KADI SARVA VISHWAVIDYALAYA

B.Sc.Curriculum as per NEP

for Semester 5

W.E.F. June 2025

KADI SARVA VISHWAVIDYALAYA

B.Sc. Programme – Structure

(Scheme for teaching and evaluation for B.Sc Programme (Basic/Honours)

Aligning to NEP–2020 as per Govt. of Gujarat Dated 11/07/2023

B.Sc. Semester V Structure

Sr. no	Component	Course code	Course title	Duration In Hrs.		Credits	Maximum Marks		TOTAL
				Theory	Practical		CCE (Formative)	SEE (Summative)	
01	Major Courses (Select any three of same subject)	MBM301-3C	Microbial Process Technology	60	0	4*3 = 12	50	50	100
		MBM302-3C	Recombinant DNA Technology	60	0				
		MBM303-3C	Microbiology Practical- V	0	120				
		CHM304-3C	Inorganic & Analytical Chemistry - III	60	0				
		CHM305-3C	Organic & Physical Chemistry -III	60	0				
		CHM306-3C	Chemistry Practicals-V	0	120				
		MTM310-3C	Real Analysis	60	0				
		MTM311-3C	Integral Transforms	60	0				
		MTM312-3C	Applications of Real Analysis and Integral Transforms	0	120				
		PHM307-3C	Mathematical Physics and Classical Mechanics	60	0				
		PHM308-3C	Atomic, Molecular and Nuclear Physics	60	0				
		PHM309-3C	Physics Practical - V	0	120				
02	Minor (Select any Two)	MBE301-3C	Water Microbiology	30	60	4*2 = 8	50	50	100
		MBE302-3C	Advanced Agriculture Microbiology	30	60				
		CHE303-3C	Chemistry in daily life: Dyes & Drugs	30	60				
		CHE304-3C	Advanced Analytical Techniques-I	30	60				
		MTE307-3C	Probability and Probability Distributions-II	30	60				
		MTE308-3C	Data Analytics and Visualizations	30	60				
		PHE305-3C	Power Electronics	30	60				
		PHE306-3C	Crystal Structure and Nanomaterial synthesis	30	60				

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Sr. no	Component	Course code	Course title	Duration In Hrs.		Credits	Maximum Marks		TOTAL
				Theory	Practical		CCE (Formative)	SEE (Summative)	
03	SEC (Select any One)	SEC311-3C	Virology	30	0	2	25	25	50
		SEC312-3C	Industrial Chemistry-III	30	0				
		SEC313-3C	Non-Destructive Testing	30	0				
		SEC314-3C	Mathematical Logic	30	0				
	Total					22	275	275	550

Note:

1. The marks distribution is mainly divided into two components named Continuous and Comprehensive Evaluation (CCE) = 50 % and Semester End Evaluation (SEE) = 50 %.
2. Passing Percentage for each subject is 36%.

KADI SARVA VISHWAVIDYALAYA

Microbiology Semester V Major Course – 11

MBM301-3C – Microbial Process Technology

COURSE OUTCOMES:

- CO1: Understand the fundamentals of Microbial process, its components and range of fermentation processes.
- CO2: Discuss formulation, sterilization of fermentation media and design optimization of fermentation media.
- CO3: Evaluate and compare methods of isolation, screening, inoculum development and strain improvement.
- CO4: Describe mode and types of fermentation process, design of fermenter /Reactors including measurement and control of process parameters and scale up.
- CO5: Demonstrate the types of fermenter and reactors.
- CO6: Describe and compare strategies for purification of microbial products.

TEACHING AND EVALUATION SCHEME:

Course code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Theory	Hrs.	Max Marks		
					CCE	SEE	
MBM301-3C	Microbial Process Technology	4	4	2.5	50	50	100

Unit 1: Fundamentals of Microbial process technology **Teaching Hours: 15 (Weightage 25%)**

- General concepts of Microbial process technology
- Definition: Upstream process, Downstream process, fermentation
- Components of fermentation technology
- Range of Fermentation processes and major microbial products
- Fermentation media: Characteristics of an ideal fermentation media, Formulation of fermentation media, Raw materials for media preparation.
- Sterilization of media: Batch and Continuous sterilizer, Filter sterilization of media, Sterilization of air and Fermenter
- Optimization of media

Unit 2: Isolation, Screening, Inoculum Development and Strain improvement

Teaching Hours: 15 (Weightage 25%)

- Primary and secondary screening.
- Inoculum development. Bacteria, Mycelial and Yeast
- **Strategies of strain improvement:**
  - Feed Back Inhibition and Regulation
  - Introduction to Mutagenesis and Isolation of Mutant (Auxotrophic, Analogue, Revertant) for overproduction of metabolites
  - Recombinant DNA technology in strain improvement.
  - Strain improvement by modifying properties other than the yield of product

Unit 3: Mode, Types of Fermentation process, Design of Fermenter and Scale up

Teaching Hours: 15 (Weightage 25%)

- Microbial Growth Kinetics
- Modes of fermentation: Batch, Continuous and Fed batch fermentation with kinetics
- Types of fermentations: Solid state and submerge fermentations
- Design of typical batch fermenter: Agitation and aeration devices, Mass transfer of oxygen, Kla and methods of measurement of Kla.
- Measurement and control of process parameters in fermenter: Temperature, pH, Oxygen, CO_2, Pressure.
- Automation: Two Position and Propionate Control, Microprocessor Based Control.
- Fundamentals of Scale up.

Unit 4: Types of fermenter and Reactors, Downstream processes

Teaching Hours: 15 (Weightage 25%)

- Types of fermenter and Reactors: Airlift, Tower, Cylindroconical, Cyclone column, Stirrer Tank, Packed bed reactor, Fluidized Bed reactor
- Separation of microbial cells and suspended solids: Filtration, Centrifugation, Floatation and Flocculation
- Intracellular product recovery: Cell disruption methods
- Concentration of products: Solubilization, solvent extraction, precipitation and distillation
- Purification of products: Crystallization, Chromatography, ultra-filtration, evaporation and drying
- Introduction to Fermentation economics.

***CCE**: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. Principles of Fermentation Technology- Stanbury P.F, Whitaker A and Hall SJ, 2nd edition, Butterworth-Heinemann, Elsevier Science Ltd, UK.
2. Industrial Microbiology- L. E. Cassida, 1st edition, Wiley Eastern Limited, USA.
3. Biotechnology: A Textbook of Industrial Microbiology- Crueger W and Crueger A, 2nd edition, Panima Publishing Corporation, India.
4. Industrial Microbiology: An Introduction. - Waites, M J and Morgan N L. Wiley-Blackwell, USA.
5. Textbook of Industrial Microbiology- A.H. Patel, 1st Edition, MacMillan India Limited Publishing Company Ltd, India.

Suggested Reference Books:

1. Fermentation technology- H.A. Modi, Pointer Publishers, India.
2. Prescott & Dunn's Industrial Microbiology- G. Reed, CBS Publishers & Distributors, India.
3. Industrial Microbiology- Agarwal and Parihar, Agrobios, India
4. Biology of Industrial Microorganisms- A.L. Demain, Benjamin Publishing Company, USA.

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	Course Outcomes	POs/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Understand the fundamentals of Microbial process, its components and range of fermentation processes.	PO1, PO2, PSO1	U, R	C	5
CO2	Discuss formulation, sterilization of fermentation media and design optimization of fermentation media.	PO3, PO4, PO6, PSO1, PSO2	U, R, Ap, C	C, P	10
CO3	Evaluate and compare methods of isolation, screening, inoculum development and strain improvement strategies.	PO3, PO4, PO6, PSO2	U, E, An, C	C, P	15
CO4	Describe mode and types of fermentation process, design of fermenter /Reactors including measurement and control of process parameters and scale up.	PO2, PO3, PO4, PSO2	U, R, Ap, C	C, P	15
CO5	Demonstrate the types of fermenter and reactors.	PO6, PSO1	U, R, An	C	6
CO6	Describe and compare strategies for purification of microbial products.	PO1, PO4, PO7, PSO1, PSO2	U, Ap, An	C, P	9
	Total hour of Instruction				**60**

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	1	2									3	
CO2			3	3		3					3	3
CO3			3	3		3						3
CO4		2		3								3
CO5						3					3	
CO6	1			3			1				3	3

3: High, 2: Medium, 1: Low

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Microbiology Semester V Major Course - 12
MBM302-3C - Recombinant DNA Technology

COURSE OUTCOMES:

- CO1: Understand the concept of R- DNA technology, strategies and tools of genetic engineering.
- CO2: Discuss the mechanism of DNA isolation and steps of constructing gene library.
- CO3: Describe and compare methods of gene transfer in to suitable host cell.
- CO4: Describe the electrophoretic techniques for separation and analysis of DNA.
- CO5: Evaluate and compare genetic engineering techniques for manipulation of DNA.
- CO6: Discuss the applications of genetic engineering; evaluate biosafety, biohazards and ethical issues of genetically modified organisms.

TEACHING AND EVALUATION SCHEME:

Course code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Theory	Hrs.	Max Marks		
					CCE	SEE	
MBM302-3C	Recombinant DNA Technology	4	4	2.5	50	50	100

Unit 1: Basics of R- DNA Technology **Teaching Hours: 15 (Weightage 25%)**

- Introduction to r-DNA technology, Genetic Engineering and Gene cloning
- Strategies of genetic engineering
- Tools of Genetic Engineering
  - Enzymes: Restriction Endonucleases, DNA Ligases, S1 Nucleases, Alkaline Phosphatase, Reverse Transcriptase, Poly Nucleotide Kinase, Polymerases
  - Cloning Vector: Plasmid, λ Phage, phagemids, Cosmid, Yeast as vector, Yeast artificial chromosome (YAC), bacterial artificial chromosome (BAC), Ti and Ri Plasmid.
  - Host cell for cloning: properties of good host, prokaryotic and eukaryotic host cells

Unit 2: Gene Cloning **Teaching Hours: 15 (Weightage 25%)**

- Obtaining desired DNA fragment: Isolation from donor cell – shot gun cloning and construction of genomic library, construction of cDNA library
- Transfer of rDNA in to suitable host cell: Methods of gene transfer
  - Physical methods: Electroporation, Gene gun- particle bombardment, Microinjection- divert transformation, transformation by ultra-sonication -liposome mediated- gene transfer
  - Chemical Methods: Cacl2 mediated gene transfer, PEG mediated gene transfer
  - Biological method: Agrobacterium mediated gene transfer
- Screening of Recombinants: Direct Selection, Insertional inactivation, blue-white selection, and colony hybridization.

Unit 3: Techniques in Genetic engineering **Teaching Hours: 15 (Weightage25%)**

- Electrophoresis
  - Introduction, Principle, Factors affecting electrophoretic mobility.
  - Agarose gel electrophoresis: Principle, steps involved in separation of nucleic acids and applications.
  - Native PAGE, SDS-PAGE: Principle, steps involved in separation of protein and applications.
- Polymerase Chain Reaction-Mechanism and application; limitations ; overview of variants in PCR
- Introduction to Molecular markers: RAPD, RFLP, AFLP
- Hybridization techniques- Southern, Northern, Western blotting technique- Principle, Process and Applications
- DNA sequencing- Maxam and Gilbert Method; Sanger method
- Overview DNA finger printing.

Unit-4: Applications of Genetic Engineering **Teaching Hours: 15 (Weightage25%)**

- Applications of genetic engineering
  - Transgenic microbes; Commercial applications of transgenic microbes in pharmaceutical industry (Insulin and other therapeutic Proteins) and environmental cleanup (Superbug)
  - Transgenic plants (BT cotton, Golden Rice, Transgenic tomato), transgenic animals and their applications
- Recombinant DNA safety guidelines
- Biohazards of genetic engineering
- Ethical issues of genetic engineering

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. Gene Cloning and DNA Analysis, 6th edition- Brown TA, Blackwell Publishing, Oxford, UK.
2. A textbook of Biotechnology- R.C. Dubey, S. Chand, and Co. S. Chand Publishing, India.
3. Genetic Engineering- Sandhya Mitra, McGraw Hill Education, USA.
4. Biotechnology: The Biological Principles, Trevan M. D., Boffey S., Goulding K. H. and Stanbury S., Tata–McGraw Hill, New Delhi– India
5. Biophysical chemistry: Principle and techniques- Upadhyay & Nath, Himalaya Publishing House, India.

