQG0EuiH6yw>

BPHY603PRA: - Practical Module-603

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

- 1) Mutual induction ‘M’ of two coils using B.G.
- 2) High resistance ‘R’ using leakage method
- 3) Maxwell’s Bridge
- 4) Solenoid Inductor
- 5) Susceptibility of FeCl₃ using Quienk’s method

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	3	3		1						3	2
CO2	3	3	3	1							2	1
CO3	3	3	3		1	1		1			2	1



BPHY604DSC: - Electronics And C-Programming

Course Objective:

The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Wave form Amplitude modulated voltage, Frequency Modulation, Frequency deviation and carrier swing, Modulation index. Classification of Photoelectric devices, Declaration of Variables, declaring a Variable as Constant, declaring a Variable as Volatile, Introduce different types of Operators.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to know different kind of modulation, basic concept of C language like Constants, Variables & Data Types, Operators and Expressions.
CO2	They develop their basic communication & Computer coding skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	They also develop their basic instrumental knowledge with experiment skill and active their digital electronic calculation skill. They also get plasma related knowledge.

Credit: - 03

Unit	Content	Credit	Weightage
I	1.1.Modulation Introduction(20.1), Expression for Amplitude modulated voltage(20.2), Wave form Amplitude modulated voltage(20.3), Side band produced in Amplitude modulated wave(20.4), Modulated power output(20.5), Frequency Modulation(20.6), Frequency deviation and carrier swing(20.7), Modulation index(20.8-20.8.1 to 20.8.3), Expression for frequency modulated wave(20.9), Phase modulation(20.10).	1	33 %
	1.2. Regulated DC Power Supply Transistor Series voltage Regulator(25.2), Negative Feedback Voltage Regulator(25.3), Transistor Shunt Regulator(25.4), Transistor Current Regulator(25.5), Glow-tube Voltage regulator(25.6).		
II	2.1. Photo Electric Devices and Thyristors Classification of Photoelectric devices(27.1), Photoconductive cells(27.10), Photovoltaic cells(27.11), SCR(26.1-16.1.1 to 26.1.4), Triac(26.4) and Diac(26.5).	1	34 %



	<p>2.2. Constants, Variables & Data Types</p> <p>Introduction(2.1), Character Set(2.2), C Tokens(2.3), Keywords and Identifiers(2.4), Constants(2.5), Variables(2.6), Data Types(2.7), Declaration of Variables(2.8), Declaration of Storage Class(2.9), Assigning Values of Variables(2.10), Defining Symbolic Constants(2.11), Declaring a Variable as Constant(2.12), Declaring a Variable as Volatile(2.13), Overflow and Underflow of Data(2.14).</p>		
III	<p>3.1. Operators and Expressions</p> <p>Introduction(3.1), Operators: Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Special(3.2-3.9). Arithmetic Expressions(3.10), Evolution of Expressions(3.11), Precedence of Arithmetic Operators(3.12), Some Computational Problems(3.13), Type Conversion in Expressions(3.14), Operator Precedence and Associativity(3.15), Mathematical Functions(3.16).</p>	1	33%
	<p>3.2. Managing Input and Output Operations</p> <p>Introduction(4.1), Reading and writing a Character(4.2-4.3), Formatted Input and Output(4.4-4.5).</p>		

Reference Books:

- Electronics and Radio Engineering by M. L. Gupta. 9 th Enlarged Edition reprint 2002. Dhanpat Rai Publication
- Programming in ANSI C by E. Balaguruswami (THM) (3rd Edition)

Suggested Readings:

- Electronic Devices and circuits – An introduction by Allen Mottershead
- The complete reference C++ : Herbert Schildt, TMH.

Online Resources:

- <https://www.electronics-tutorials.ws/>
- www.youtube.com
- <https://www.tutorialspoint.com/cprogramming/index.htm>
- <https://electricala2z.com/electronics/photoelectric-devices-and-their-applications/>





BPHY604PRA: - Practical Module-604

Credit: - 1.5

Practical / Activities:

LIST OF EXPERIMENTS

1. A study of transistorized Colpitt's oscillator using CRO/Wave meter
2. Negative Feedback Amplifier
3. A study of Half subtractor and Full subtractor.
4. To determine frequency of AFO using Wien bridge
5. Use of Computer- Programming in 'c' language.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes											
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PSO1	PSO2
CO1	3	1	3			1					2	3
CO2	2	1	3	1		1					2	3
CO3	2	1	3	1	1			1			1	3

BPHY602SE: - ATMOSPHERIC SCIENCE

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	0	0	10	05	35	50

Course Objective:

- The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics introduction and chemistry of earth's atmosphere, and atmospheric aerosols. Some industry relevant topics are also covered under which basic concepts are taught.





Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand about evolution of earth's atmosphere, different kind of gases and carbon containing compounds in atmosphere, ozone and neutral chemistry, chemical and photochemical processes, eddy diffusion and turbulence.
CO2	The student understands about concentration and size, sources and transformation chemical composition, transport and sinks, residence time of aerosols, geographic distribution and atmospheric effect, air pollution, sources of anthropogenic pollution, emission inventory, atmospheric effects- smog, visibility, measurement of particulate matters and knowledge about Sox, NOx, and CO.

Credit: - 02

Unit	Content	Credit	Weightage
I	Introduction and Chemistry of Earth's atmosphere	1	50 %
	Evolution of earth's atmosphere, Nitrogen, hydrogen halogen, sulfur, carbon-containing compounds in the atmosphere, ozone and neutral chemistry, chemical and photochemical processes, Chemical and dynamical life time of atmospheric constituent. Eddy diffusion and Turbulence.		
II	Atmospheric aerosols	1	50 %
	Concentration and size, sources, and transformation, Chemical composition, transport and sinks, residence times of aerosols, geographical distribution and atmospheric effects, Air Pollution: Sources of anthropogenic pollution, Emission Inventory, Atmospheric effects- smog, visibility. Measurements of Particulate matters, SOx, NOx and CO		

Reference Books:

- Introduction to Atmospheric Chemistry by P.V. Hobbs
- Atmospheric Chemistry and Physics : From Air Pollution to Climate Change by John H. Seinfeld, Spyros N. Pandis
- Chemistry of the Upper and Lower Atmosphere by Barbara J. Finlayson-Pitts, Jr., James N. Pitts.
- Chemistry of Atmospheres by Richard P. Wayne.
- Basic Physical Chemistry for Atmospheric Sciences by P.V. Hobbs





Suggested Readings:

- Introduction to Atmospheric Chemistry by P.V. Hobbs
- Atmospheric Chemistry and Physics : From Air Pollution to Climate Change by John H. Seinfeld, Spyros N. Pandis

Online Resources:

1. <https://www.encyclopedia.com/earth-and-environment/atmosphere-and-weather/atmospheric-and-space-sciences-atmosphere/atmospheric-chemistry#:~:text=The%20atmosphere%20is%20a%20mixture,that%20has%20altered%20atmospheric%20chemistry.>
2. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atmospheric-chemistry>
3. <https://www.nasa.gov/centers/langley/news/factsheets/Aerosols.html>
4. <https://www.sciencedirect.com/topics/chemistry/atmospheric-aerosol>
5. <https://www.nature.com/scitable/knowledge/library/aerosols-and-their-relation-to-global-climate-102215345/>
6. http://irina.eas.gatech.edu/ATOC3500_Fall1998/Lecture25.pdf
7. <https://en.wikipedia.org/wiki/Aerosol>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes										PSO1	PSO2
	1: - Less relevant, 2: - Mild relevant, 3: - Highly relevant											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	2	2	3	1		1		1			3	2
CO2	2	2	3		1						3	1





**GOKUL
GLOBAL
UNIVERSITY**

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Bachelor of Science

Zoology

Under

Choice Based Credit System (CBCS)



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Bachelor of Science Program outcomes (PO)

PO No.	Program Outcome Description
PO1	Foundational Knowledge: Graduates will possess a strong foundation in the fundamental concepts, theories, and principles of their chosen discipline, as per the prescribed curriculum.
PO2	Practical Skills: Students will acquire practical skills relevant to their field, including laboratory techniques, data collection, analysis, and interpretation.
PO3	Critical Thinking: Graduates will develop critical thinking skills to analyze, evaluate, and solve scientific problems, applying logical reasoning and evidence-based approaches.
PO4	Effective Communication: Students will demonstrate effective communication skills, both orally and in writing, to convey scientific ideas and findings to different audiences.
PO5	Collaboration and Teamwork: Graduates will work collaboratively in teams, engaging in effective communication, cooperation, and coordination to accomplish shared objectives.
PO6	Information Literacy: Students will develop information literacy skills to access, evaluate, and utilize scientific information from diverse sources, including digital resources.
PO7	Ethical Awareness: Graduates will demonstrate ethical awareness and responsibility in scientific practice, understanding the importance of integrity, honesty, and ethical conduct.
PO8	Lifelong Learning: Students will develop a commitment to lifelong learning, staying updated with advancements in their field and engaging in continuous professional development.
PO9	Societal Impact: Graduates will recognize the social and ethical implications of scientific knowledge and contribute positively to society through their discipline.



B.Sc. Zoology:

PSO No.	Program Specific Outcome Description
PSO1	Zoological Knowledge and Diversity: Graduates of the B.Sc. Zoology program will acquire a comprehensive understanding of animal biology, including animal morphology, physiology, taxonomy, and behaviour. They will be able to identify and classify diverse animal species.
PSO2	Animal Conservation and Wildlife Management: Graduates will demonstrate an understanding of animal conservation principles and possess skills to manage and protect animal habitats. They will contribute to wildlife conservation efforts, conduct research on animal behaviour and ecology, and promote sustainable wildlife management practices.