Suggested Reference Books:

1. Principles of Microbiology, R. M. Atlas, 2nd Edition (Indian Edition) (2015), McGraw Hill Education (India) Private Limited –New Delhi
2. Biotechnology- U. Satyanarayana, 1st Edition, Books & Allied Ltd, India.
3. Cell Biology, Genetics, Molecular biology, Evolution and Ecology- Verma and Agrawal. - S. Chand Publishing, India
4. Biotechnology- S.S.Purohit. Agrobios, India.
5. Genomics: Applications in human biology- Primrose SB and Twyman RM. Blackwell Publishing, Oxford, UK.

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	Course Outcomes	POs/ PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Understand the concept of R- DNA technology, strategies and tools of genetic engineering.	PO1, PO7, PSO1	U, R	C	15
CO2	Discuss the mechanism of DNA isolation and steps of constructing gene library.	PO1, PO6, PSO1, PSO2	U, C	C, P	6
CO3	Describe and compare methods of gene transfer in to suitable host cell.	PO1, PO2, PO3, PSO1, PSO2	U, R, An	C, P	9
CO4	Describe and demonstrate the electrophoretic techniques for separation and analysis of DNA.	PO1, PO6, PSO1, PSO2	U, R, Ap	C, P	7
CO5	Evaluate and compare genetic engineering techniques for manipulation of DNA.	PO1, PO2, PO3, PSO1, PSO2	U, E, An	C, P	8
CO6	Discuss the applications of genetic engineering, evaluate biosafety, biohazards and ethical issues of genetically modified organisms.	PO1, PO3, PO8, PO9, PO10, PSO1, PSO2	U, Ap, E,	C, P	15
	Total hour of Instruction				**60**

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3						2				3	
CO2	3					1					3	3
CO3	3	2	3								3	3
CO4	3					1					3	3
CO5	3	2	3								3	3
CO6	3		3					2	2	2	3	3

3: High, 2: Medium, 1: Low

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Microbiology Semester V Major Course -13

MBM303-3C – Microbiology Practical V

COURSE OUTCOMES:

- CO1: Develop skills to isolate and screen industrially important soil microorganisms for antibiotic, enzyme, and organic acid production.
- CO2: Analyze antimicrobial potential of antibiotic-producing microbes. bioassay and quantification of antibiotic.
- CO3: Develop expertise in extracting microbial pigments and determining their λ max.
- CO4: Determine the Oxygen Transfer Rate (OTR) essential for optimizing bioprocesses using the sodium sulphite method.
- CO5: Develop proficiency in the isolation, purification, and quantitative analysis of nucleic acids and analyze (molecular characterization) nucleic acids and protein using electrophoretic techniques.
- CO6: Demonstrate and apply gene cloning steps for genetic manipulation.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Practical	Hrs.	Max Marks CCE	Max Marks SEE	
MBM303-3C	Microbiology Practical 5	4	8	5	50	50	100

Practicals **Teaching Hours: 60 (Weightage 50%)**

1. Screening for antibiotic producer from soil sample: Crowded plate and Wilkins method.
2. Screening for Amylase producer from soil sample.
3. Screening for Protease producer from soil sample.
4. Screening for Lipase producer from soil sample.
5. Screening for organic acid producer from soil sample.
6. Determination of Antimicrobial spectrum of Antibiotic producer.
7. Estimation of streptomycin by sodium nitroprusside method.
8. Extraction of Pigment from *Pseudomonas and Serratia* and determination of their λ max.
9. Bioassay of Penicillin.
10. Determination of Oxygen Transfer Rate (OTR) under static, sparing and shaking condition by sodium sulphite method.

Practicals **Teaching Hours: 60 (Weightage 50%)**

11. Isolation of Plasmid DNA.
12. Isolation of Plant DNA.

13. Total RNA isolation.
14. DNA and RNA Purity check using UV spectroscopy.
15. Quantitative analysis of DNA using UV-Visible spectroscopy.
16. Quantitative analysis of RNA using UV-Visible spectroscopy.
17. Agarose gel Electrophoresis- Demonstration.
18. SDS-PAGE- Demonstration.
19. Restriction digestion of DNA- Demonstration.
20. Ligation of DNA fragments- Demonstration.
21. Transformation and selection of recombinants- Demonstration

***CCE**: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. Experimental Microbiology- Patel R.J. and Patel R.K., Volume I and II, 9th Edition, Aditya Publisher, India.
2. Cell and Molecular Biology: A lab manual- K.V. Chaitanya, PHI Learning Pvt. Ltd., India.
3. Dubey R. C. and Maheshwari D. K, Practical Microbiology. S. Chand and Company Limited, New Delhi, India

Suggested Reference Books:

1. Molecular Cloning-A Laboratory Manual. 3rd edition Sambrook J and Russell D. (2001). Cold Spring Harbor Laboratory Press, USA.
2. Current Protocols in Molecular Biology by Frederick M. Ausubel et al. – Wiley, USA.
3. Microbiology: A Laboratory Manual- James G. Cappuccino and Chad Wels, 11th Edition, Global edition, Pearson Education, USA.

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	Course Outcomes	POs/ PSOs	CL Cognitive level	Knowledge Category	Lab Session
CO1	Develop skills to isolate and screen industrially important soil microorganisms for antibiotic, enzyme, and organic acid production.	PO1, PO3, PO6, PSO1, PSO2	U, C	C, P	30
CO2	Analyze antimicrobial potential of antibiotic-producing microbes, bioassay and quantification of antibiotic.	PO2, PO4, PO6, PSO1, PSO2	U, An	C, P	18
CO3	Develop expertise in extracting microbial pigments and determining their λ max.	PO1, PO7, PSO2	Ap, C	P	6
CO4	Determine the Oxygen Transfer Rate (OTR) essential for optimizing bioprocesses using the Sodium sulphite method.	PO3, PO6, PO7, PSO2	Ap, An	P	12
CO5	Develop proficiency in the isolation, purification, and quantification of nucleic acids and analyze nucleic acids and protein using electrophoresis.	PO1, PO6, PO7, PSO1, PSO2	U, An, C	C, P	36
CO6	Demonstrate and apply gene cloning steps for genetic manipulation.	PO2, PO4, PO8, PSO1, PSO2	U, Ap	C, P	18
	Total hour of Instruction				**120**

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3		2			3					3	3
CO2		2		2		3					3	3
CO3	3						3					3
CO4			2			3	3					3
CO5	3					3	3				3	3
CO6		2		2				1			3	3

3: High, 2: Medium, 1: Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Major Course

CHM304-3C INORGANIC AND ANALYTICAL CHEMISTRY - III

Course Outcomes:

- CO1: Describe and classify molecules based on symmetry operations, elements, and point groups.
- CO2: Apply group theory concepts to predict molecular properties.
- CO3: Examine the bonding, structure, reactivity and applications of organo metallic compounds.
- CO4: Discuss the various separation techniques for the analysis of drugs.
- CO5: Apply analytical skills for identification and quantification of drugs
- CO6: Examine problems in biochemistry with modern analytical techniques.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Practical hrs Per Week			CCE	SEE	
CHM304-3C	Inorganic and Analytical Chemistry-III	4	0	4	2.5	50	50	100

CONTENT:

UNIT	
1	**Molecular Symmetry** **Teaching Hours:15(Weightage 25%)** Introduction: Importance of symmetry in structural analysis, spectroscopy and bonding. Symmetry Operations and Elements: Types of operations (E, Cn, σ, i, Sn) with examples of molecules. Point Groups: Classification of molecules into point groups (excluding $S_{2n}$and I_h) using flowcharts or examples. Groups and Characteristics: Definitionand characteristics of groups; concept of subgroups. Matrix Representation: Matrix forms of symmetry operations (E, Cn, σ, i, Sn) and combining rules with examples. Multiplication Tables: Construction and interpretation for point groups (C_{3v},C_{2h},C_{3v}).
2	**Organo metallic Compounds** **TeachingHours:15(Weightage25%)** Introduction: Definition, significance, historical development, and applications in catalysis, synthesis and materials science. Classification: By metal-carbon bonds (ionic, σ, π) and metaloxidationstates. Nomenclature: IUPAC guidelines with examples. Types of Bonds: σ-bonds: Alkyls, aryls, π-bonds: Alkenes, alkynes, aromatics. EAN and 18-Electron Rule: Concepts and applications with examples. Structure and Bonding: Metal-olefin complexes (e.g., Ziese's salt). Dihepto complexes and metallocenes (e.g.,ferrocene). **Main Group Organo metallics**:Lithium, aluminum and beryllium Compound.

3	**Chromatographic Techniques-1** **TeachingHours:15(Weightage25%)** **Thin Layer Chromatography (TLC)**–Introduction and Principle of Thin Layer Chromatography (TLC), Working methodology, Mobile phase, Stationary phase, Normal phase and Reverse phase, Retention factor ($R_f$value) and factors affecting $R_f$value, Visualization method (UV-Chamber), Staining solutions (Iodine vapours, Ninhydrin solution), Applications and Numerical. **Ion Exchange Chromatography-** Introduction to Ion exchange, Classification (Types of ion exchangers), Types of resin and its properties, Ion exchange mechanism, factors affecting Ion exchange, methodology, applications.
4	**Chromatographic Techniques-2** **TeachingHours:15(Weightage25%)** **High Performance Thin Layer Chromatography (HPTLC)-** Principle and instrumentation of High Performance Thin Layer Chromatography (HPTLC), and Advantages of HPTLC technique. **High Performance Liquid Chromatography (HPLC)**– Introduction, Principle and Instrumentation of High Performance Liquid Chromatography (HPLC), Injector (Syringe, Stop-flow, solvent flowing), Pump (Displacement, Reciprocating and Pneumatic), Column (Preparative column), Detector (Ultraviolet, Refractive index, Fluorescence) Elution systems-Isocratic and Gradient, Chromatogram, Resolution, Retention time, Dead time, Dead volume, Column efficiency, Applications and Numerical.

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations / Quizzes / Surprise Tests.

***SEE:** Semester End Evaluation

REFERENCEBOOKS

- Advanced inorganic chemistry by Cotton and Wilkinson
- Chemical applications of Group theory by F.A.Cotton
- Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey ,Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi
- Principles of inorganic chemistry, Puri, Sharma & Kalia
- AdvancedIn organic Chemistry by G.D. Tuli, Madan, Basu and Satyaprakash
- Advance Inorganic Chemistry Vol-II Satya Prakash (S.Chand) Concise Inorganic chemistry by J. D. Lee.
- Basic concepts of Analytical Chemistry, SMK hopkar, New Age International Publications.
- Principals of Instrumental Analysis, D.A.Skoog, F. James Holler, and TimothyA. Nieman, 5th edition, Eastern press.
- Pharmaceutical Analysis, Volume-II, Dr.A.V.Kasture, Dr.K.R. Mahadik, Dr.S.G. Wadodkar, Dr. H.N. More, NiraliPrakshan.

SUGGESTEDBOOKS:

- Gurdeep and Raj–Inorganic Chemistry
- Valency and Molecular structure by Cartmell and Fowles.
- Textbook of Inorganic Chemistry by Durrant and Durrant.
- Advanced Inorganic Chemistry by G.D.Tuli,Madan, Basu and Satyaprakash

- Advance Inorganic Chemistry Vol-II Satya Prakash(S.Chand) Concise Inorganic Chemistry by J.D. Lee.
- Instrumental methods of chemical analysis (Analytical Chemistry), Dr.H. Kaur, Pragati Prakashan.
- Instrumental methods of chemical analysis (AnalyticalChemistry), Dr.H.Kaur, Pragati Prakashan.
- Pharmaceutical Analysis - II: Instrumental Methods, P.C.Kamboj, Vallabh Publication.

CO	Course Outcome	POs/PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Describe and classify molecules based on symmetry operations, elements, and point groups.	PO1,PO2, PSO1	U,R	C	05
CO2	Apply group theory concepts to predict molecular properties.	PO2,PO3, PSO1	U,R,Ap	C,P	10
CO3	Examine the bonding, structure, reactivity and applications of organo metallic compounds	PO1, PO2, PO3,PSO1, PSO2	U, Ap,An	C,P	15
CO4	Discuss the various separation techniques for the analysis of drugs.	PO1,PSO1	U,R	C	08
CO5	Apply analytical skills for identification and quantification of Drugs	PO2,PO3, PSO1	U, Ap,An	C,P	15
CO6	Examine problems in biochemistry with modern analytical techniques.	PO2, PO3, PSO1,PSO2	E,Ap	C,P	07
Total Hours of Instructions					60

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3									3	
CO2		3	3								3	
CO3	3	3	3								3	2
CO4	3										3	
CO5		3	3								3	
CO6		3	3								3	2

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Major Course

CHM305-3C ORGANIC AND PHYSICAL CHEMISTRY - III

Course Outcomes:

- CO1: Explain the concept of Stereochemistry
- CO2: Identify the three dimensional arrangement of at omsi molecules and the effect of this behavior on chemical properties.
- CO3: Discuss the synthesis and properties of Benzene and its derivatives and their significance in the industry.
- CO4: Describe the advance concepts of bonding in solids and their electronic structure.
- CO5:Identify types of defects and conductivity in solids
- CO6: Discuss Chemical Kinetics and the theories related to it.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Practical hrs Per Week			CCE	SEE	
CHM305-3C	Organic and Physical Chemistry- III	4	0	4	2.5	50	50	100

CONTENT:

UNIT	
1	**Stereochemistry** **TeachingHours:15(Weightage25%)** Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions. Geometrical isomerism: cis–trans and syn-anti isomerism, E/Z notations with Cahn Ingold and Prelog (CIP) rules for determining absolute configuration. Optical Isomerism: Optical Activity, SpecificRotation,Chirality/Asymmetry,Enantiomers,Moleculeswithtwoormorechiral-centers, Diastereoisomers, Meso structures, Racemic mixture. Resolution of Racemic mixtures. Relative andabsoluteconfiguration:D/LandR/S designations.
2	**Benzene and its Derivatives** **TeachingHours:15(Weightage25%)** Nomenclature of aromatic compounds, Preparation, Physical properties, Chemical Properties (reactions) of Benzene, Toluene. (No mechanism) Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation / acylation with their mechanism. Directing effects of the groups, determination of orientation, classification of substituent groups.

	Polynuclear Aromatic Compounds, Preparation, Physical properties,Chemical Properties (reactions) of Naphthalene, Anthracene & Phenanthrene. (No mechanism)
3	**Solid State Chemistry** **TeachingHours:15(Weightage25%)** Introduction, bonding in solids and electronic structure in solids, band theory- Metals semiconductors and insulators, defects in crystals, calculation of Schottky and Frenkel defects using statistical method, solid electrolytes, diffusion in solids, electrical conductivity in solids, super conductivity, perovskites.
4	**Chemical Kinetics** **TeachingHours:15(Weightage25%)** Introduction, Concept of Activation energy, Effect of temperature on rate of reaction, Arrhenius equation (No derivation), Theories of reaction rate -Collision theory & Transition state theory, Comparison of collision and transition state theory, Theories of Unimolecular reaction Lindemann'stheory, Trimolecular reaction, Trautz'sLaw, Primarysalt effect andSecondarysalt effect. Numerical

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations /Quizzes / Surprise Tests.

***SEE:** Semester End Evaluation

REFERENCEBOOKS

- Morrison,R.N.&Boyd,R.N.,OrganicChemistry.DorlingKindersley(India)Pvt.Ltd. (Pearson Education).
- I.L. Finar: Organic Chemistry (Vol.I&II), E.L.B.S
- Advance Organic Chemistry by Jerry March.
- Physical Chemistry, P.W. Atkins, Oxford University Press
- Principles of the Solid State,H.V. Keer, Wiley Eastern
- Physical Chemistry by K.L. Kapoor

SUGGESTEDBOOKS

- O.P.Agrawal, Synthetic Organic Chemistry, Krishna Prakashan Media.
- Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition,S. Chand Publisher.
- Dhawan, S.N.,Pradeep's Organic Chemistry ,(Vol.IandII), Pradeep Publications.
- Mehta & Mehta, Organic Chemistry, PHI Learning Private Limited.
- Organic Chemistry Vol.I & II by S.M. Mukherji, S.P.Sing R.P.Kapoor.
- Chemical Kinetics, K.J. Laidler, Mc Graw Hill
- Kinetics and Mechanism, A.A. Frost and R.G.Pearson, John Wiley and Sons
- Physical Chemistry,G.W.Castellan, Narosa
- Concepts of Modern Catalysis and Kinetics, I. Chorkendorff and J.W. Niemants verdriet
- Solid State Physics,C. Kittel, John Wiley.
- Solid State Physics by NeilW. Ashcroft and N.DavidMermin
- The Physics of Solar Cells (Properties of Semiconductor Materials) by Jenny Nelson.

KADI SARVA VISHWAVIDYALAYA

CO	Course Outcome	POs/PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Explain the concept of Stereochemistry	PO1,PSO1	R,U	C	05
CO2	Identify the three dimensional arrangement of atoms in molecules And the effect of this behavior on chemical properties.	PO2,PSO1, PSO2	U, Ap,An	C,P	10
CO3	Discuss the synthesis and properties of Benzene and its derivatives and their Significance in the industry.	PO1,PO2, PSO1	R,U	C	15
CO4	Describe the advance concepts of bonding in solids and their electronic structure.	PO1,PO2, PSO1	R,U,An	C,P	10
CO5	Identify types of defects and conductivity in solids.	PO2,PSO1	R,U,An	C	05
CO6	Discuss Chemical Kinetics and the theories related to it.	PO1,PO2,PO3, PSO1	U,Ap	C,P	15
Total Hours of Instructions					60

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3										3	
CO2		3									3	2
CO3	3	3									3	
CO4	3	3									3	
CO5		3									3	
CO6	3	3	2								3	

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Major Course

CHM306-3C CHEMISTRY PRACTICALS - V

Course Outcomes :

- CO1:Perform synthesis of coordination and organometallic complexes of transition metals,demonstrating an understanding of reaction stoichiometry and ligand behavior.
- CO2:Apply chromatographic techniques to separate and identify inorganic ions, organic molecules, dyes, and bioactive substances, calculating retention factors (Rf values) accurately.
- CO3:Execute gravimetric analysis techniques to determine metallic and non-metallic components.
- CO4: Apply Thin Layer Chromatography (TLC) and ion-exchange chromatography to identify compounds in pharmaceutical and biological samples.
- CO5: Utilize Crystallization and Chromatography techniques for purification and isolation of individual components from mixtures.
- CO6: Analyze and solve practical chemistry problems through hands- on experimentation and numerical exercises, fostering critical thinking and data interpretation skills.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
						Max Marks		
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	CCE	SEE	
CHM306-3C	Chemistry Practicals-V	0	8	4	5	50	50	100

Contents:

Practicals: **Practical Hrs60 (Weightage50%)**

A. Inorganic Preparations.(Minimum8)

1. Preparationofacetylacetanatocomplexesof$Cu^{+2}Fe^{+3}$.
2. Synthesis of ammine complexes of Ni (II) and its lig and exchange reactions (e.g.bidentate ligands like acetylacetone, DMG, glycine) by substitution method.
3. Synthesis of copper (II) tetraamine sulfate.
4. Preparation of chromium (III) chloride complex.
5. Synthesis of $Ni(CO)_4$
6. Preparation of Cuprous Chloride.
7. Preparation of Hexathiourea Plumbous Nitrate.
8. Preparation of Tris-Thiourea Copper Sulphatedi-hydrate.
9. Preparation of Hexamine Cobalt Chloride.
10. Preparation of Prussianblue.
11. Preparation of Sodium Perborate.

B. Paper Chromatography.(Any-2)

1. Separation of Inorganic Radicals by using Paper Chromatography.

C.Gravimetric Analysis: (Any2)

1. Determination of aluminium as aluminum oxide.
2. Determination of sulphate ions as barium sulphate.
3. Determination of copper and nickel involving gravimetric methods.
4. Determination of copper and barium involving volumetric and gravimetric methods.

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List of Practicals **PracticalHrs60(Weightage50%)**

D. Analytical Chemistry Practicals (Minimum10)

1. To determine Aspirin from the given unknown drug using TLC.
2. To determine Paracetamol from the given unknown drug using TLC.
3. To determine Amino acid from the given unknown mixture sample using TLC or paper chromatography.
4. SeparationandPurificationoforganicmixturebyextractiontechniqueusingcolumn chromatography. **(at least 2 practical)**
5. Separation of constituents of a mixture of Red and Blue inks (OR any dye mixture) by Paper Chromatography.
6. A study of food colors by Paper Chromatography (Calculate R_f value).
7. To separate the plant pigments by using column chromatography.
8. Separation and Purification of binary organic mixture by Column chromatograph
9. Separation of a mixture of potassium permanganate and potassium dichromate by Column Chromatography.
10. Separate and estimate the amount of nickel and zinc from the given mixture using ion-excahnge chromatography.
11. Separation and purification of organic compounds by crystallization technique. Calculate the R_f value.
12. Conceptual numerical problems / exercises **(Compulsory-Minimum3)**
13. Demonstration of 2-Dseparation of binary mixture using TLC technique.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations / Quizzes /Surprise Tests.

*SEE: Semester End Evaluation

REFERENCEBOOKS

- Mendham,J.,A.I.Vogel'sQuantitativeChemicalAnalysis6th Ed., Pearson, 2009.
- Vogel's qualitative inorganic analysis, 7th edition, textbook of practical chemistry.
- AdvancedPracticalChemistrybyJagdambaSingh,R.K.P.Singh,JayaSingh,LDSYadav, I.R. Siddiqui, Jaya Shrivastava
- Vogel's Textbook of Quantitative Chemical Analysis byA.I. Vogel.
- Practical Pharmaceutical Chemistry byA.H.Beckettand J.B. Stenlake.
- Quantitative Analysis of Drugs byD.C.Garrett.

SUGGESTED BOOKS

- Marr & Rockett Practical Inorganic Chemistry. John Wiley & Sons 1972.
- Advanced Inorganic Analysis by Agrawal Keemtilal, Pragati Additions
- Practical Physical Chemistry by B. Vishwanathan and P.S.Ragvan
- Advanced Physical Chemistry Experiments by Gurtu-Gurtu Pragati Additions
- Textbook of Organic Chemistry by Parashar and Ahluvalia
- Comprehensive Practical Organic Chemistry by K Ahluwalia and Renu Aggarwal
- Quantitative Analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi.
- Pharmaceutical Analysis - II. Instrumental Methods by P.C. Kamboj, Vallabh Publication.