Course Structure

B.Sc. Sem 1 Zoology

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B101FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT101UDSC	Microbiology & Phycology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO101UDSC	Non-chordates I: Protista to Pseudocoelomates	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE101UDSC	Inorganic, Organic, Physical & Volumetric	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT101UPRA	Botany practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BZOO101UPRA	Zoology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE101UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BZOO101USE/ BZOO102USE	Subject Elective: Wetland Ecology OR Human Disease and Control	2	0	2	15	35	50
9	Elective Generic	B101EG	Elective Generic: Communication Skills	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650



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Course Structure

B.Sc. Sem 2 Zoology

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B201FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT201UDSC	Biomolecules and Cell Biology	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO201UDSC	Non-chordates II: Coelomates	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BCHE201UDSC	Inorganic, Organic, Physical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	BBOT201UPRA	Botany practical	0	4	2	0	50	50
6	PRACTICAL COURSE (PRA)	BZOO201UPRA	Zoology practical	0	4	2	0	50	50
7	PRACTICAL COURSE (PRA)	BCHE201UPRA	Chemistry Practical	0	4	2	0	50	50
8	Subject Elective	BZOO201USE/ BZOO202USE	Subject Elective: Environmental Pollution and Climate Change OR Pest Control Technology	2	0	2	15	35	50
9	Elective Generic	B201UEG	Elective Generic: Elective Generic: Disaster Management	2	0	2	0	50	50
		Total credit		18	12	24	135	515	650





Course Structure

B.Sc. Sem 3 Zoology

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B301FC	Foundation Compulsory-English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO301UDSC	Principles of Ecology	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO302UDSC	Chordates- I	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT301UDSC	Mycology and Phytopathology	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT302UDSC	Archegoniate	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BZOO301UPRA	Zoology practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BBOT301UPRA	Botany practical	0	6	3	0	100	100
8	Subject Elective	BZOO301USE/ BZOO302USE	Disaster Management OR Poultry Science	2	0	2	15	35	50
9	Elective Generic	B301EG	Elective Generic: Personality Development	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800



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Course Structure

B.Sc. Sem 4 Zoology

Sr No.	Course Type	Course Code	Course Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	Foundation Compulsory	B401FC	Foundation Compulsory -English	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO401UDSC	Comparative Anatomy of Vertebrates	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO402UDSC	Chordates II	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT401DSC	Anatomy and Angiosperms	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BBOT402DSC	Economic Botany	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BZOO401UPRA	Zoology practical	0	6	3	0	100	100
7	PRACTICAL COURSE (PRA)	BBOT401PRA	Botany practical	0	6	3	0	100	100
8	Subject Elective	BZOO401USE/ BZOO402USE	Public Health and Management OR Applications of Computer in Zoology	2	0	2	15	35	50
9	Elective Generic	B401EG	Elective Generic: Human Rights	2	0	2	0	50	50
		Total credit		18	12	24	165	635	800



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Course Structure

B.Sc. Sem 5 Zoology

Sr.No	course type	course code	course name				Examination		Total Marks
				Lecture (Hrs.)	Practical (Hrs.)	Credits	internal	External	
1	FOUNDATION COMPULSORY	B501FC	FOUNDATION COMPULSORY- ENGLISH	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO501UDSC	MOLECULAR AND CELLULAR BIOLOGY	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO502UDSC	DEVELOPMENTAL BIOLOGY	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO503UDSC	BIOSTATISSTICS, TOOLS AND TECHNIQUES	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO504UDSC	BIODIVERSITY AND CONSERVATION BIOLOGY	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BZOO501UPRA	ZOOLOGY PRACTICAL	0	12	6	0	200	200
9	Elective Generic	B501EG	ENVIRONMENT AND SUSTAINABLE DEVELOPMENT	2	0	2	0	50	50
10	Elective course	BZOO501USE	FISHERY SCIENCE	2	0	2	15	35	50
		BZOO502USE	AIR POLLUTION						
		BZOO503USE	ANIMAL BIOTECHNOLOGY						
		Total		18	12	24	165	635	800





Course Structure

B.Sc. Sem 6 Zoology

Sr.No	course type	course code	course name				Examination		Total Marks
				Lecture (Hrs.)	Practical (Hrs.)	Credits	internal	External	
1	FOUNDATION COMPULSORY	B601FC	FOUNDATION COMPULSORY-ENGLISH	2	0	2	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO601UDSC	BIOCHEMISTRY AND ANALYTICAL TECHNIQUES	3	0	3	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO602UDSC	GENETICS	3	0	3	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO603UDSC	ANIMAL BEHAVIOUR AND EVOLUTION	3	0	3	30	70	100
5	DISCIPLINE SPECIFIC COURSE (DSC)	BZOO604UDSC	ECONOMIC ZOOLOGY & TOXICOLOGY	3	0	3	30	70	100
6	PRACTICAL COURSE (PRA)	BZOO601UPRA	ZOOLOGY PRACTICAL	0	12	6	0	200	200
9	Elective Generic	B501EG	ENVIRONMENT AND SUSTAINABLE DEVELOPMENT	2	0	2	0	50	50
10	Elective course	BZOO601USE	ANIMAL ADAPTATIONS	2	0	2	15	35	50
		BZOO602USE	FILD TECHNIQUES IN ZOOLOGY						
		BZOO603USE	WILDLIFE BIOLOGY						
		Total		18	12	24	165	635	800





GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme Code	BZOO	Programme Name	B.Sc. Zoology	
Course Code	BZOO101UDSC	Semester	I	
NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES				
Course type:	Discipline Specific Course	Total Credit:	04	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
60	00	30	70 (Paper of 3 hrs)	100

Course Objective: The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; economic, ecological and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

Course Outcomes: At the end of the course, students shall be able to

CO1	After thorough understanding of this unit students will be able to explain about the importance of systematics, taxonomy and structural organization of animals. Also, general characteristics and classification of phylum Protista.
CO2	From this unit student will learn about general characteristics and classification of phylum Porifera, Cnidaria.
CO3	From this unit student will learn about general characteristics and classification of phylum Platyhelminthes.
CO4	From this unit student will be able to comprehend the economic importance of non-chordates, their interaction with the environment and role in ecosystem. Also, Platyhelminthes and Nematode related diseases.





Unit	Topic	Content	Hours	Weightage
1		Unit 1 Protista	15	25%
	1.1	Grades of body organization: level of organization, body symmetry, formation of germ layers, formation of coelom, body segmentation.		
	1.2	General characteristics and classification of protozoa (up to class).		
	1.3	Type study: Paramecium, Amoeba (habit and habitat, body structure, locomotion, nutrition, respiration, excretion and reproduction).		
	1.4	Life cycle of Plasmodium.		
2		Unit 2 Porifera & Cnidaria	15	25%
	2.1	General characteristics and classification of phylum porifera (up to class).		
	2.2	Canal system and types of spicules in sponges.		
	2.3	General characteristics and classification of phylum cnidaria (up to class)		
	2.4	Type study: Hydra (habit and habitat, external and internal structure, digestive system, respiration, excretion, nervous system, reproduction and regeneration		
3		Unit 3 Platyhelminths & Nematoda	15	25%
	3.1	General characteristics and classification of phylum platyhelminths (up to class).		
	3.2	Type study: Fasciola (habit and habitat, structure, digestive system, respiration, excretion, nervous system, reproduction).		
	3.3	General characteristics and classification of phylum Nematoda (up to class).		
	3.4	Type study: Ascaris (habit and habitat, structure, digestive system, respiration, excretion, nervous system, reproduction).		
4		Unit 4 Diseases	15	25%
	4.1	Protozoan related diseases: infestation, symptoms and treatment (Amoebiasis, Giardiasis, Malaria)		
	4.2	Coral and coral reefs		
	4.3	Classification and adaptations of parasites		
	4.4	Platyhelminthes and Nematode related diseases: infestation, symptoms and treatment (Cysticercosis, Ascariasis, Filariasis).		

Reference Books:

- 1) Hickman C. P., et al. (2006) Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.



- 2) Pechnik J. A. (2015) Biology of the Invertebrates, McGraw Hill Higher Education. 555 pp. 7th edition.
- 3) Jordan E. L. and Verma P. S. (1993) Invertebrate Zoology, S. Chand publishing. New Delhi.
- 4) EkambaranathaAyyar, M. and T.N. Ananthakrishnan, (1992) Manual of Zoology Vol. 1 (Invertebrate), parts I and II.S. Viswanathan (Printers and Publishers) Pvt. Ltd; Madras.2.

Online resource:

<https://uou.ac.in/sites/default/files/slm/BSCZO-101.pdf>

<https://www.vedantu.com/biology/difference-between-chordates-and-non-chordates>

Practical:

- 1) Study of classification of protozoans (up to class) using (Amoeba, Euglena, Paramecium, Plasmodium).
- 2) Study of classification of phylum porifera (up to class) using laboratory specimens, models, slides, charts (Sycon or Leucosolenia, Hylonema or Euplectella, Spongilla or Euspongia).
- 3) Study of classification of phylum cnidaria (up to class) using laboratory specimens, models, slides, charts (Physalia or Hydra, Aurelia, Coral).
- 4) Study of classification of phylum Platyhelminthes (up to class) using laboratory specimens, models, slides, charts (Planaria, Liver fluke or Polystomum, Tap worm).
- 5) Study of classification of phylum Nematoda (up to class) using laboratory specimens, models, slides, charts (Ascaris or Filarial worm).
- 6) Study of external morphology of Paramecium and preparation of whole mount slide of Paramecium from culture.
- 7) Examination of pond water collected from different places for diversity in Protista.
- 8) Study of adult Fasciola hepatica, Taenia solanium, Ascaris lumbricoides and its life stages (Slides/micro-photographs).
- 9) Study of different body systems of Hydra, Fasciola and Ascaris using models, slides and charts.
- 10) Study of human parasitic diseases related to protozoan, Platyhelminthes and nematode (Malaria, Schistosomiasis, Lymphatic filariasis (Elephantiasis)).
- 11) Field trip and report preparation.





CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	-	2	1
CO2	3	2	-	-	-	-	-	-	-	2	-
CO3	3	1	-	1	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	1	1	1





GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme Code	BZOO	Programme Name	B.Sc. Zoology	
Course Code	BZOO101USE	Semester	I	
WETLAND ECOLOGY				
Course type:	Subject Elective	Total Credit:	02	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	-----	15	35	50

Course Objective:

Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. Trees, root mats and other wetland vegetation also slow the speed of flood waters and distribute them more slowly over the floodplain.

Course Outcomes: At the end of the course, students shall be able to

CO1	From this unit Student will learn about history and classification of wetland.
CO2	Students will learn about importance of wetland of types of wetlands.
CO3	Students learn human impact and management of wetlands
CO4	Students learn skill and law and protection

Unit	Topic	Content	Hours	Weightage
		Unit 1		
1	1.1	History and classification of wetlands.	15	50%
	1.2	Types of wetlands; Tidal marshes, mangroves and freshwater marshes.		
	1.3	Human impact and management of wetlands.		
	1.4	Wetlands laws and protection.		
		Unit 2		
2	2.1	Important wetlands of the world.	15	50%
	2.2	Important wetlands of India.		
	2.3	Important wetlands of Gujarat.		
	2.4	Threats to the wetland habitat.		



Reference books :

1. Mitsch W. J. and Gosselink J. G. (2015) Wetlands, Wiley publications, 747 pp.
2. Chatrath K. S. J. (1997) Wetlands of India South Asia Books.
3. Kamboj R. D. and Tatu K. (2017) Important wetland destinations of Gujarat-A guide for ecotourist to explore some wetland jewels in Gujarat, GEER foundation, Gandhinagar.

Online resource :

<https://education.nationalgeographic.org/resource/wetland/>

<https://www.nature.com/scitable/knowledge/library/ecology-of-wetland-ecosystems-water-substrate-and-17059765/>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	2	2	-	-	2	1	2	2	2	1
CO2	1	2	2	-	-	2	-	2	2	2	-
CO3	2	3	1	-	-	2	-	1	1	2	1
CO4	1	1	1	-	-	1	2	2	1	2	-



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GOKUL GLOBAL UNIVERSITY, SIDHPUR

Programme Code	BZOO	Programme Name	B.Sc. ZOOLOGY	
Course Code	BZOO201UDSC	Semester	II	
NON-CHORDATES II: COELOMATES				
Course type:	Discipline Specific Course	Total Credit:	04	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
60	00	30	70 (Paper of 3 hrs)	100

Course Objective:

The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; economic, ecological and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about general characteristics, importance of systematics, taxonomy and structural organization of Animals [Mollusca].
CO2	They will understand about general characteristics, importance of systematics, taxonomy, economic importance structural organization of Animals [Annelida].
CO3	Students learn about how organism are classified based in non-chordates and their identification, characteristics, classification, economic importance of Animals [Arthropoda].
CO4	Students learn about how organism are classified based in non-chordates on their complexity organization and characteristics, importance of systematics, taxonomy, structural organization of animals. [Echinodermata, Hemichordata]





Unit	Topic	Content	Hours	Weightage
1		Unit 1 Mollusca	15	25%
	1.1	General characteristics and classification of phylum Mollusca (up to class).		
	1.2	Type study: Pila (habit and habitat, external features, digestive system, respiratory system, blood vascular system, excretory system, nervous and sensory system and reproductive system)		
	1.3	Torsion in gastropods.		
	1.4	Pearl culture.		
2		Unit 2 Annelida	15	25%
	2.1	General characteristics and classification of phylum Annelida (up to class).		
	2.2	Metamerism in Annelida.		
	2.3	Type study: Leech (habit and habitat, external features, digestive system, respiratory system, excretory system, nervous system and reproductive system).		
	2.4	Economic importance of annelids.		
3		Unit 3 Arthropoda	15	25%
	3.1	General characteristics and classification of phylum Arthropoda (up to class).		
	3.2	Type study: Cockroach (habit and habitat, external features, body wall, endoskeleton, locomotion, digestive system, respiratory system, blood vascular system, excretory system, nervous and sensory system and reproductive system).		
	3.3	Metamorphosis in insects.		
	3.4	Useful and harmful insects.		
4		Unit 4 Echinodermata	15	25%
	4.1	General characteristics and classification of phylum Echinodermata (up to class).		
	4.2	Type study: sea star (habit and habitat, external features, body wall, digestive system, circulatory system, water vascular system).		
	4.3	Life history, larval development, regeneration and autotomy in star fish.		
	4.4	General characteristics and classification of phylum Hemichordata (up to class).		



Reference Books:

- 1) Hickman C. P., et al. (2006) Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.
- 2) Pechnik J. A. (2015) Biology of the Invertebrates, McGraw Hill Higher Education. 555 pp. 7th edition.
- 3) Jordan E. L. and Verma P. S. (1993) Invertebrate Zoology, S. Chand publishing. New Delhi.
- 4) EkambaranathaAyyar, M. and T.N. Ananthkrishnan, (1992) Manual of Zoology Vol. 1 (In vertebrata), parts I and II.S. Viswanathan (Printers and Publishers) Pvt. Ltd; Madras. 2.

Online resource:

<https://vtputkal.odisha.gov.in/subjectwise/non-chordates-ii-coleomates-core-iii/>
<https://en.wikipedia.org/wiki/Coelom>
<https://patnawomenscollege.in/upload/e-content/General-Characteristics-and-Classification-of-Echinodermata.pdf>

Practical:

- 1) Study of classification of phylum Mollusca (up to class) using laboratory specimens, models, slides, charts (Chiton, Dentalium, Pila, Mytilus, Octopus).
- 2) Study of classification of phylum Annelida (up to class) using laboratory specimens, models, slides, charts (Earthworm, Nereis, Leech).
- 3) Study of classification of phylum Arthropoda (up to class) using laboratory specimens, models, slides, charts (Peripatus, Limulus, Prawn, Spider, Centipede, Cockroach).
- 4) Study of classification of phylum Echinodermata (up to class) using laboratory specimens, models, slides, charts (Starfish, Brittle star, Sea urchin, Sea cucumber, Feather star).
- 5) Study of classification of phylum Hemichordata (up to class) using laboratory specimens, models, slides, charts (Balanoglossus).
- 6) Study of anatomy of different systems of Pila using charts and models (Digestive system, Nervous system and Reproductive system).
- 7) Study of anatomy of different systems of leech using charts and models (Digestive system, Nervous system and Reproductive system).
- 8) Study of anatomy of different systems of cockroach using charts and models (Digestive system, Nervous system and Reproductive system).
- 9) Study of anatomy of different systems of star fish using charts and models (Digestive system, Water vascular system).





- 10) Study of histological structure of pharynx, gizzard, typhlosole and ovary of earthworm using permanent slides.
- 11) Study of mouth parts of Leech.
- 12) Mounting of mouth parts of housefly, honey bee and mosquito.
- 13) Study of respiratory spiracles of cockroach
- 14) Study of radula of pila.
- 15) Field trip and report preparation

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	2	-	-	-	2	-	1	2	2	1
CO2	3	1	-	-	-	2	-	2	2	2	-
CO3	2	2	-	-	-	2	-	2	-	2	1
CO4	2	1	2	-	-	1	2	2	1	1	-





GOKUL GLOBAL UNIVERSITY, SIDHPUR				
Programme Code	BZOO	Programme Name	B.Sc. Zoology	
Course Code	BZOO201USE	Semester	II	
ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE				
Course type:	Subject Elective	Total Credit:	02	
Teaching time (hours)	Examination Marking scheme			
Theory (hrs)	Practical (hrs)	Internal (Marks)	External (Marks)	Total (Marks)
30	-----	15	35	50

Course Objective:

Environment pollution is the introduction of pollutants into the natural environment, and causes adverse effects. Climate change refers to a change in average weather conditions, or in the time variation of weather in the context of longer-term average conditions.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students learn about Air and Noise pollution
CO2	Students learn about water pollution
CO3	Students learn about skills of pollution control methods
CO4	Students learn about effect of climate change and public health

Unit	Topic	Content	Hours	Weightage
		Unit 1		
1	1.1	Air and Noise pollution: sources and effect.	15	50%
	1.2	Water pollution: sources and effect.		
	1.3	Soil pollution: sources and effect.		
	1.4	Pollution control methods.		
		Unit 2		
2	2.1	Greenhouse gases and global warming.	15	50%
	2.2	Acid rain and Ozone layer destruction.		
	2.3	Effect of climate change on public health.		
	2.4	Mitigation efforts to deal with climate change.		



Reference Books:

- 1) Sharma, V.K. (Ed.). 1995. Climate Change, IIPA, New Delhi.
- 2) Singh T. 2005 Climate Change Environmental Pollution, Akansha Publishing House, New Delhi

Online Resources:

<https://www.ncbi.nlm.nih.gov/books/NBK11769/>

<https://byjus.com/biology/types-of-pollution/>

<https://byjus.com/biology/air-water-and-soil-pollution/>

https://www.ide.go.jp/library/English/Publish/Reports/Apec/pdf/1997_18.pdf

http://www.soghracollege.com/Adminpanel/Lecture/14_Air_Water_Noise_Pollution.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	2	-	-	-	2	-	2	2	2	-
CO2	3	2	-	-	-	2	-	2	2	1	1
CO3	2	1	-	-	-	2	-	1	1	2	-
CO4	1	1	-	-	-	1	-	1	1	2	1



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Program: Bachelor of science

Subject / Branch: Zoology

Year : 2022/23

Semester: III

Course title: Principles of Ecology
Course type: Discipline Specific Course

Course code : BZOO301UDSC
Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. Understand ecological principles and their historical context.
2. Explore the impact of environmental factors such as light, temperature and interspecific interactions on organisms.
3. Gain insights into ecosystem structure, function, and biogeochemical cycles.
4. Develop a comprehensive knowledge of diverse aquatic and terrestrial ecosystems and their biotic communities.