KADI SARVA VISHWAVIDYALAYA

CO	CourseOutcome	POs/PSOs	Cognitive Level	Knowledge Category	Class Session
CO1	Perform synthesis of coordination and organometallic complexes of transitionmetals, demonstrating an understanding of reaction stoichiometry and ligand behavior.	PO1, PO4, PSO1,PSO2	U,Ap,An	P	22
CO2	Apply chromatographic techniques to separate and identify inorganic ions, organic molecules, dyes, and Bioactive substances, calculating retention factors (Rf values) accurately.	PO1,PO2, PO4,PSO2	U,Ap,An	C, P	18
CO3	Execute gravimetric analysis techniques to determine metallic and non-metallic components.	PO1,PO2, PSO2	U,Ap	P	20
CO4	Apply Thin Layer Chromatography(TLC) and ion-exchange chromatography to identify compounds in Pharmaceutical and biological samples.	PO1, PO4, PO6,PSO2	Ap,An	C, P	18
CO5	Utilize Crystallization and Chromatography techniques for purification and isolation of Individual components from mixtures.	PO1, PO2, PO6,PSO2	Ap,An	C, P	20
CO6	Analyze and solve practical chemistry problems through hands-on experimentation and numerical exercises, fostering critical thinking and data interpretation skills.	PO2, PO3, PO6,PSO1, PSO2	E,An	P	22
Total Hours of Instructions					**120**

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3			3							2	3
CO2	3	3		3								3
CO3	3	3										3
CO4	3			3		3						3
CO5	3	3				3					2	3
CO6		3	1			3						3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V – Major Course

MTM310-3C Real Analysis

Course Outcomes:

- **CO1:** Explain the field and order structure of real numbers and distinguish between bounded and unbounded sets.
- **CO2:** Interpret the concepts of supremum, infimum, and completeness properties including Archimedean and Dedekind completeness.
- **CO3:** Apply convergence theorems and analyze properties of bounded, monotonic, and Cauchy sequences.
- **CO4:** Apply standard convergence tests to evaluate infinite series and determine absolute convergence and radius of convergence.
- **CO5:** Analyze topological notions like open/closed sets, closure, interior, exterior, and boundary in metric spaces.
- **CO6:** Examine the properties of convergence and completeness in metric spaces including dense sets and complete metric spaces.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM310-3C	Real Analysis	4	4	2.5	50	50	100

Unit 1 Boundedness and Completeness of a Set — **Teaching Hours: 15**

Set, Relation, Function, Field structure, Order structure, Bounded and Unbounded sets, Supremum & Infimum, Completeness & Order Completeness in R, Archimedean property of real numbers, Dedekind form of completeness property, Absolute value of a real number.

Unit 2 Sequences — **Teaching Hours: 15**

Sequences, Bounded sequence, Limit point of sequence, Convergence of sequence, Cauchy sequence, Theorems on bounded sequence, Sandwich theorem, Cauchy's first theorem on limits, Cauchy's Second theorem on limits, Monotonic sequence, Subsequence.

Unit 3 Series — **Teaching Hours: 15**

Series, Positive term series, Geometric series, Convergence of a series, Addition and multiplication of series, Comparison test, Limit comparison test, Cauchy's root test, D'Alembert's ratio test, Alternating series, Absolute convergence, Power series, Radius of convergence.

Unit 4 Metric Space **Teaching Hours: 15**

Definition of Metric space, Open and closed spheres, Neighborhood of a point, Open set, Limit point of a set, Closed set, Subspaces, Closure of a set and its properties, Interior of a set and its properties, Exterior of a set and its properties Frontier and Boundary of a set and its properties, Dense set, Convergence and completeness, Complete Metric space.

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*SEE: Semester End Evaluation

Reference Books:

1. "Mathematical Analysis", S.C. Malik, Savita Arora, New Age International (P) Limited, Publishers, 5th Edition.
2. "Principles of Mathematical Analysis", Tom M. Apostol, 2nd Edition
3. "Principles of Mathematical Analysis", Walter Rudin, McGraw Hill (International Student Edition), 3rd Edition.
4. "A First Course in Mathematical Analysis", D. Somasundaram & B. Choudhary, Narosa Publishing House
5. "Fundamentals of Mathematical Analysis", G. Das & S. Pattnayak Tata Mcgraw Hill Pub. Co
6. "Fundamental of Real Analysis", S. L. Gupta & Nisha Rani, Vikas Pub. House Pvt. Ltd. New Delhi.
7. "Real Analysis", N. P. Bali, Golden Maths Series, Laxmi Publications (P) Limited.

KADI SARVA VISHWAVIDYALAYA

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Explain the field and order structure of real numbers and distinguish between bounded and unbounded sets.	PO1, PO2, PSO1	R, U	C	10
CO2	Interpret the concepts of supremum, infimum, and completeness properties including Archimedean and Dedekind completeness.	PO1, PO2, PSO1	R, U	C	5
CO3	Apply convergence theorems and analyze properties of bounded, monotonic, and Cauchy sequences.	PO1, PO2, PO4, PSO1	Ap, An	C, P	15
CO4	Apply standard convergence tests and determine absolute convergence and radius of convergence.	PO1, PO2, PO4, PO6, PSO1, PSO2	Ap, E	P	15
CO5	Analyze open sets, closed sets, closure, interior, exterior, and boundary in metric spaces.	PO1, PO2, PO4, PSO1, PSO2	An	C, P	8
CO6	Examine the properties of convergence and completeness in metric spaces including dense sets and complete metric spaces	PO1, PO2, PSO1, PSO2	An	C, P	7
Total hours of instruction					**60**

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	0	0	0	0	0	0	0	0	3	0
CO2	3	3	0	0	0	0	0	0	0	0	3	0
CO3	3	3	0	3	0	0	0	0	0	0	3	0
CO4	3	3	0	3	0	2	0	0	0	0	3	3
CO5	3	3	0	3	0	0	0	0	0	0	3	3
CO6	3	3	0	0	0	0	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V - Major Course

MTM311-3C Integral Transforms

Course Outcomes:

- **CO1:** Define and prove Laplace transform properties
- **CO2:** Define and Calculate the inverse Laplace transform of rational functions.
- **CO3:** Solve differential equations via Laplace methods.
- **CO4:** Define and use Fourier series to represent periodic functions given the interval $[-\pi,\pi]$ by correctly computing all nonzero Fourier coefficients functions with coefficient errors $\leq 5\%$
- **CO5:** Apply Fourier sine, cosine, and complex transforms and the Convolution Theorem.
- **CO6:** Apply the inversion theorems for Fourier transforms given frequency domain expressions by recovering the original time domain functions with point wise accuracy of at least 90% on a prescribed test set.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM311-3C	Integral Transforms	4	4	2.5	50	50	100

Unit 1 Laplace Transform **Teaching Hours: 15** Definition and properties of Laplace transform, Rules of shifting, scale property, examples based on properties, Laplace transforms of derivatives and integrals.
Unit 2 Inverse Laplace Transform **Teaching Hours: 15** Null function, Properties of inverse Laplace transform, Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Complex inversion formula.
Unit 3 Fourier Series **Teaching Hours: 15** Dirichlet's conditions, Advantages of Fourier series, Useful integrals, Determination of Fourier constants (Euler's formulas), Functions defined in two or more sub-ranges, , Even functions, Perceval's formula.
Unit 4 Fourier Transform **Teaching Hours: 15** Definition and properties of Fourier sine, cosine and complex transforms, Convolution theorem, Inversion theorems,Fourier transform of derivatives.

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*SEE: Semester End Evaluation

Reference Books:

1. "Integral Transforms and Their Applications", Brian Davies 3rd edition Springer Publication.
2. "Integral Transforms for Engineers" Larry C Andrews, Bhimsen K. Shivamoggi, published by SPIER – The International Society for Optical Engineering.
3. "Applied Integral Transforms" M. Ya. Antimirov, A. A. Kolyshkin, Remi Vaillancourt. Published by American Mathematical Society.
4. "Advanced Engineering Mathematics", H. K. Dass, S. Chand & Company Pvt. Ltd.
5. "Integral Transforms", A. R. Vasishtha, R. K. Gupta, Krishna Prakashan.

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Define and Prove Laplace Transform Properties	PO1, PO2, PO3, PSO1	R, U	C, P	15
CO2	Define and Calculate the inverse Laplace transform of rational functions	PO1, PO2, PO3, PO6, PSO1, PSO2	R, U, E	C, P	8
CO3	Solve Differential Equations via Laplace Methods	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap, E	C, P	7
CO4	Define and use Fourier series to represent periodic functions given the interval $[-\pi,\pi]$ by correctly computing all nonzero Fourier coefficients with coefficient errors $\leq 5\%$	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	R, U, E, An	C, P	15
CO5	Apply Fourier sine, cosine, and complex transforms and the Convolution Theorem.	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	R, U, Ap	C, P	8
CO6	Apply the inversion theorems for Fourier transforms given frequency domain expressions by recovering the original time domain functions with point wise accuracy of at least **90%** on a prescribed test set.	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	R, U, Ap	C, P	7
Total hours of instruction					**60**

KADI SARVA VISHWAVIDYALAYA

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	3	0	0	0	0	0	0	0	3	0
CO2	3	3	3	0	0	3	0	0	0	0	3	3
CO3	3	3	3	0	0	3	0	0	0	0	3	3
CO4	3	3	3	3	0	3	0	0	0	0	3	3
CO5	3	3	3	3	0	3	0	0	0	0	3	3
CO6	3	3	3	3	0	3	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V – Major Course

MTM312-3C Applications of Real Analysis and Integral Transforms

Course Outcomes:

- **CO1**:Identify and classify the convergence behavior of real sequences using limit concepts and related theorems when given theoretical examples.
- **CO2**:Apply comparison tests, Cauchy's root test, and D'Alembert's ratio test for evaluating the convergence of series.
- **CO3**:Analyze alternating series and determine the radius of convergence of power series using appropriate tests.
- **CO4**:Interpret the concepts of metric spaces and limit points of sets through geometric and analytical examples.
- **CO5**:Solve ordinary and partial differential equations using Laplace transforms in real-world contexts such as electrical circuits and mechanics.
- **CO6**:Construct Fourier series and Fourier sine/complex transforms for piecewise continuous functions over specified intervals.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Practical Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM312-3C	Applications of Real Analysis and Integral Transforms	8	4	5	50	50	100

Unit 1 Applications of Real Analysis **Teaching Hours: 60**

1. Examples on finding limit point of a sequence.
2. Examples to determine given sequence is convergent or divergent.
3. Examples on Sandwich theorem.
4. Examples on Cauchy's first theorem on limits.
5. Examples on Cauchy's Second theorem on limits.
6. Examples on Comparison test.
7. Examples on Limit comparison test.
8. Examples on Cauchy's root test.
9. Examples on D'Alembert's ratio test.
10. Examples on alternating series and Radius of convergence.
11. Examples on Metric space and limit point of a set.

Unit 2 Applications of Integral Transforms **Teaching Hours: 60**

1. Application of Laplace transform to solve Ordinary differential equations with constant coefficients.
2. Application of Laplace transform to solve Ordinary differential equations with variable coefficients.
3. Application of Laplace transform to solve Partial differential equations.
4. Application of Laplace transform to Electrical circuits.
5. Application of Laplace transform to Mechanics.
6. Application of Laplace transform to Integral equations.
7. Examples based on finding Fourier series corresponding to given function.
8. Examples based on Fourier complex transforms.
9. Examples based on Fourier sine transforms.

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***SEE:** Semester End Evaluation

Reference Books:

1. "Mathematical Analysis", S.C. Malik, Savita Arora, New Age International (P) Limited, Publishers, 5th Edition.
2. "Principles of Mathematical Analysis", Tom M. Apostol, 2nd Edition
3. "Principles of Mathematical Analysis", Walter Rudin, McGraw Hill (International Student Edition), 3rd Edition.
4. "A First Course in Mathematical Analysis", D. Somasundaram & B. Choudhary, Narosa Publishing House
5. "Fundamentals of Mathematical Analysis", G. Das & S. Pattnayak Tata Mcgraw Hill Pub. Co
6. "Fundamental of Real Analysis", S.L. Gupta & Nisha Rani, Vikas Pub. House Pvt. Ltd. New Delhi.
7. "Integral Transforms and Their Applications", Brian Davies 3rd edition Springer Publication.
8. "Integral Transforms for Engineers" Larry C Andrews, Bhimsen K. Shivamoggi, published by SPIER – The International Society for Optical Engineering.
9. "Applied Integral Transforms" M. Ya. Antimirov, A. A. Kolyshkin, Remi Vaillancourt.Published by American Mathematical Society.
10. "Advanced Engineering Mathematics", H. K. Dass, S. Chand & Company Pvt. Ltd.
11. "Real Analysis", N.P. Bali, Golden Maths Series, Laxmi Publications (P) Limited.
12. "Integral Transforms", A. R. Vasishtha, R. K. Gupta, Krishna Prakashan.

KADI SARVA VISHWAVIDYALAYA

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Identify and classify the convergence behavior of real sequences using limit concepts and related theorems when given theoretical examples.	PO1, PO2, PO6, PSO1,	U, An	C	15
CO2	Apply comparison tests, Cauchy's root test, and D'Alembert's ratio test for evaluating the convergence of series.	PO1, PO2, PO3, PO4, PSO1, PSO2	AP	C, P	15
CO3	Analyze alternating series and determine the radius of convergence of power series using appropriate tests.	PO1, PO2, PO3, PO4, PSO1, PSO2	An, E	C, P	15
CO4	Interpret the concepts of metric spaces and limit points of sets through geometric and analytical examples.	PO1, PO2, PO6, PSO1, PSO2	R, U	C	15
CO5	Solve ordinary and partial differential equations using Laplace transforms in real-world contexts such as electrical circuits and mechanics.	PO1, PO2, PO3, PO4, PO6, PO7, PSO1	Ap, E	C, P	36
CO6	Construct Fourier series and Fourier sine/complex transforms for piecewise continuous functions over specified intervals.	PO1, PO2, PO3, PO4, PO7, PSO1, PSO2	Ap	P	24
Total hours of instruction					**120**

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	0	0	0	3	0	0	0	0	3	0
CO2	3	3	3	3	0	0	0	0	0	0	3	3
CO3	3	3	3	3	0	0	0	0	0	0	3	3
CO4	3	3	0	0	0	3	0	0	0	0	3	3
CO5	3	3	3	3	0	3	3	0	0	0	3	0
CO6	3	3	3	3	0	0	3	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Major Course

PHM307-3C Mathematical Physics and Classical Mechanics

COURSEOUTCOMES:

- **CO1:** Apply techniques of single, double, and triple integrals to solve problems involving area, volume, and surface integrals, including transformation of variables using Jacobians.
- **CO2:** Solve first and second order ordinary differential equations using standard analytical methods and interpret the physical significance of the solutions.
- **CO3:**Analyze mechanical systems using generalized coordinates and derive equations of motion using Lagrange's formulation for systems with constraints.
- **CO4:** Utilize principles of symmetry and conservation laws in classical mechanics to simplify and solve complex physical systems.
- **CO5:** Understand and apply the variational principles, particularly Hamilton's principle, to derive equations of motion and compare Lagrangian and Newtonian approaches.
- **CO6:** Develop and solve Hamiltonian formulations for classical systems, and demonstrate proficiency in applying both Lagrangian and Hamiltonian mechanics to practical and theoretical problems.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	ExaminationScheme			Total Marks
		Theory PerWeek		Hrs.	MaxMarks		
					CCE	SEE	
PHM307-3C	Mathematical Physics and Classical Mechanics	4	4	2.5	50	50	100

Unit 1: Mathematical Physics: Multiple Integrals **Teaching Hours: 15 (Weightage 25%)**

Double and Triple Integrals, Applications of Integration; single and multiple integrals, change of variables in integrals, Jacobian's, Surface Integrals, Illustrative Problems.

Unit 2: Mathematical Physics: Ordinary Differential Equations
Teaching Hours: 15 (Weightage 25%)

Separable equations, Linear First Order Equations, Other Methods for First order equations, Second order linear equations, second order linear equations with constant coefficients other second order equations, Illustrative Examples.

Unit-3 Classical Mechanics - Lagrangian Formulation **Teaching Hours: 15 (Weightage 25%)**

Constraints, Generalized Coordinates, D'Alembert's Principle, Lagrange's Equations, A general expression for kinetic energy, Double Pendulum, Symmetries and The Laws of Conservation, Cyclic or Ignorable Coordinates, Lagrangian Formulation: Atwood's Machine, A Bead Sliding along a uniformly rotating wire, Spherical Pendulum, Velocity dependent potential of electromagnetic field, Rayleigh's Dissipation Function, Illustrative Examples.

Unit-4 Classical Mechanics - Variational Principle: Lagrange's and Hamilton's EquationsTeaching Hours: 15 (Weightage 25%)

Configuration space, Some techniques of calculus of variation, Applications of the Variational principle, Hamilton's principle. Equivalence of Lagrange's and Newton's equations, Advantages of the Lagrangian formulation-Electromechanical analogies, Lagrange's undetermined multipliers, Application of the Lagrangian method of undetermined multipliers, Hamilton's equations of motion, Some applications of the Hamiltonian formulation, Illustrative Examples.

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*SEE: Semester End Evaluation

Reference Books

1) Mathematical Methods in Physical Sciences by M. L. Boas, John Wiley & Sons
2) Mathematical Physics byP. K. Chattopadhyay, New Age International Publishers
3) Mathematical Physics by B.D.Gupta
4) Introduction to Classical Mechanics, R G Takwale& P S Puranik, Mc Graw Hill
5) Classical Mechanics, by Goldstein. Narosa Publishing House, New Delhi
6) Classical Mechanics by N.C.Rana and P.S.Joag, Tata McGraw Hill

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Apply techniques of single, double, and triple integrals to solve problems involving area, volume, and surface integrals, including transformation of variables using Jacobians.	PO1, PO3, PO6, PO7 PSO1	U, Ap	P	11
CO2	Solve first and second order ordinary differential equations using standard analytical methods and interpret the physical significance of the solutions.	PO1, PO2, PO3, PO6 PSO1	Ap, C	C	9
CO3	Analyze mechanical systems using generalized coordinates and derive equations of motion using Lagrange's formulation for systems with constraints.	PO1, PO2, PO3, PO6 PSO1, PSO2	U, An	P	10
CO4	Utilize principles of symmetry and conservation laws in classical mechanics to simplify and solve complex physical systems.	PO1, PO3, PO4, PO6 PSO1, PSO2	An, E	C	12
CO5	Understand and apply the variational principles, particularly Hamilton's principle, to derive equations of motion and compare Lagrangian and Newtonian approaches.	PO1, PO3, PO6 PSO1, PSO2	U, C	C	8
CO6	Develop and solve Hamiltonian formulations for classical systems, and demonstrate proficiency in applying both Lagrangian and Hamiltonian mechanics to practical and theoretical problems.	PO1, PO3, PO6, PO7 PSO1, PSO2	Ap	P	10
				Total hour of Instruction	**60**

KADI SARVA VISHWAVIDYALAYA

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3		3			3	2				3	
CO2	3	2	3			3					3	
CO3	3	2	3			3					3	3
CO4	3		3	1		3					3	3
CO5	3		3			3					3	3
CO6	3		3			3	2				3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Major Course

PHM308-3C Atomic, Molecular and Nuclear Physics

COURSE OUTCOMES:

- **CO1:** Explain the origin and features of atomic spectra, including Bohr's postulates and their application to hydrogen-like atoms, and evaluate the limitations of the Bohr-Sommerfield model.
- **CO2:**Analyze rotational and vibrational spectra of diatomic molecules using rigid and non-rigid rotator models, and explain the isotope effect in molecular spectroscopy.
- **CO3:** Describe nuclear properties such as nuclear size, composition, binding energy, and apply the semi-empirical mass formula to calculate nuclear stability parameters.
- **CO4:** Interpret the principles of radioactivity, including laws of radioactive decay and displacement laws, and apply them to real-world examples such as radioactive dating.
- **CO5:** Understand nuclear reactions including fission and fusion, and describe the working principles of particle accelerators like Van de Graaff and cyclotron.
- **CO6:** Explain alpha and beta decay mechanisms, apply the Gamow theory to alpha decay, and understand the Pauli's neutrino hypothesis and Fermi's theory in the context of beta decay.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory PerWeek		Hrs.	Max Marks		
					CCE	SEE	
PHM308-3C	Atomic, Molecular and Nuclear Physics	4	4	2.5	50	50	100

Unit 1: Atomic Spectra: Hydrogen Atom Teaching Hours: 15 (Weightage 25%)

Atomic Spectra, Bohr's Postulates, Explanation of Spectra of Hydrogen Like Atoms, Un-quantized states and continuous spectra, Absorption Spectra, Comparison of H and He+ Spectra, Wilson-Sommerfield Quantization rules, De Broglie's interpretation of Bohr's Quantization law, Bohr's Correspondence Principle, Sommerfield's extension of Bohr's Model, Shortcomings of the Bohr-Sommerfield theory, Illustrative Examples.

Unit 2: Molecular Spectra – Rotational and Vibrational Spectra Teaching Hours: 15 (Weightage 25%)

Types of Molecular Spectra, Rotational Spectra: Salient Features, Molecular Requirement and Experimental Arrangement, Rigid Rotator, Non - Rigid Rotator, Isotope Effect, Illustrative Examples.

Unit-3 General Properties of Atomic NucleusTeaching Hours: 15 (Weightage 25%)

Introduction, Nuclear Size: alpha scattering and electron scattering, Theories of nuclear composition, Binding Energy, Semi-Empirical Mass formula, Application of Semi-Empirical Mass formula, Quantum numbers for individual nucleons, Independence of Atomic and Nuclear Properties, Quantum Properties of Nuclear States, Derivation of Nuclear Magnetic Dipole Moment (μ), Illustrative Examples.

Unit-4 Radioactivity, Elementary Particles and Nuclear DecayTeaching Hours: 15 (Weightage 25%)

Introduction, Law of radioactive integration, Displacement Laws of Soddy Russels and Fajan, Measurement of Decay constant, Radioactive Dating: The age of earth, Accelerator: Van de Graff, Cyclotron, Definition of nuclear fission and fusion.
Classification of elementary particles, fundamental interactions, and conservation laws.
Alpha Decay: Range of alpha particles, energy of alpha particles, Geiger Nuttal Law, Energy and Mass number of alpha decay, alpha particle spectra, Gamow theory of alpha decay, Illustrative Examples.
Beta Decay: Introduction, Concept of Beta decay Spectrum, Pauli's Neutrino Hypothesis, Cowan and Reines Experiment, Fermi theory of Beta decay, Violation of Parity conservation in Beta Decay, Illustrative Examples.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books

1) Atomic & Molecular-Spectra: Laser by Raj Kumar, KedarNath RamNath, Delhi
2) Elements of Spectroscopy-Atomic, Molecular and Laser Physics, Gupta, Kumar, Sharma, Pragati Prakashan
3) Concept of Modern Physics by A.Beiser. McGraw-Hill
4) Molecular Spectra Vol I by Herzberg, Gerhard, D.Van Nostrand Company Inc.
5) Nuclear Physics by D. C. Tayal, Himalaya Publisher
6) Introduction to Nuclear Physics by H.Enge, Addison Wesley
7) Nuclear Physics by Irvin Kaplan, Narosa
8) Nuclear Physics: An Introduction by S B Patel, New Age International Pvt Ltd

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Explain the origin and features of atomic spectra, including Bohr's postulates and their application to hydrogen like atoms, and evaluate the limitations of the Bohr Sommerfield model.	PO1, PO2, PO3, PO6 PSO1	U, E	C	10
CO2	Analyze rotational and vibrational spectra of diatomic molecules using rigid and nonrigid rotator models, and explain the isotope effect in molecular spectroscopy.	PO1, PO3, PO6 PSO1	An, U	P	12
CO3	Describe nuclear properties such as nuclear size, composition, binding energy, and apply the semiempirical mass formula to calculate nuclear stability parameters.	PO1, PO3, PO6 PSO1, PSO2	U, Ap	C	8
CO4	Interpret the principles of radioactivity, including laws of radioactive decay and displacement laws, and apply them to real world examples such as radioactive dating.	PO1, PO3, PO6 PSO1, PSO2	U, Ap	P	9
CO5	Understand nuclear reactions including fission and fusion, and describe the working principles of particle accelerators like Van de Graaff and cyclotron.	PO1, PO2, PO3, PO6 PSO1, PSO2	U	C	10
CO6	Explain alpha and beta decay mechanisms, apply the Gamow theory to alpha decay, and understand the Pauli's neutrino hypothesis and Fermi's theory in the context of beta decay.	PO1, PO3, PO6 PSO1, PSO2	U, Ap	C	11
				Total hour of Instruction	**60**