Course Outcome: At the end of the course, students shall be able to

CO1	After thorough learning of this course student will understand the population and community characteristics ecosystem development and climax theories.
CO2	Knowledge about the type of ecosystem food chains food web energy modals and ecological efficiencies.
CO3	They will understand about the paramount role and importance of nature.
CO4	It will impact then with the knowledge about the judicious use of existing ecological recourse for sustainable development.





Content

Unit	Description in detail	Credit	Weightage
I	Introduction to ecology, historical background, branches of ecology. Structure of atmosphere, lithosphere and hydrosphere Light and radiation: light variation in different environments, light receptors in organisms, effect of light on plants and animals. Temperature: temperature fluctuations in different environments, effect of temperature on plant and animals, thermal adaptations of plants and animals	1	33 %
II	Interspecific interactions: positive interactions- mutualism, commensalism, protocooperation; negative interaction- exploitation, mentalism, competition Kinds of ecosystems, structure of ecosystem, abiotic and biotic components of Ecosystem Functions of ecosystem- productivity of ecosystem, types of food chain, types of ecological pyramids, energy flow in ecosystem. Biogeochemical cycles: types of biogeochemical cycles, water cycle, oxygen cycle, carbon cycle, nitrogen cycle, sulphur and phosphorous cycle	1	33 %
III	Aquatic ecosystems: sub division of aquatic ecosystems, freshwater ecosystems, lentic and lotic ecosystems. Zonation of marine environment, stratification of marine environment, biotic communities of marine environment. Classification of terrestrial ecosystem: different types of biomes. Zoogeography.	1	34 %

Reference Books:

1. Odum. E.P. 1996 Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
2. Verma PS and Agrawal Vk, 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand publications. New Delhi.
3. Smith, R.L.1986. Elements of Ecology. Harpet and Row Publishers, New York.

Online Resources:

<https://www.cbsetuts.com/what-is-ecology/>
<https://www.nature.com/scitable/knowledge/library/terrestrial-biomes-13236757/>
<https://byjus.com/biology/biogeochemical-cycles/>
<https://byjus.com/biology/aquatic-ecosystem/>



Practical

- 1) Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hair hygrometer, Lux meter, Rain gauge, Soil thermometer and thermometer.
- 2) To determine pH, EC, Acidity, Total hardness, calcium hardness, Dissolve oxygen content of given water sample.
- 3) To determine soli texture, bulk density and particle density of given soil sample.
- 4) To determine water holding capacity and percolation rate of soil.
- 5) To determine pH, Chloride, Sulphate and Total Nitrogen, organic matter of given soil sample.
- 6) Study of effect of temperature and light, thermal adaptations on plant and animals using models or charts.
- 7) Study of mutualism, commensalism and proto cooperation, negative interaction- exploitation, mentalism, competition with example using models or charts.
- 8) Study of negative interaction- exploitation, mentalism, competition with example using models or charts.
- 9) Study of abiotic and biotic components, types of food chain, types of ecological pyramids in ecosystem, energy flow of ecosystem using models, or charts.
- 10) Study of different types of biological cycles, zonation, stratification and biotic communities of marine environment, biomes, zoogeography using models or charts.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	2	-	-	-	2	2	2	1	2	1
CO2	2	2	-	-	-	1	-	2	2	2	1
CO3	1	2	-	-	-	2	-	2	-	2	2
CO4	2	1	2	-	-	1	2	2	-	-	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2022/23

Semester: III

Course title: Chordates- I

Course code : BZOO302UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To provide a comprehensive understanding of chordates and vertebrates, their classification, and unique characteristics.
2. To explore the origins and evolutionary significance of primitive chordate groups.
3. To examine the diverse adaptations and biological features of fishes and amphibians, including migration, parental care, and metamorphosis.
4. To facilitate practical knowledge through type studies of representative species, enhancing comprehension of their anatomy, physiology, and ecological roles.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the evolution history and relationship between the different classes of chordates.
CO2	Know the different characteristic along with their habit's habitats and distribution of the chordates.
CO3	Understand the significance of the difference in physiological system between the vertebrates.
CO4	Distinguish the significance of chordates from other lower organism and comprehend their advantages.





Content

Unit	Description in detail	Credit	Weightage
I	General characters and origin of chordates. Outline classification of chordates Classification and general characters of subphylum Urochordata and Cephalochordate Type study: Herdmania(Urochordata) and Amphioxus (Cephalochordate) (habit and habitat, external features and systems)	1	33 %
II	General characteristics and classification of subphylum vertebrata General characters and classification of fishes (up to orders), differences between Chondrichthyes and Osteichthyes, types of scales and caudal fins Migration and parental care in fishes Type study: <i>Scoliodon</i> - dog fish (habit and habitat, external features, digestive system, respiration, blood vascular, nervous and Urinogenital system)	1	33 %
III	General characteristics and classification of class amphibia Metamorphosis in frog Parental care in amphibia Type study: <i>Hoplobatrachus tigrinus</i> - bull frog (habit and habitat, external features, digestive system, respiration, blood vascular, nervous and Urinogenital system)	1	34 %

Reference Books:

- 1) Hickman C. P., et al. (2006) Integrated principals of Zoology, McGraw Hill Higher Education. 931pp.14th edition.
- 2) Kotpal R. L. (2010) vertebrates, Rastogi Publications, 882 pp
- 3) Jordan E. L. and Verma P. S. (2013) Chordate Zoology, S. Chand publishing. New Delhi.

Online Resources:

<https://www.notesonzology.com/frog/habit-and-habitat-of-indian-bull-frog-vertebrates-chordata-zoology/8083>

<https://pcsstudies.com/parental-care-in-amphibians/>

http://www.lscollege.ac.in/sites/default/files/e-content/AMPHIBIA_1.pdf

<https://www.uou.ac.in/sites/default/files/slm/BSCZO-201.pdf>



Practical

- 1) Study of classification of subphylum Urochordata and cephalochordate (up to Order) using laboratory specimens, models, slides, charts.
- 2) Study of classification of fishes (up to Order) using laboratory specimens, models, slides, charts.
- 3) Study of classification of Amphibian up to orders using laboratory specimens, models, slides, charts.
- 4) Study of Digestive system, Arterial system, venous system, Nervous system, Urinogenital system of Scoliodon using models, slides and charts.
- 5) Study of Digestive system, Arterial system, venous system, Nervous system, Urinogenital system of Bull frog using models, slides and charts.
- 6) Study of Embryology of Amphioxus using models, slides and charts.
- 7) Study of Migration, Parental care, in fishes.
- 8) Study of Metamorphosis in frog.
- 9) Study of Parental care in amphibian.
- 10) Study of Ampullae of Lorenzen, scale and internal ear of Dog fish using models, slides and charts (Mounting).
- 11) Study of buccal cavity, eye and Ear of Bull frog using models, slides and charts (Mounting).

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	-	-	-	2	2	2	-	2	1
CO2	2	2	-	-	-	2	-	1	2	1	-
CO3	2	2	-	-	-	1	-	2	-	2	-
CO4	2	1	2	-	-	1	2	2	1	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2022/23

Semester: III

Course title : Disaster Management

Course code : BZOO301USE

Course type: Elective

Course credit : 02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
2	00	00	Mid	CE	35	50
			10	05		

Course Objective:

1. To impart a comprehensive understanding of disasters, including their types, origins, and parameters of risk assessment.
2. To equip students with the knowledge of disaster management components and strategies.
3. To elucidate the roles played by governments and NGOs in disaster response and recovery efforts.
4. To enhance practical skills through case studies, enabling students to analyse, plan, and respond effectively to real-world disaster scenarios.

Course Outcomes: At the end of the course, students shall be able to

CO1	Participants will gain a nuanced understanding of natural and man-made disasters, adeptly assessing risk parameters and applying national guidelines for categorization and intervention at different levels.
CO2	Participants will master disaster risk assessment, understand the key components of effective disaster management
CO3	Student will understand the pivotal roles played by governments and NGOs through insightful case studies in the field of disaster management.
CO4	Student will study different type of disaster



Content

Unit	Description in detail	Credit	Weightage
I	Introduction to disaster Different types of disasters: Natural and Man made Parameters of disaster risk Levels of disaster as per national guideline	1	50 %
II	Disaster risk assessment Components of disaster management Role of government and NGO in disaster management Case studies in disaster management	1	50 %

Reference books:

- 3) Sharma, V.K. (Ed.). 1995. Disaster Management, IIPA, New Delhi.
- 4) Singh T. 2006 Disaster management Approaches and Strategies, Akansha Publishing House, New Delhi
- 5) Sinha, D. K. 2006 Towards Basics of Natural Disaster Reduction, Research Book Centre, New Delhi.

Online Resources:

<https://www.samhsa.gov/find-help/disaster-distress-helpline/disaster-types>

<https://nidm.gov.in/PDF/guidelines/sdmp.pdf>

<https://environmentclearance.nic.in/writereaddata/online/RiskAssessment/070420160QN4P0QFANNEXURERISKASSESSMENT.pdf>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	1	-	-	-	2	1	2	2	2	1
CO2	2	2	-	-	-	2	-	2	2	1	-
CO3	2	2	-	-	-	2	-	1	1	2	-
CO4	1	1	2	-	-	1	1	1	1	1	1





Program: Bachelor of science

Subject / Branch: Zoology

Year : 2022/23

Semester: IV

Course title: Comparative Anatomy of Vertebrates

Course code : BZOO401UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To impart students with a comprehensive understanding of vertebrate morphology, encompassing the integumentary system, digestive and respiratory organs, skeletal structures, receptors, and nervous systems.
2. To facilitate comparative analysis across vertebrate groups, enabling students to recognize anatomical variations and adaptations.
3. To equip students with the knowledge and skills necessary for careers in biology, zoology, and veterinary sciences by fostering a deep appreciation for vertebrate structure and function.
4. To prepare individuals to contribute to research and education in the field of vertebrate morphology, promoting a deeper understanding of the animal kingdom's diversity and evolution.

Course Outcome: At the end of the course, students shall be able to

CO1	To impart students with a comprehensive understanding of vertebrate morphology, encompassing the integumentary system
CO2	To facilitate comparative analysis across vertebrate groups, enabling students to recognize anatomical variations and adaptations.
CO3	To equip students with the knowledge and skills necessary for careers in biology, zoology, and veterinary sciences by fostering a deep appreciation for vertebrate structure and function.
CO4	To impart students with a comprehensive understanding of vertebrate digestive and respiratory organs, skeletal structures, receptors, and nervous systems



Content

Unit	Description in detail	Credit	Weightage
I	Vertebrate morphology: definition, scope and importance Development, structure and functions of vertebrate integument and its derivatives (glands, scales, feathers and hair) Comparative account of digestive organs of different vertebrate groups Comparative account of respiratory organs of different vertebrate groups	1	33 %
II	Overview of axial and appendicular skeleton of vertebrates Comparative account of skeletal system of different vertebrate groups (skull, pectoral and pelvic girdles, vertebral column, teeth and jaw suspensorium) Classification of receptors, Brief account of olfactory and auditory receptors in vertebrate Comparative account of urinogenital system in vertebrates	1	33 %
III	Comparative account of heart in vertebrates Comparative account of aortic arches and portal systems of vertebrates. Comparative account of brain and spinal cord of vertebrates Comparative account of peripheral and autonomous nervous system.	1	34 %

Reference Books:

- 1) Hickman C. P., et al. (2006) Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.
- 2) Kotpal R. L. (2010) vertebrates, Rastogi Publications, 882 pp
- 3) Jordan E. L. and Verma P. S. (2013) Chordate Zoology, S. Chand publishing. New Delhi.

Online Resources:

http://gdckulgam.edu.in/Files/f07ef270-7e91-4716-8825-2966f17cc0f7/Custom/Comparative%20Anatomy%20and%20Developmental%20Biology%20of%20Vertebrates_compressed.pdf

<https://content.patnawomenscollege.in/zoology/COMPARITIVE%20ANATOMY%20OF%20DIGESTIVE%20SYSTEM%20IN%20VERTEBRATES.pdf>

<https://opentextbc.ca/biology/chapter/19-1-types-of-skeletal-systems/>

http://www.citycollegekolkata.org/online_course_materials/Comparative_Anatomy_of_Aortic_Arches_in_Vertebrates.pdf

http://www.citycollegekolkata.org/online_course_materials/20201203_Comparative_Anatomy_of_Heart_in_Vertebrates.pdf





Practical:

- 1) Study of vertebrate integument and its derivatives (glands, scales, feathers and hair).
- 2) Comparative account of digestive organs (Stomach), respiratory organs Lung and trachea, Skull of different vertebrate groups.
- 3) Comparative account of pectoral girdles, pelvic girdles, vertebral column, teeth and Jaw of different vertebrate groups.
- 4) Study of olfactory receptors, auditory receptors in vertebrate animals.
- 5) Study of Comparative account of kidney, heart, aortic arches, portal systems, brain of vertebrates.
- 6) Study of Comparative account of brain, spinal cord, peripheral nervous system, autonomous nervous system of vertebrates.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	1	-	-	-	2	-	2	2	2	-
CO2	2	2	-	-	-	2	-	2	2	1	1
CO3	2	2	-	-	-	2	-	-	1	2	-
CO4	1	1	2	-	-	1	-	1	1	1	1





Program: Bachelor of science

Subject / Branch: Zoology

Year : 2022/23

Semester: IV

Course title: Chordates- II

Course code : BZOO402UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To provide students with a comprehensive understanding of vertebrate biology by exploring the classification, anatomy, and adaptations of reptiles, birds, and mammals.
2. To facilitate in-depth type studies of representative species, fostering analytical skills and knowledge of vertebrate anatomy and physiology.
3. To equip students with the expertise needed to appreciate the ecological roles, adaptations, and economic significance of these vertebrate classes, preparing them for careers in biology and conservation.
4. To inspire a deep appreciation for biodiversity and evolution in the natural world, motivating students to contribute to research, education, and conservation efforts in vertebrate biology.

Course Outcomes: At the end of the course, students shall be able to

CO1	Understand the evolutionary history and relationship between the different classes of chordates.
CO2	Know the different characteristics along with their habits and distribution of the chordates.
CO3	Understand the significance of the different in physiological systems between the vertebrates.
CO4	Distinguish the significance of the chordates from other lower organisms and comprehend their advantages





Content

Unit	Description in detail	Credit	Weightage
I	General characters and classification of class Reptilia Origin, evolution and adaptive radiation in reptiles. Type study: <i>Calotes versicolor</i> - The Garden Lizard (habit and habitat, external features, digestive system, respiration, blood vascular, nervous and Urinogenital system) Introduction to venomous and non- venomous snakes, poison apparatus and biting mechanism in snakes, symptoms and cure of snake bite	1	33 %
II	General characteristics and classification of class Aves Type study: <i>Columba livia</i> - The common rock pigeon (habit and habitat, external features, digestive system, respiration, blood vascular, nervous and Urinogenital system) Origin, mechanism, mode and adaptation of bird flight Migration and economic importance of birds	1	33 %
III	General characteristics and classification of class Mammalia Type study: <i>Rattus rattus</i> - The Rat (habit and habitat, external features, digestive system, respiration, blood vascular, nervous and Urinogenital system) Adaptations in terrestrial, aquatic and flying mammals Economic importance of mammals	1	34 %

Reference Books:

- 1) Hickman C. P., et al. (2006) Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.
- 2) Kotpal R. L. (2010) vertebrates, Rastogi Publications, 882 pp
- 3) Jordan E. L. and Verma P. S. (2013) Chordate Zoology, S. Chand publishing. New Delhi.

Online Resources:

<https://www.notesonzooology.com/vertebrates/reptiles/reptiles-origin-and-adaptive-radiation-with-diagram-chordata-zoology/8230>

<https://www.biologydiscussion.com/zoology/reptiles/calotes-structure-sense-organs-and-ecdysis-reptiles/41163>

https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/225/6922/et/20_Academic%20Script200319070703034848.pdf



Practical:

- 1) Study of classification of Class Reptilia (up to Order) using laboratory specimens, models, slides, charts.
- 2) Study of classification of class Aves (up to Order) using laboratory specimens, models, slides, charts.
- 3) Study of classification of class Mammalia up to orders using laboratory specimens, models, slides, charts.
- 4) Study of Digestive system, Arterial system, venous system, Nervous system, Urinogenital system of *Calotis versicolor* using models, slides and charts.
- 5) Study of Digestive system, Arterial system, venous system, Nervous system, Urinogenital system, of *Columba Livia* using models, slides and charts.
- 6) Study of Digestive system, Arterial system, venous system, Nervous system, Urinogenital system, of *Rattus rattus* using models, slides and charts.
- 7) Study of Air sac and gizzard of *Columba Livia* using models, slides and charts (mounting).
- 8) Study of Pecten and cloacae of *Calotis versicolor* using models, slides and charts (mounting).
- 9) Study of hair and teeth of *Rattus rattus* using models, slides and charts (mounting).
- 10) Study of Adaptations in terrestrial, aquatic, flying mammals.
- 11) Study of venomous snakes and non- venomous snakes using models, biting mechanism in snakes using models, slides and charts.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	-	-	-	2	2	2	2	2	-
CO2	1	1	-	-	-	2	-	2	2	3	-
CO3	2	2	-	-	-	2	-	1	1	2	1
CO4	2	1	-	-	-	1	2	2	2	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: IV

Course title : Limnology

Course code : BZOO401USE

Course type: Elective

Course credit : 02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	00	00	10	05	35	50

Course Objective:

- 1) To develop knowledge about limnology.
- 2) To develop knowledge about different characteristics of freshwater ecosystem.

Course Outcomes: At the end of the course, students shall be able to

CO1	limnology is a comprehensive, integrated, scientific understanding of inland waters.
CO2	limnologists are working on construction of artificial wetlands, which could serve as habitats for a variety of animal and plant species and aid in decreasing water pollution.
CO3	Limnology is the study of the structural and functional interrelationships of organisms of inland waters as their dynamic physical, chemical, and biotic environments affect them.
CO4	Freshwater biology is the study of the biological characteristics and interactions of organisms of fresh waters.