KADI SARVA VISHWAVIDYALAYA

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	2	3			3					3	
CO2	3		3			3					3	
CO3	3		3			3					3	3
CO4	3		3			3					3	3
CO5	3	2	3			3					3	3
CO6	3		3			3					3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Major Course

PHM309-3CPhysics Practical - V

COURSEOUTCOMES:

- **CO1:** Determine physical constants such as gravitational acceleration and thermal conductivity through experimental techniques including Kater's pendulum and rubber tube apparatus.
- **CO2:** Analyze thermoelectric properties using thermocouple setups and investigate thermal response characteristics under varied conditions.
- **CO3:** Examine optical properties by studying absorption spectra of gases and liquids and apply wave optics principles to determine curvature using Newton's rings.
- **CO4:** Measure and compute fundamental atomic and nuclear properties using instruments like G.M. Counter and Thomson's e/m method.
- **CO5:** Investigate characteristics of electronic components and circuits (e.g., Colpitt's oscillator) and analyze signal response using CRO or wave meter.
- **CO6:** Determine the refractive index of a material using total internal reflection and analyze the resolving power of a diffraction grating to understand optical resolution and interference phenomena.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Practical PerWeek		Hrs.	Max Marks		
					CCE	SEE	
PHM309-3C	Physics Practical - V	8	4	5	50	50	100

Unit-I (Weightage :50%)

1) Acceleration due to gravity (g) using Kater's pendulum (with movable knife edges)
2) Acceleration due to gravity (g) using Kater's pendulum (with fixed knife edges)
3) Determination of Thermal conductivity 'K' of a rubber tube.
4) Study of thermocouple
5) To study absorption spectra of Iodine gas molecule
6) Newton's Ring (determination of R)
7) To study absorption spectra of liquid ($KMnO_4$)

Unit-II (Weightage :50%)

1) Comparison of capacity (C_1/C_2) using method of mixture
2) Calibration of magnetic field
3) Determination of M and H using Deflection and Vibrational Magnetometer
4) *e/m* Thomson method
5) G.M. Counter (Plateau Characteristics)
6) Refractive index 'μ 'by total internal Reflection method using Gauss eye piece
7) Resolving power of grating
8) A study of transistorized Colpits's oscillator using CRO/Wave meter

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation.

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Note:

1) New Experiments can be introduced AND / OR replaced as per need by the permission of the Head / Principal of the institute.
2) Hands-on / Project /Model etc. will carried out additionally for the enhancement of related skills

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Determine physical constants such as gravitational acceleration and thermal conductivity through experimental techniques including Kater's pendulum and rubber tube apparatus.	PO1, PO3, PO6 PSO1	Ap, An	P	20
CO2	Analyze thermoelectric properties using thermocouple setups and investigate thermal response characteristics under varied conditions.	PO1, PO2, PO6 PSO1, PSO2	An	P	20
CO3	Examine optical properties by studying absorption spectra of gases and liquids and apply wave optics principles to determine curvature using Newton's rings.	PO1, PO3, PO6 PSO1, PSO2	Ap, An	P	20
CO4	Measure and compute fundamental atomic and nuclear properties using instruments like G.M. Counter and Thomson's e/m method.	PO1, PO3, PO7 PSO1, PSO2	Ap	P	20
CO5	Investigate characteristics of electronic components and circuits (e.g., Colpitt's oscillator) and analyze signal response using CRO or wave meter.	PO1, PO6, PO7 PSO1, PSO2	An, E	P	20
CO6	Determine the refractive index of a material using total internal reflection and analyze the resolving power of a diffraction grating to understand optical resolution and interference phenomena.	PO1, PO2, PO6 PSO1, PSO2	Ap, An	P	20
				Total hour of Instruction	**120**

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3		3			3					3	
CO2	3	3				3					3	3
CO3	3	3	3			3					3	3
CO4	3		3			3					3	3
CO5	3					3	1				3	3
CO6	3	3				3					3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Microbiology Semester V Minor Course

MBE301-3C - Water Microbiology

COURSE OUTCOMES:

- CO1: Understand the fundamentals of aquatic environment and water as a microbial habitat including extreme aquatic habitats and their unique microbiology.
- CO2: Discuss the environmental impact of water pollution on aquatic ecosystems.
- CO3: Describe the sources of water, its contaminants and illustrate treatment methods for drinking water.
- CO4: Illustrate microbial indicators of water quality and evaluate biological methods of water analysis.
- CO5: Evaluate and assess water quality using microbiological and biological indicators.
- CO6: Determine water quality by chemical methods.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	
			Theory	Practical
MBE301-3C	Water Microbiology	4	2	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1: Aquatic environment and Microbiology of Drinking Water

Teaching Hours: 15 (Weightage 25%)

- Aquatic Environment: Physical and Chemical conditions
- Water as Microbial Habitat: Microorganisms in Marine and Fresh water environment
- Distribution of microorganisms in Aquatic environment
- Nuisance organisms in water: Slime forming bacteria, Iron &Sulfur bacteria and Algae.
- Productivity of aquatic ecosystem.
- Deep Sea Hydrothermal Vents
- Concept of Biomagnification and Eutrophication

Unit 2: Microbiology of Drinking Water **Teaching Hours: 15 (Weightage 25%)**

- Sources of water and its contamination.
- Drinking water standards.

- Microbial indicators of fecal pollution
  - Coliforms as indicators
  - Methods of differentiation: IMViC test and Elevated temperature test.
- Microbial indicators other than coliforms
- Microbial analysis of water
  - Standard plate count, Test for coliforms (Presumptive, confirmed & completed test),
  - MPN, Membrane filter technique,
  - Defined substrate test, Presence- Absence test
- Drinking water treatments: Filtration, Sedimentation, Coagulation and Chlorination

Practicals **Teaching Hours: 60 (Weightage 50%)**

1. To study various water sampling techniques and sample preservation
2. Test for Coliforms from drinking water.
3. Bacteriological analysis of water by Most Probable Number (MPN) technique.
4. Microbiological analysis of water by SPC. Or Total Viable count of Fresh water and Marine water.
5. Determination of Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) from water.
6. Estimation of Hardness from given water sample.
7. Estimation of NO_2-N from the given water sample.
8. Estimation of Chloride from the given water sample.
9. Estimation of Phosphate from the given water sample.

***CCE**: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books

1. Principles of Microbiology – Atlas, R.M. Wm. C, Brown Publishers, USA
2. Microbiology – Pelczar, ECS Chan, Krieg, Affiliated East-West Press, India
3. Environmental Biotechnology: Basic Concepts and Applications- Indu Shekhar Thakur, I K International Publishing House Pvt. Ltd., India
4. Wastewater Treatment – Arceivala, Tata McGraw-Hill Publishing Company Limited, India
5. Environmental Microbiology – Maier, Pepper, Gerba, Academic Press, USA.
6. Experimental Microbiology- Rakesh Patel. Aditya Publisher, India.

Suggested Reference Books

1. Microbial Ecology: Fundamentals and Applications – Atlas, R.M., Bartha, Benjamin/Cummings, USA.
2. Standard Methods for the Examination of Water and Wastewater – S. Clesceri, APHA American Public Health Association, USA.

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	Course Outcome	POs/ PSOs	CL Cognitive level	Knowledge Category	Class/ Lab Session
CO1	Understand the fundamentals of aquatic environment and water as a microbial habitat including extreme aquatic habitats and their unique microbiology.	PO1, PSO1	U, R	C	9
CO2	Discuss the environmental impact of water pollution on aquatic ecosystems.	PO1, PO9, PSO1	U, R	C	6
CO3	Describe the sources of water, its contaminants and illustrate treatment methods for drinking water.	PO1, PO3, PO7, PO9, PSO1, PSO2	U, Ap	C, P	6
CO4	Discuss microbial indicators of water quality and biological methods of water analysis.	PO1, PO6, PSO1, PSO2	U, E	C, P	9
CO5	Evaluate and assess water quality using microbiological and biological indicators.	PO2, PO6, PSO2	E,An	P	30
CO6	Determine water quality by chemical methods.	PO6, PSO2	Ap, An	P	30
	Total hour of Instruction				90

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	2										2	
CO2	2								1		2	
CO3	2		1				1		1		2	3
CO4	2					3					2	3
CO5		2				3						3
CO6						3						3

3: High, 2: Medium, 1: Low

KADI SARVA VISHWAVIDYALAYA

Microbiology Semester V Minor Course

MBE302-3C - Advanced Agriculture Microbiology

COURSE OUTCOMES:

- CO1: Understand the basic concepts of Plant tissue culture, laboratory facilities and scope of tissue culture.
- CO2: Describe the tissue culture media, and role of plant hormones.
- CO3: Illustrate the stages and techniques of micro propagation.
- CO4: Understand the concept of disease in plants, disease development and identify plant diseases.
- CO5: Develop the skills of preparing tissue culture media, its sterilization and aseptic laboratory techniques, evaluate role of plant hormones in micro propagation.
- CO6: Demonstrate the steps of micro propagation, sub culturing and acclimatization.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	
			Theory	Practical
MBE302-3C	Advanced Agriculture Microbiology	4	2	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1: Basic concepts in Plant Tissue Culture **Teaching Hours: 15 (Weightage 25%)**

- Overview of Plant tissue culture and History.
- Tissue culture laboratory facilities: Equipment, apparatus and design.
- Plant tissue culture media: types of media, media composition and significance of media components.
- Concepts of totipotency of cells and morphogenesis.
- Micro propagation and its stages.
- Techniques of Micro propagation: Single cell culture, Callus culture, Protoplast culture, Cell suspension culture, Organ Culture.
- Scope and importance of tissue culture in crop improvement.

Unit 2: Plant hormones and Plant pathology **Teaching Hours: 15 (Weightage 25%)**

- Plant hormones:
  - Auxin, Gibberlin, Cytokinins, Absyssic acid, Ethylene, Hormone signaling pathway.
- Plant pathology
  - Concept of disease in plants: biotic and abiotic causes of plant diseases, Host parasite interaction, recognition concept and infection.

- Disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens.
- Plant diseases: Groundnut rust, Citrus canker and Tomato leaf curl: Causative agent, distribution, symptoms, disease cycle and control.

Practicals **Teaching Hours: 60 (Weightage 50%)**

1. Study of laboratory equipment and tissue culture laboratory set up.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium): Stocks and working media preparation.
3. Sterilization techniques in plant tissue culture: Glass ware sterilization, Media sterilization.
4. To study steps of micropropagation: explant selection, sterilization, preparation and inoculation.
5. To study significance of growth hormones in culture medium.
6. Development of callus culture.
7. Sub culturing of initiated cultures.
8. Acclimatization of cultures.
9. Isolation of pathogen from citrus cancer/tomato leaf curl/ ground nut rust.