Unit	Description in detail	Credit	Weightage
I	Introduction to limnology. Properties of freshwater: physic-chemical characteristic, abiotic and biotic factors affecting freshwater ecosystem. Classification of freshwater ecosystem. Stratification of lake, flora and fauna of fresh water ecosystem	1	50 %
II	Food web of freshwater ecosystem, Energy flow in freshwater ecosystem. Threats to freshwater ecosystem: eutrophication, acidification and pollution Conservation and management of freshwater ecosystem.	1	50 %



Reference books:

1. Verma PS and Agrawal Vk, 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand publications, New Delhi.
2. Odum. E.P. 1996 Fundamentals of Ecology. Nataraj Publishers, Dehradun Suggested Readings:
3. Smith, R.L. 1986. Elements of Ecology. Harpet and Row Publishers, New York.
4. Berwer. A.1988 The Science of ecology. Saunder's college publishing

Online Resources:

https://en.wikipedia.org/wiki/Lake_stratification

<https://en.wikipedia.org/wiki/Limnology>

<https://teara.govt.nz/en/diagram/11628/freshwater-food-web>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	3	-	-	-	1	-	1	1	2	1
CO2	3	1	-	-	-	2	-	2	2	3	-
CO3	2	2	1	-	-	2	-	1	1	2	-
CO4	2	1	2	-	-	1	-	2	2	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: V

Course title: MOLECULAR AND CELLULAR BIOLOGY
Course code : BZOO501UDSC
Course type: Discipline Specific Course
Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3	0	3	Mid	CE	70	100
			20	10		

Course Objective:

1. To understand the general characteristics of prokaryotic and eukaryotic cell.
2. To understand the structures and functions of basic components of prokaryotic and eukaryotic cell.
3. To develop knowledge of the organization of nucleus.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of Cell Biology student will learn about basic functional unit of living body, prokaryotic and eukaryotic cell organization.
CO2	In this unit student will understand about concept of intra-inter molecular interaction and also get deep understanding in structure function and properties of carbohydrate and lipids.
CO3	From this unit student will get to know about composition of nucleic acid, nucleotide, DNA, RNA.
CO4	Student will learn about DNA Replication, Lac operon and Tryptophan operon.



Content

Unit	Description in detail	Credit	Weightage
I	Cells as basic functional unit of living body, cellular classification domains, i.e., eubacteria, archaebacteria, eukaryotes) Prokaryotic cell organization (Prokaryotic cell structure, Bacterial cell walls) Eukaryotic cell organization (Brief idea of structure and function of --- Plasma membrane, Nucleus, Endoplasmic reticulum, Golgi apparatus, Mitochondria, Chloroplast, Lysosome, Peroxisome, cytosol, Plant cell wall, Plant cell vacuole,)	1	33 %
II	Importance of carbon molecule (valency, chiral carbon, types of isomers) Concept of intra- and intermolecular interaction (covalent bond, ionic bond, hydrogen bond, hydrophobic interaction, van der Waals interaction) Carbohydrate: Structure, Function and properties of Monosaccharides (Hexoses and pentoses), Disaccharides (sucrose, lactose, maltose), storage & structural polysaccharide (glycogen, starch and cellulose) Lipids: Definition and classification of lipids, Structure and function of fatty acid, storage lipids, structural lipids.	1	33 %
III	Nucleic Acids: Composition of Nucleic Acids and Synthesis of Nucleotides Type of RNA (mRNA tRNA rRNA polymerase various types Transcription in Prokaryotes and genetic code DNA Replication in Prokaryotes and Eukaryotes; Enzymes involved in Replication. Lac operon and Tryptophan operon Translation: Process of Protein synthesis.	1	34 %

Reference Books:

1. Verma PS and Agrawal Vk, 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand publications. New Delhi.
2. Powar CB 1983 Cell Biology, Himalaya Publishing House, Mumbai, India
3. David ES, Jones B Cell biology, Organelle structure and function 11
4. Lavished. al., 2007 Molecular Cell Biology, W.H. Freeman and Company, New York, USA2.
5. Sambamurty A.V. S. S. 2008 Molecular Biology, Narosa Publishing House, New Delhi

Online Resources

https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology

<https://www.cellmolbiol.org/index.php/CMB>

<https://www.cmb.res.in/>



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Practical

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Study of structure of different models of cell membrane using charts or models.
5. Study of structure and function of Endoplasmic reticulum using charts or models.
6. Study of structure and function of Mitochondria using charts or models.
7. Study of structure and function of Golgi apparatus using charts or models.
8. Study of structure and function of Lysosome using charts or models.
9. Study of structure and function of Ribosome using charts or models.
10. Isolation of chloroplast from given sample.
11. Perform staining of mitochondria in given sample.
12. Study of osmosis in grapes.
13. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A₂₆₀ measurement)
14. Quantitative estimation of RNA using Orcinol reaction
15. Study of Prokaryotic cells and Eukaryotic cells, Cell cycle, Watson and Crick model of DNA, Replication, Transcription in Prokaryotes and Eukaryotes, RNA Polymerases, Translation using charts or models.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	-	1	-	-	1	3	1
CO2	3	2	-	-	-	-	-	-	1	3	-
CO3	3	2	1	-	-	-	-	-	1	3	1
CO4	2	1		-	-	1	-	1	1	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: V

Course title: DEVELOPMENTAL BIOLOGY **Course code :** BZOO502UDSC
Course type: Discipline Specific Course **Course credit :** 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To develop knowledge of developmental biology.
2. To develop knowledge about early developmental stages in animals.
3. To develop knowledge about later developmental stages in animals.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this concept of Developmental Biology student will learn about history of developmental biology and fundamentals of gametogenesis.
CO2	From this unit student will get deep knowledge about process of fertilization, physiological changes during fertilization and gastrulation. One will also get to learn about development of frog and chick embryo.
CO3	In this unit student will learn about internal(mammals) and external fertilization(amphibian), neurulation in frog embryo, vitellogenesis in birds.
CO4	Later development processes occurring in vertebrates.



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Content

Unit	Description in detail	Credit	Weightage
I	History and concepts of developmental biology Gametogenesis, Spermatogenesis, Oogenesis Male gamete: structure and types of sperms Female gamete: structure, types of eggs, Egg membranes	1	33 %
II	Process of fertilization, blocks to polyspermy, physiological changes during fertilization Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques) Early development of frog and chick up to gastrulation; Embryonic induction and organizers Organogenesis in frog: formation of neural tube and heart Development of chick embryo	1	33 %
III	Gametogenesis: Spermatogenesis and oogenesis mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	1	34 %

Reference Books:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
3. Carlson, R. F. Patten's Foundations of Embryology 13
4. Kolthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
5. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

Online Resources

https://rationalwiki.org/wiki/Evolutionary_developmental_biology

<https://plato.stanford.edu/entries/theories-biological-development/>

<https://www.cos.uni-heidelberg.de/en/research-groups/cell-and-developmental-biology>



Practical

1. To study the process of spermatogenesis through permanent slides
2. To study the different types of sperm through permanent slides
3. To prepare temporary mount of sperm from collected sample
4. To study the process of oogenesis through permanent slides
5. To study the different types of eggs through permanent slides or specimen
6. To study the different types of cleavage through permanent slides
7. To study the different patterns of cleavage through permanent slides
8. To study blastula and gastrula stages in frog and chick through permanent slides
9. To study structure of egg of hen using fresh or boiled egg
10. To study development of chick embryo with respect to hour of incubation through permanent slides
11. To study permanent mount of chick embryo from fertilized eggs
12. To study torsion and flexion in chick through permanent slides or charts
13. To study formation of various organs in frog through permanent slides of T. S. and L.S. of various organs.
14. To study metamorphosis in frog through modes, permanent slides or live specimens

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	1	3	1
CO2	3	2	-	-	-	-	-	-	1	2	-
CO3	3	1	-	-	-	-	1	-	-	3	1
CO4	2	-	1	-	-	-	-	-	1	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: V

Course title: BIOSTATISTICS, TOOLS AND
TECHNIQUES

Course code : BZOO503UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To develop basic understanding on biostatistical analysis.
2. To develop knowledge about light microscopy.
3. To develop basic understanding of laboratory practice and common lab instruments.

Course Outcomes: At the end of the course, students shall be able to

CO1	From this unit student will get understanding in basic of biostatics, Sampling methods and Measures of central tendency.
CO2	In this unit students will learn about principle, working procedure and application of simple, light and compound microscope also about SEM and TEM.
CO3	From this unit student will get a knowledge about principle and uses, types of the various instruments (pH meter, calorimeter, microtome, spectrophotometer, centrifuge, electrophoresis).
CO4	Historical prospective, classification of chromatography, principle, working procedure and application of chromatography.





Content

Unit	Description in detail	Credit	Weightage
I	Definition and scope, organizing a statistical survey and presentation of statistically analysed information Sampling, Measures of central tendency (mean, median and Mode) and dispersion (variance, standard deviation and standard error); Correlation and Regression	1	33 %
II	Principle, working procedure and application of Simple, Light and compound microscope Principle and application of Electron (SEM and TEM) microscope Chromatography: Historical prospective Principle and classification of chromatography Principle and application of paper and thin layer chromatography	1	33 %
III	Principles and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer & Centrifuge. Microscopy (light, transmission and scanning electron microscopy) Chromatography and Electrophoresis.	1	34 %

Reference Books:

1. Wilson, K. and Walker, J., (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambridge University Press (Low price edition), New York. 15
2. Webster J. G., (2009). Bioinstrumentation, Student edition, Wiley India (P) Ltd. New Delhi.
3. Milton, J.S 1992 Statistical Methods in Biological and Health Science. McGraw-Hill Inc, New York.
4. Scheffler, W.C. 1963 Statistics for biological sciences. Addition - Wesley Publication Co., London.