***CCE**: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. Plant Biotechnology – B.D. Singh, Kalyani Publishers, India
2. Plant Propagation by Tissue Culture – Edwin F. George, Michael A. Hall, Geert-Jan De Klerk, Springer, Germany
3. An Introduction to Plant Tissue Culture – M.K. Razdan, Science Publishers, USA
4. Physiological Plant Pathology – Mehrotra R.S., Aggarwal A., McGraw Hill Education, India
5. Introduction to Principles of Plant Pathology – R.S. Singh, Medtec, India
6. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition- Aneja K.R. (2001). New Age International Publishers. India

Suggested Reference Books:

1. Biotechnology – U. Satyanarayan, Books & Allied Ltd., India
2. Elements of Biotechnology – P.K. Gupta, Rastogi Publications, India
3. Biotechnology in Crop Improvement – H.S. Chawla, International Book Distributing Company, India
4. Microbiology – Pelczar M.J., Chan E.C.S., Krieg N.R., McGraw Hill Education, USA
5. Plant Pathology – George N. Agrios, Academic Press (Elsevier), USA
6. Disease and Insect Resistance in Plants – D.P. Singh, Aarti Singh, Science Publishers, USA

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	Course Outcome	POs/ PSOs	CL Cognitive level	Knowledge Category	Class/ Lab Session
CO1	Understand the basic concepts of Plant tissue culture, laboratory facilities and scope of tissue culture.	PO1, PSO1, PSO2	U, R	C,P	5
CO2	Describe the tissue culture media, and plant hormones.	PO1, PSO1	U, R	C	5
CO3	Illustrate the stages and techniques of micropropagation.	PO1, P03, PSO1, PSO2	U, R, Ap, An	C, P	10
CO4	Understand the concept of disease in plants, disease development and identify plant diseases.	PO1, PO2, PSO1	U, R, Ap	C, P	10
CO5	Develop the skills of preparing tissue culture media, its sterilization and aseptic laboratory techniques, evaluate role of plant hormones in micropropagation.	PO1, PO2, PO3, PO4, PO6, PO7 PSO2	E, C	P	25
CO6	Demonstrate the steps of micropropagation, sub-culturing and acclimatization.	PO1, PO3, PO4, PO6, PO7, PSO2	Ap, An,C	P	35
	Total hour of Instruction				**90**

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3										2	3
CO2	3										2	
CO3	3		3								2	3
CO4	3	2									2	
CO5	3	2	3	3		3	3					3
CO6	3		3	3		3	3					3

3: High, 2: Medium, 1: Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Minor Course

CHE303-3C CHEMISTRY IN DAILYLIFE- Dyes &Drugs

Course Outcomes:

- CO1: Discuss and classify significant organic dyes, pigments and dyes intermediates.
- CO2: Identify basic theories of colour and their applications in industry.
- CO3: Explain the important terminology and nomenclature of drugs.
- CO4: Outline the synthesis & characterization of some important drugs used in daily life.
- CO5: Perform synthesis and separation dyes using different chromatography techniques.
- CO6: Illustrate and perform estimation of different acids, drugs, chemical solvents and their applications in industry.

Course Code	Course Title	Teaching Scheme		Credits
		Theory hrs Per Week	Practical hrs Per Week	
CHE303-3C	Chemistry in Daily Life-Dyes & Drugs	2	4	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Content:

Unit	
1.	**Basics of dyes and its intermediates** **Teaching Hours: 15 (Weightage 25%)** **Basic theories of colour:** Bathochromic and hypsochromic effect–Hyperchromic and hypochromic effect, Witt's theory (Chromophore-auxochrome Theory), Armstrong's theory (Quinonoidtheory), Resonance theory, M.O. theory. Definition and difference between dyes and pigments, Classification of dyes based on (i) Chemical constitution (ii) Method of application to fibres. Classification of Pigments. **Dyes intermediates:** Name and structure of benzene, naphthalene and anthraquinone Intermediates useful in the dyestuff industry, synthesis of 4-amino-2-methoxy toluene, 2, 3 – diamino anthraquinone and p-cresidine.

2.	**Basics of Drugs** **Teaching Hours: 15 (Weightage 25%)** **Introduction:** Drug, disease (definition), Historical evolution, Sources – Plant, Animal synthetic, Biotechnology and human gene therapy, **Terminology:** Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors – brief treatment) Metabolites, Anti metabolites, Prodrug, Half-life, efficiency, LD50, ED50, Therapeutic Index, Receptors, Agonists, Antagonists, Drug-receptor interaction, Drug Potency, Bioavailability, Drug toxicity, Drug addiction, spurious drugs, misbranded drugs, Adulterated drugs Pharmacopoeia. Requirements of an ideal drug, **Nomenclature of drugs:**Genericname,Brandname,Systematicnameandtradenameswithexamples, Types of microorganisms, Bacteria& Bacterial Cell wall, fungi, viruses, protozoa. Classification of bacteria based on their shape and their staining property. Classification based on structures and therapeutic activitywith example each. **Synthesis of following drugs**: Paracetamol, Niacin, Metronidazole, Aspirin and Ibuprofen
3	**Chemistry Practical** **TeachingHours:60 (Weightage50%)** **A. Preparation, separation and dyeing of different dyes (Any 7)** 1. Methyl orange from sulphanilic acid. 2. Sudan-1fromaniline. 3. Pararedfrom p-nitroaniline. 4. Orange-1 from sulphanilic acid. 5. Orange-2from sulphanilic acid. 6. Methyl red from anthranilic acid. 7. Azo violet from p-nitroaniline. 8. Phenolphthalein from phenol. 9. Indigo using aldol condensation reaction. 10. Fluorescein from dimethyl aniline. **B.Estimations:(Any5)** 1. Estimation of Organic acid (Oxalic, Succinic, Citric, Tartaric, Benzoic, Phthalic, Cinnamic) [Any one] 2. Estimation of Ketone (Acetone) 3. Estimation of Ester 4. Estimation of tincture iodine 5. Estimation of Ibuprofen 6. Estimation of Aspirin

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations / Quizzes/ Surprise Tests.

*SEE: Semester End Evaluation

REFERENCEBOOKS

- Synthetic organic chemistry by O. P.Agrawal, Krishna Prakashan Media.
- The chemistry of synthetic dyes and pigments by H.A.Lubes
- Synthetic dyes by G.R.Chatwal.

- Principles of Medicinal Chemistry, Volume – I & II, 15th edition, Dr. S.S.Kadam, Dr. K.R.Mahadik, Dr. K.G.Bothara, NiraliPrakashan, ISBN: 81-85790-04-3.
- Medicinal Chemistry, Ashutoshkar(author), New age international publisher, ISBN – 81-2241970-4.
- Burger's Medicinal Chemistry, Drug Discovery and Development, Volume 1 to 6, Editors: Donald J. Abraham, David P. Rotella, Wiley-Interscience, ISBN-10: 0471370282, ISBN-13:9780471370284
- V.K.AhluwaliaandSunitaDhingra,ComprehensivePracticalOrganicChemistry:Qualitative Analysis, Universities Press (India) Pvt. Ltd., Hyderabad, 2000.
- Arthur, I.V. QuantitativeOrganicAnalysis, Pearson.

SUGGESTEDBOOKS

- Synthetic dyes and pigments by E.N. Abrahart.
- High tech Dyes by Smith
- Chemistry of synthetic dyes VOL I to VII by K. Venkatraman.
- An introduction to synthetic dyes by D.W. Ranghekar & P.P. Singh.
- A handbook of synthetic dyes and their application by C.T. Bhastana & V. H.Raichura & others.
- Chemistry of dyes & principles of dyeing Vol II by V.A. Shehai, Sevak Publications.
- Chemistry of synthetic dyes by I.G. Vashi
- Chemistry of dyes and pigments by K.M. Shah.
- Foye's Principles of Medicinal Chemistry, 5thedition, David A. Williams, Thomas L. Lemke, Lippincott Williams & Wilkins publisher-a Walter kluwer business, ISBN – 13: 978-81-8983602-3, ISBN–10:81-89836-02-1ISBN:0-7817-4211-0.
- WilsonandGisvold'sTextbookofOrganicMedicinalandPharmaceuticalChemistry, 11thedition, John H.Block, John M. Beale, Jr., Lippincott Williams & Wilkins publisher – a Walter, kluwer business, ISBN – 0-7817-3481-9.
- Brian S.Furniss, AntonyJ. Hannaford, Peter W.G. Smith, Austin R.Tatchell Eds; In 'Vogel's Textbook of Practical Organic Chemistry', fifth edition Published by ELBS with Longman publishers Pvt. Ltd, Singapore, 1989.

Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

	Course Outcome	POs/PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Discuss and classify significant organic dyes, pigments and dyes intermediates.	PO1,PSO1	R,U	C	05
CO2	Identify basic theories of colour and their applications in industry.	PO1, PO2, PO3,PSO1	U, Ap,An	C,P	10
CO3	Explain the important terminology and nomenclature of drugs.	PO1,PSO1	R,U,An	C	07
CO4	Outline the synthesis & characterization of some important drugs used in daily life.	PO1,PO2, PO3,PSO1, PSO2	U, Ap,An	C,P	08
CO5	Perform synthesis and separation of dyes using different chromatography techniques.	PO1,PO3, PO7,PSO1, PSO2	E,Ap,An	C,P	40
CO6	Illustrate and perform estimation of different acids, drugs, chemical solvents and their applications in industry.	PO1, PO3, PO6,PSO1, PSO2	E,Ap,An	C,P	20
	Total Hours of Instructions				90

KADI SARVA VISHWAVIDYALAYA

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3										3	
CO2	3	1	3								3	
CO3	3										3	
CO4	3	1	3								3	3
CO5	3		3				3				3	3
CO6	3		3			1					3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Minor Course

CHE304-3C Advanced Analytical Techniques - I

Course Outcomes:

- CO1: Discuss the basic principle and instruments involved in various Spectroscopic techniques.
- CO2: Apply spectroscopic techniques for qualitative and quantitative estimation of compounds.
- CO3: Explain the basic and advanced concepts of Chromatographic Techniques.
- CO4: Identify the applications of Chromatographic techniques for separating, identifying and analyzing the components of a mixture.
- CO5: Examine Spectroscopy graphs and charts to interpret unknown compounds and their structures.
- CO6: Utilize Chromatography techniques for purification and isolation of individual components from mixtures.

Course Code	Course Title	Teaching Scheme		Credits
		Theory hrs Per Week	Practical hrs Per Week	
CHE304-3C	Advanced Analytical Techniques-I	2	4	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Contents

UNIT	
1	**Spectroscopic Techniques** **Teaching Hours: 15 (Weightage :25%) IR** **Spectroscopy:** Principle, Types of vibrations in IR, Different important group frequency criteria for compound to be IR active, Instrumentation ofIR, Important IR frequencies, Applications of IR Spectroscopy. **NMR Spectroscopy**: Principle, basics of NMR (Peak height, Peak signal, Chemical shift, shielding-deshielding, splitting, TMS) instrumentation and applications of NMR spectroscopy. **Mass Spectroscopy:** Theory, instrumentation, important terms-singly and doubly charged ions, meta stable peak, base peak, isotropic mass peaks, relative intensity, etc.; Recognition of M^+ ion peak; General fragmentation rules, Applications of Mass Spectroscopy.

2	**Chromatographic Techniques** **Teaching Hours: 15 (Weightage: 25%)** Definition and basic concept of Chromatography, General principles underlying Chromatographic techniques: Partition, Adsorption and ion exchange. **Types of Chromatography:** • Planner chromatography • Paper Chromatography and Thin Layer Chromatography:Introduction and Principle, practical requirements, procedure and applications • Column Chromatography: Basics, Introduction, working principle, practical requirements, procedure and applications of Ion Exchange Chromatography, Gel Exclusion Chromatography, Affinity Chromatography. **Overview of High Performance Liquid Chromatography (HPLC)** Introduction, Principle, mechanism and Applications of HPLC. **Overview of Gas Chromatography:** Introduction, Principle, mechanism and Applications of HPLC.
3	**Practicals** **TeachingHours:60(Weightage:50%)** **List of Practicals** 1. Graphical interpretation of IR spectra.**(minimum3spectra)** 2. Graphical interpretation of NMR spectra.**(minimum3spectra)** 3. Graphical interpretation of Mass spectra.**(minimum3 spectra)** 4. Separation of carbohydrates by ascending paper chromatography. 5. Separation of amino acids by radial paper chromatography. 6. Separation of amino acids / lipids by TLC. 7. Separation of amino acids by two dimensional paper chromatography. 8. Demonstration of column packing.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations / Quizzes / Surprise Tests.