Online Resources

https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000034ST/P001025/M009957/ET/1546938553M1.pdf

<http://hstathome.com/tjziyuan/Biostatistical%20Method.pdf>

<https://old.amu.ac.in/emp/studym/99991854.pdf>



Practical

1. To study different types of charts for data presentation using manual method or MSEXCEL
2. To calculate mean, median and mode using given data set (10 examples)
3. To calculate mean and standard deviation using given data set (10 examples)
4. Examples related to student t test and F test (10 examples)
5. Examples related to chi square test (10 examples)
6. Examples of correlation and regression analysis (10 examples)
7. Principles, working and use of following laboratory instruments: microscope, incubator, pH meter, spectrometer and colorimeter
8. Study of different types of microscopes
9. Separation of biomolecules using thin layer chromatography
10. Separation of amino acids using paper chromatography
11. Study of different types of centrifuges

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	3	3	-	-	2	-	2	1	2	1
CO2	2	3	-	-	1	1	-	1	1	2	1
CO3	2	3	-	-	-	1	-	1	1	2	-
CO4	2	3	2	-	-	-	-	-	1	1	-



Program: Bachelor of science
Year : 2023/24

Subject / Branch: Zoology
Semester : V

Course title: BIODIVERSITY AND CONSERVATION
BIOLOGY
Course type: Discipline Specific Course

Course code : BZOO504UDSC
Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To develop knowledge of biodiversity and its components.
2. To develop knowledge of biodiversity hotspots and protected areas.
3. To develop knowledge about conservation strategies for wildlife of India.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this unit of biodiversity and conservation biology student will learn about values of biodiversity and conservation ethics, losses and threats to biodiversity, biological consequences of different effects (crowd effect, habitat fragmentation...) Also, significance of ecological restoration in conservation.
CO2	In this unit student will understand about biodiversity hotspots, important protected areas in India and Gujarat. Significance and types of conservation, role of protected areas in biodiversity conservation in India.
CO3	From this unit student will learn about major conservation projects (project tiger, project elephant).
CO4	Also, about conservation significance. laws, policies, about the IUCN and various acts for wildlife protection and biodiversity conservation

Content

Unit	Description in detail	Credit	Weightage
I	Introduction to conservation biology, values of biodiversity and conservation ethics. Patterns and process of biodiversity, losses and threats to biodiversity. Biological consequences of habitat fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects, changes in species composition and problem of climate change Population genetics and conservation; community and ecosystem level conservation. Theories, planning and designing conservation reserves; scales of management and cultural context. Conservation outside protected areas. Control of invasive species. Significance of ecological restoration in conservation.	1	33 %
II	Biodiversity hotspots of India Important Protected Areas in India and Gujarat Significance of Conservation: Definition, History and Background and types of conservation Significance of conservation; In-situ conservation and Ex-situ conservation. Role of protected areas in biodiversity conservation in India.	1	33 %
III	Major Conservation Projects: project tiger, project elephant Conservation significance, Conservation Laws & Policies International Union for Conservation of Nature (IUCN), threat categories, Red data book, and role of IUCN in biodiversity conservation National Biodiversity Act (2002) Indian wildlife protection act (1972)	1	34 %

Reference Books:

1. Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.
2. Gadgil, M. (2002) A methodology manual for scientific inventorying, monitoring and conservation of Biodiversity.
3. Odum. E.P. 1996 Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
4. Smith, R.L. 1986. Elements of Ecology. Harpet and Row Publishers, New York.
5. Berwer. A. 1988. The Science of ecology. Saunder's college publishing



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Online source:

<https://www.sciencedirect.com/science/article/abs/pii/S1369848613001301>

<https://pubmed.ncbi.nlm.nih.gov/24216191/>

<https://plato.stanford.edu/entries/conservation-biology/>

Practical

1. Mapping of different biogeographical realm and study of related fauna
2. Mapping of biodiversity hotspots of the world and study of related fauna
3. Mapping and study of fauna of selected national parks and sanctuaries of India
4. Mapping and study of fauna of national parks of Gujarat
5. Mapping and study of fauna of selected sanctuaries of Gujarat
6. Mapping of distribution of endemic and critically endangered fauna of India
7. Calculation of different biodiversity indices using given data
8. To determine density, abundance, and frequency of occurrence of the vegetation by quadrat method in the field or on given simulation sheet
9. To prepare the report on local faunal diversity.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	-	2	1	-	2	-	2	3	3
CO2	2	-	-	2	-	1	1	-	1	2	3
CO3	2	-	1	-	-	1	1	-	1	2	2
CO4	2	-	2	-	-	-	-	-	1	1	2

Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: V

Course title : Fisheries Science

Course code : BZOO501USE

Course type: Elective

Course credit : 02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	00	00	10	05	35	50

Course Objective:

1. To ensure conservation of fishes and their environment.
2. To develop and execute fisheries development plan.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this unit student will understand the basic nutritional requirements of fishes, recognize different prescription diets on the animals' basic indications for use.
CO2	From this unit student will get to know about main stages of embryonic and larval development.
CO3	Hormonal changes behavioural changes that occur across the breeding period.
CO4	Students will learn about different fish culture methods.



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Content

Unit	Description in detail	Credit	Weightage
I	Marine capture fisheries resources of India - Commercially important fisheries in India (Taxonomy; distribution, food and feeding and catch trends of the following fisheries) Oil Sardine fishery Mackerel fishery Bombay duck fishery Pomfret fishery Sole fishery Hilsa fishery Fisheries of Non fish organisms Prawn and Shrimp capture fishery Crab capture fishery Molluscan fisheries Chank fisheries	1	50 %
II	Mari Culture Cultivable Crustacean resources and their culture i) Prawn ii) Crabs Cultivable Molluscan resources and their culture i) Mussels ii) Edible oyster iii) Pearl oyster Sea weed culture Fish Culture Methods - Pen culture Cage culture Sewage fed fish culture Integrated fish farming practices Paddy cum fish culture Poultry cum fish culture Livestock fish culture	1	50 %

Reference Books:

1. A Textbook of Fish Biology and Fisheries S. S. Khanna, H. R. Singh
2. A Text Book Of Fishery Science and Indian Fisheries Disha Experts
3. Recirculating Aquaculture Systems: A Guide to Farm Andy Davison

Online Resources

<https://sustainablefisheries-uw.org/seafood-101/fishery-science/>

<https://icar.org.in/content/fisheries-science-institutes>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	2	1	1	-	1	-	2	1	2	1
CO2	2	3	-	-	1	-	1	3	1	2	2
CO3	1	-	1	-	-	-	1	-	1	2	2
CO4	2	3	2	-	-	-	-	-	1	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: VI

Course title: Biochemistry and Analytical techniques
Course code : BZOO601UDSC
Course type: Discipline Specific Course
Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To develop basic knowledge of bonding between Atoms, Elements and Molecules.
2. To develop basic knowledge of carbohydrates and Lipids.
3. To develop basic knowledge of proteins.

Course Outcomes: At the end of the course, students shall be able to

CO1	From this unit student will understand about basics of biochemistry, like protein structure and function and carbohydrate and glucose metabolism. Also, characteristics of lipids, metabolism of dietary lipids, fatty acid and glycerol.
CO2	In this unit student will understand about characteristics and types of amino acids, nucleotide metabolism, metabolic effects of insulin, and DNA-RNA structure and replication.
CO3	From this unit student will learn about electrochemistry (pH, buffers, Potentiometric and conduct metric titration) also about Microscopy.
CO4	Students will learn about function and classification of proteins.



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Content

Unit	Description in detail	Credit	Weightage
I	Basic chemistry for biologist Protein Structure and Function: Amino Acids, Structure of Proteins, Globular Proteins, Fibrous Proteins, Enzymes Introduction to Carbohydrates, Glycolysis, Tricarboxylic Acid Cycle, Gluconeogenesis, Glycogen Metabolism, Metabolism of Monosaccharides and Disaccharides, Pentose Phosphate Pathway and NADPH, Glycosaminoglycans and Glycoproteins Characteristics and types of lipids, Metabolism of Dietary Lipids, Fatty Acid and Triacylglycerol	1	33 %
II	Amino Acids: Characteristics and types of Amino acids, Conversion of Amino Acids to Specialized Products, Nucleotide Metabolism Integration of Metabolism: Metabolic Effects of Insulin and Glucagon, The Feed/Fast Cycle, Diabetes Mellitus, Obesity. Nutrition, Vitamins Nucleotide metabolism: Characteristics and types of Nucleic acids, Biosynthesis and catabolism of purines and pyrimidines Storage and Expression of Genetic Information: DNA Structure and Replication, RNA Structure and Synthesis, Protein	1	33 %
III	Electrochemistry: pH and buffers, Potentiometric and Conductometric titration Microscopy: Light, phase contrast, fluorescence, scanning and transmission electron microscopy and other advanced microscopy	1	34 %

Reference Books:

1. Harper H. A. 1993 Review of Physiological Chemistry (Lange Publications).
2. Lehninger A. I., Nelson D. L. and Cox M.M. 1993. Principles of Biochemistry (CBC Publishers).
3. Rastogi S. C. 2003 Biochemistry (Tata Mc Graw Hill Publishing Co. Ltd.).



Online Resources

<https://en.wikipedia.org/wiki/Biochemistry>

<https://www.britannica.com/science/biochemistry>

Practical

1. Detection of monosaccharides: Glucose, fructose
2. Detection of disaccharides: Lactose, Maltose, Sucrose
3. Detection of Polysaccharides: Starch, casein
4. Detection of protein: Egg albumin, Peptone
5. Detection of oil through biochemical test
6. Preparation of ball and stick model of following molecules: Glucose, Fructose, Galactose, Maltose, Lactose, Sucrose, Amino acids, Glycerol
7. Detection of enzymatic activity on starch at normal temperature/Ph
8. Detection of enzymatic activity on starch at low temperature/Acidic pH
9. Detection of enzymatic activity on starch at high temperature/basic pH
10. To study lock and key mechanism of enzyme action through model/chart

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	-	-	-	-	-	-	1	2	1	2
CO2	2	1	1	-	-	-	-	1	2	1	1
CO3	2	2	1	-	-	-	-	1	-	2	1
CO4	1	-	2	-	-	-	-	-	1	1	-





Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: VI

Course title: GENETICS

Course code : BZOO602UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
3	0	3	20	10	70	100

Course Objective:

1. To develop knowledge of genetics.
2. To develop basic understanding of structure, organization and types of chromosomes.
3. To develop knowledge of human genetics.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this unit student will understand about history of genetics, pre-mendelian genetic concepts, concept of phenotype, genotype, heredity, variation, pure lines and Inbred lines.
CO2	From this unit students get deep understanding of Mendelian genetics and Its Extension.
CO3	In this unit student will learn about various kind of Mutation and their application.
CO4	Students will learn about molecular basis of genetic information.





Unit	Topic	Content	Hours	Weightage
1		Introduction of Genetics	15	33%
	1.1	History of Genetics: Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory.		
	1.2	Heredity and Environment: Concepts of Phenotype, Genotype, Heredity, variation, Pure lines and Inbred lines.		
	1.3	Molecular basis of Genetic Information		
2		Mendelian Genetics and Its Extension	15	33%
	2.1	Principles of Inheritance, Chromosome theory of inheritance,		
	2.2	Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy,		
	2.3	sex linked inheritance, extra-chromosomal inheritance		
3		Mutation	15	33%
	3.1	Occurrence, kinds of Mutation, spontaneous & induced Mutation,		
	3.2	Mutagens, detection of Mutation, Lethal Mutations, Biochemical Mutations,		
	3.3	Phenotypic effects of Mutation, Molecular basis of Mutation, Significance & Practical applications of Mutation.		

Reference Books:

1. Verma P. S. and Agrawal V. K. 2010 Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
2. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
3. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
4. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings

Online Resources

<https://en.wikipedia.org/wiki/Genetics>



<https://www.britannica.com/science/genetics>

Practical

1. To study structure of chromosome through permanent slide of mitosis
2. To study structure of chromosome through temporary preparation of onion root tip
3. To study process of meiosis through permanent slides
4. To prepare temporary mounting of giant polytene chromosome from salivary gland of Chironomus larva
5. To solve problems of post-Mendelian genetics
6. To solve problem of sex-linked inheritance
7. To prepare and study normal karyotype
8. To prepare and study abnormal karyotype
9. To study inheritance in humans through pedigree analysis
10. To study types of twins through charts/photos

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	-	1	-	-	1	1	2	1	1	2
CO2	3	1	-	-	1	-	-	-	-	1	1
CO3	3	1	-	-	-	-	-	1	1	2	-
CO4	2	-	2	-	-	-	-	-	1	1	-



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Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: VI

Course title: ANIMAL BEHAVIOUR AND
EVOLUTION

Course code : BZOO603UDSC

Course type: Discipline Specific Course

Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3	0	3	Mid	CE	70	100
			20	10		

Course Objective:

1. To develop basic knowledge of animal behaviour.
2. To develop basic knowledge of animal communication.
3. To develop basic knowledge of evolution.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this unit student will understand about introduction animal behaviour, concepts of animal behaviour, fixed action pattern, sign stimulus, innate behaviour and approaches and methods to study animal behaviour.
CO2	From this unit student will understand about brief history of evolution, direct and indirect evidences of evolution.
CO3	In this unit student will learn about communication in animals, types of parental care, role of pheromones and hormones in animal behaviour.
CO4	Students will learn about various theories of evolution, Hardy-Weinberg law and living fossils.





Content

Unit	Description in detail	Credit	Weightage
I	Introduction and history of animal behaviour. Concepts of animal behaviour: Motivation, fixed action pattern, sign stimulus, innate behaviour. Imprinting animals. Learning behaviour. Approaches and methods to study animal behaviour	1	33 %
II	Brief history of evolution. Direct and indirect evidences of evolution. Theories of evolution, Hardy-Weinberg law. Isolation and speciation. Living fossils and Human evolution	1	33 %
III	Communication in animals. Parental care: Types and affecting factors. Social organization in mammals. Role of pheromones in animal behaviour. Role of hormones in animal behavior	1	34 %

Reference Books:

1. Alcock J. 2013 Animal Behavior: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.)
2. Bolhuis J. J. and Girardeau L. (eds) 2005 The behaviour of animals (Blackwell Pub.)
3. Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press)
4. Mathur R. 2008 Animal behaviour (Rastogi Pub.: India)
5. Riddle M. (1996) Evolution. 2nd edn. Blackwell.

Online Resources

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/animal-behavior>

<https://www.britannica.com/science/animal-behavior/History-and-basic-concepts>



Practical

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioral responses of red gram flour beetle to dry and humid conditions.
3. To study the behavioral responses of red gram flour beetle to light and dark conditions.
4. To study geotaxis behavior in earthworm.
5. To study the phototaxis behavior in earthworm.
6. To study instruments for different methods of learning behavior
7. To study trial and error method of learning in human through Maze/ playing cards
8. To study learning behavior in rat zigzag maze
9. To study parental care in invertebrate and vertebrates using museum specimen or field visit
10. Prepare an ethogram of behavior performed by any animal

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	1	1	-	-	-	1	1	2	3	2
CO2	2	1	1	-	1	-	-	1	2	2	1
CO3	2	-	1	1	-	-	1	-	1	2	-
CO4	1	-	-	-	-	-	-	-	1	1	1



Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: VI

Course title: ECONOMIC ZOOLOGY AND TOXICOLOGY
Course type: Discipline Specific Course
Course code : BZOO604UDSC
Course credit : 03

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
3	0	3	Mid	CE		
			20	10	70	100

Course Objective:

1. To develop basic knowledge of economic zoology.
2. To develop basic knowledge of commercially important fishes of India.
3. To develop basic knowledge of toxicology.

Course Outcomes: At the end of the course, students shall be able to

CO1	Students will learn about scope of economic zoology, harmful and beneficial aspects of pest.
CO2	Different marine and fresh water aquaculture practices in India.
CO3	Basic understanding of the field of toxicology.
CO4	Importance of animals in pharmaceutical.

Content

Unit	Description in detail	Credit	Weightage
I	Introduction and entrepreneurship scope of economic zoology. Insect pest of economically important crops. Household insect pest Economic importance of insets: Apiculture, Sericulture, Lac culture. Insect pest management.	1	33 %
II	Breeds of cow, buffalo, goat and their importance in dairy industry. Importance of mammals in wool and leather industry.	1	33 %



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	Importance of animals in pharmaceutical.		
III	Economic Zoology - Apiculture, Lac Culture, Seri Culture and Prawn Culture. Toxicology. Introduction, Scope, Division and Goal of Toxicology. Toxic Chemicals: Fertilizers, Pesticides, Automobile, Heavy Metals.	1	34 %

Reference Books:

1. David B.V. and Ananth Krishnan T. N. 2004. General and Applied Entomology. Tata McGraw Hill, New Delhi.
2. Dunston P. A. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
3. Mathur and Upadhyay A textbook of Entomology. Aman publication house, India.
4. G.S Shukla and V. B Upadhyay. Economic Zoology, , Rastogi Publications
5. A.A. Khan. Encyclopedia of Economic Zoology Anmol Publications

Online Resources

[https://www.aisectuniversityjharkhand.ac.in/PDFDoc/StudyNotes/B.SC%20Zoology/B.Sc%20Zoology%20\(Sem%20V\)/Sem%20V%20DSE-1%20Economic%20Zoology.pdf](https://www.aisectuniversityjharkhand.ac.in/PDFDoc/StudyNotes/B.SC%20Zoology/B.Sc%20Zoology%20(Sem%20V)/Sem%20V%20DSE-1%20Economic%20Zoology.pdf)

<https://www.iaszoology.com/insect/>

Practical

1. To study identification, damage and control of insect pest of sugarcane and pulse crop.
2. To study identification, damage and control of insect pest of vegetables and fruits
3. To study identification, damage and control of house hold insect pest
4. To study life cycle of honey bee and method of apiculture
5. To study life cycle of lac insect and method of lac culture
6. To study life cycle of silk worm and method of sericulture
7. To study identification and economic importance of selected freshwater fishes of India
8. To study identification and economic importance of selected marine fishes of India
9. To study method of pearl culture
10. To study identification and economic importance of selected prawns of India





CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	2	-	1	-	-	-	1	1	2	3	2
CO2	2	-	1	-	-	-	-	1	2	1	-
CO3	2	-	1	-	-	-	1	-	1	2	1
CO4	1	-	-	-	-	-	-	-	1	1	1





Program: Bachelor of science

Subject / Branch: Zoology

Year : 2023/24

Semester: VI

Course title : WILDLIFE BIOLOGY

Course code : BZOO603USE

Course type : Elective

Course credit : 02

Teaching Examination Scheme:

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
2	00	00	10	05	35	50

Course Objective:

1. Build up scientific knowledge on wildlife resources.
2. Carry out research relevant to management including the development of techniques appropriate to Indian conditions.

Course Outcomes: At the end of the course, students shall be able to

CO1	In this unit student will understand about estimating number of wildlife (census technique), measuring habitat use, and wildlife habitat evaluation and population monitoring techniques.
CO2	From this unit student will understand about human wildlife interaction and immobilization and rescue of wildlife.
CO3	Students will learn about certain species roles in an ecosystem.
CO4	Students will discover that life can be found almost everywhere on earth.





Content

Unit	Description in detail	Credit	Weightage
I	Estimating number of wildlife (Census techniques) Measuring habitat use and occupancy Wildlife habitat evaluation techniques Wildlife population monitoring techniques	1	50 %
II	Human-wildlife Interaction Management and mitigation of conflicts Conservation outreach programmers Immobilization and rescue of wildlife	1	50 %

Reference Books:

1. T A Bookhout 1996. Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, ML
2. D E Wilson 2002. Measuring and Monitoring Biological Diversity: Standard Methods. The Smithsonian Institution, USA
3. J P Sands et al. 2012. Wildlife Science: Connecting Research with Management. CRC Press, Taylor and Francis Group

Online Resources

<https://www.wildlifebiology.org/>

<https://onlinelibrary.wiley.com/journal/1903220x>

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1-Less Relevant, 2- Mild Relevant, 3-Highly Relevant)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3	2	1	-	-	1	2	1	1	1	3
CO2	3	2	1	-	-	1	-	1	2	3	3
CO3	2	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	1	-	2