*SEE: Semester End Evaluation

REFERENCEBOOKS:

- Analytical Chemistry–by Gary D. Christian, 6th Edition, John Wiley and SonsInc. New Jersey.
- Principles of Instrumental Analysis–by Douglas A.Skoog,3rd Edition, Holt-Saunders International Edition.
- Instrumental Methods of Chemical Analysis-by Galen W.Erwing, 4th Edition, International Student Edition.
- Quantitative chemical analysis by A.I.Vogel (Longman Series).
- Basic Concepts of Analytical Chemistry-by S. M. Khopkar, New Age International Publishers.
- Organic Spectroscopy-William Kemp.
- Elementary Organic Spectroscopy: Principles and Chemical Applications,Y.R.Sharma, S. Chand Publications.
- Introduction to Spectroscopy, Donald L. Pavia, Cengage India Private Limited.
- Spectroscopy of Organic Compounds, P.S. Kalsi, New Age International Private Limited.

- Advanced Practical Chemistry by Jagdamba Singh, PragatiEdition
- Nirav College Practical Chemistry, Nirav Prakashan

SUGGESTED BOOKS

- QuantitativeChemicalAnalysis–byDanielC.Harris,5th Edition,W.H.Freeman and Company, New York.
- Instrumental Methods of Chemical Analysis-byGalenW.Erwing, 4th Edition, International Student Edition.
- Quantitative Analysis-by Day and Underwood, Prentice-Hall
- Pharmaceutical Analysis volume1-by Kasture, Mahadik,NiraliPrakashan
- Instrumental methods of chemic alanalysis (Analytical Chemistry),Dr.H. Kaur, Pragati Prakashan.
- Instrumental methods of chemical analysis (Analytical Chemistry) –by Gurdeep Chatwal, Himalaya Publication.
- Spectrometric Identification of Organic compounds – Robert M Silverstein, John Wiley & Sons.
- College Practical Chemistry by Pateland Turakhia, Himalaya Publishing House

	Course Outcome	POs/ PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Discuss the basic principle and instruments involved in various Spectroscopic techniques.	PO1, PSO1	R,U	C	07
CO2	Apply spectroscopic techniques for qualitative and quantitative estimation of compounds.	PO1,PO2, PO6,PO7, PSO1	R,U,Ap	C,P	08
CO3	Explain the basic and advanced Concepts of Chromatographic Techniques.	PO1, PSO1	U,Ap	C	07
CO4	Identify the applications of Chromatographic techniques for separating, identifying and analyzing the components of a mixture.	PO1,PO2, PO6,PSO1	U, Ap,An	C,P	08
CO5	Examine Spectroscopy graphs and charts to interpret unknown compounds and their structures.	PO2,PO3, PO7 PSO1, PSO2	E,Ap,An	C,P	30
CO6	Utilize Chromatography techniques for purification and isolation of individual components from mixtures.	PO2,PO3, PSO1, PSO2	E,Ap,An	C,P	30
Total Hours of Instructions					90

KADI SARVA VISHWAVIDYALAYA

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2										3	
CO2	2	3				1	3				3	
CO3	2										3	
CO4	2	3				1					3	
CO5		3	3				3				3	3
CO6		3	3								3	3

3:High,2:Medium,1:Low

SCVPatel

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V – Minor Course

MTE307-3C Probability and Probability Distributions-II

Course Outcomes:

- **CO1:** Define and apply the properties, conditions, and characteristics of the Poisson, Hypergeometric, and Normal distributions, and solve related problems using expected frequency and probability concepts.
- **CO2:** Use the Central Limit Theorem to estimate population behavior based on sample distributions, and apply it to practical examples.
- **CO3:** Interpret and compute measures of skewness using Karl Pearson's, Bowley's, and Kelly's coefficients, and differentiate between dispersion and skewness.
- **CO4:** Define and calculate moments about arbitrary origin, mean, and zero; apply Sheppard's correction to adjust for grouping errors.
- **CO5:** Examine and interpret kurtosis and apply moment-based techniques to measure skewness and kurtosis, identifying types and significance.
- **CO6:** Analyze and interpret correlation using scatter diagrams, graphical methods, and covariance-based techniques, distinguishing between covariance and variance, and evaluating the nature and strength of relationships.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
MTE307-3C	Probability and Probability Distributions-II	2	4	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1 **Teaching Hours: 15**

Meaning of Poisson distribution, Conditions of Poisson distribution, Characteristics of Poisson distribution, Constants of Poisson distribution and its examples, Hypergeometric distribution, Meaning of normal distribution, Conditions of normal distribution, Characteristics of normal distribution, Relation between Binomial, Poisson and Normal distributions, Properties of normal distribution, Constants of normal distribution and its examples, Area under the normal curve, Central limit theorem (without proof).

Unit 2 **Teaching Hours: 15**

Meaning and characteristics of Skewness, Difference between dispersion and skewness, Tests of skewness, Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness, Kelly's coefficient of skewness. Moments, Kurtosis, Types of Kurtosis, Importance of moments, Moments about arbitrary origin, Moments about zero, Sheppard's correction for grouping errors, Measure of skewness based on moments, Measures of Kurtosis, Meaning of correlation, Types of correlation, Uses of correlation, Methods of studying correlation: Scatter diagram method, Graphic method, Covariance, Difference between variance and covariance, Properties of covariance.

Practicals **Teaching Hours:60**

1. Examples on Poisson distribution.
2. Examples based on confidence interval.
3. Examples based on expected frequency of Poisson distribution.
4. Examples on hypergeometric distribution.
5. Examples on Normal Distribution.
6. Examples on Central limit theorem.
7. Examples on calculation of Karl Pearson's coefficient of skewness.
8. Examples on calculation of Bowley's coefficient of skewness
9. Examples on calculation of Kelly's coefficient of skewness
10. Examples on calculation of moments about arbitrary origin.
11. Examples on calculation of moments about mean.
12. Examples on calculation of moments about zero.
13. Examples of calculation of skewness and Kurtosis using moments.
14. Examples on finding nature of correlation.

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. "Statistical analysis: Graphs and diagrams", Spectrum books (P) Ltd, New Delhi.
2. "Introduction to the Practice of Statistics", Moore, S. David; Mc Cabe, P. George W. H. Freeman and Company, New York.
3. "Basic Statistics", Agarwal, B. L., New Age International(P)Ltd.
4. "Introduction to the theory of Statistics", Mood, A. M., Greybill, F.A., Boes, D.C., McGraw Hill.
5. "Business Statistics", P. C. Tulsian and Bharat Jhunjhnuwala, S Chand and Company Limited, New Delhi.
6. "Fundamentals of Mathematical Statistics", S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Define and apply the properties, conditions, and characteristics of the Poisson, Hypergeometric, and Normal distributions, and solve related problems using expected frequency and probability concepts.	PO1, PO2, PO3, PSO1,PSO2	R, U, Ap	C, P	18
CO2	Explain and use the Central Limit Theorem to estimate population behavior based on sample distributions, and apply it to practical examples.	PO1, PO2, PO6, PSO1	U, Ap, An	C, P	15
CO3	Interpret and compute measures of skewness using Karl Pearson's, Bowley's, and Kelly's coefficients, and differentiate between dispersion and skewness.	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap, An	C, P	13
CO4	Define and calculate moments about arbitrary origin, mean, and zero; apply Sheppard's correction to adjust for grouping errors.	PO1, PO2, PO6, PSO1, PSO2	R, Ap, An	C, P	14
CO5	Examine and interpret kurtosis and apply moment-based techniques to measure skewness and kurtosis, identifying types and significance.	PO1, PO2, PO3, PSO1, PSO2	U, Ap, An	C, P	14
CO6	Analyze and interpret correlation using scatter diagrams, graphical methods, and covariance-based techniques, distinguishing between covariance and variance, and evaluating the nature and strength of relationships.	PO1, PO2, PO3, PSO1, PSO2	U, Ap ,An ,E	C, P	16
Total hours of instruction					**90**

KADI SARVA VISHWAVIDYALAYA

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	3	0	0	0	0	0	0	0	3	3
CO2	3	3	0	0	0	3	0	0	0	0	3	0
CO3	3	3	3	0	0	3	0	0	0	0	3	3
CO4	3	3	0	0	0	3	0	0	0	0	3	3
CO5	3	3	3	0	0	0	0	0	0	0	3	3
CO6	3	3	3	0	0	0	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V - Minor Course
MTE308-3C Data Analytics and Visualizations

Course Outcomes:

- **CO1:**Explain the benefits and uses of data science, types of analytics, and the role of Python and its libraries in data science work flows.
- **CO2:**Use NumPy for array creation, manipulation, broadcasting, aggregation, and universal functions.
- **CO3:**Perform data manipulation using Pandas including indexing, grouping, merging, and time series operations on structured datasets during hands-on sessions.
- **CO4:**Perform exploratory data analysis including univariate and bivariate analysis and visualizations using matplotlib.
- **CO5:**Acquire, clean, and transform data using Python from various sources including APIs, and implement data preprocessing techniques.
- **CO6:**Implement end-to-end data preparation and analysis using Python libraries through structured lab exercises and case-based exploratory data analysis tasks.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
MTE308-3C	Data Analytics and Visualizations	2	4	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1 **Teaching Hours: 15**

Data Science: Benefits and uses - facets of data, Data analytics overview, types of data analytics, Understanding Python's role in data science, Overview of important python libraries used in data science.

Working with NumPy: Introduction to NumPy, Understanding data types in Python, The basics of NumPy arrays, Computation on NumPy arrays: Universal functions, Aggregations. Computation on arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Sorting arrays.

Data Manipulation with Pandas: Introducing Pandas, Objects, Data indexing and selection, Operating on data in Pandas, Handling missing data. Hierarchical indexing, Combining datasets: Concat and Append, Merge and Join, Aggregation and Grouping, Pivot tables, Working with time series.

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Unit 2

Teaching Hours: 15

Exploratory data analysis: Data visualization using matplotlib library, Creating graphs (bar, line, pie, boxplot, histogram, etc.), Summarizing data, Univariate analysis (distribution of data), Bivariate analysis (cross tabs, distributions and relationships, graphical analysis).

Data Acquisition, Data Pre-processing and Preparation, Transformation: Overview of gather information from different sources: Web APIs, Open data sources, Data APIs, Web scrapping, Data munging, Data wrangling, Data cleansing and handling missing values, Outlier detection and treating the outliers, Data imputation, Understand various techniques for data imputation, Data Transformation (minmax, log transform, z-score transform), Binning, Classing and Standardization.

Practicals

Teaching Hours:60

1. Write a Python script to perform basic arithmetic operations.
2. Create and manipulate lists, tuples, dictionaries, and sets.
3. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
4. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
5. Computation on NumPy arrays using Universal Functions and Mathematical methods.
6. Load an image file and do crop and flip operation using NumPy Indexing
7. Create Pandas Series and Data Frame from various inputs.
8. Import any CSV file to Pandas Data Frame and perform the following:
    - Visualize the first and last 10 records (b) Get the shape, index and column details
    - Select/Delete the records (rows)/columns based on conditions.
    - Perform ranking and sorting operations.
    - Do required statistical operations on the given columns.
    - Find the count and uniqueness of the given categorical values.
    - Rename single/multiple columns
9. Import any CSV file to Pandas Data Frame and perform the following:
    - Handle missing data by detecting and dropping/ filling missing values.
    - Transform data using apply () and map () method.
    - Detect and filter outliers.
    - Perform Vectorized String operations on Pandas Series.
    - Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.
10. Create basic plots (line, scatter, bar) using Matplotlib.
11. Generate statistical plots (histograms, box plots) using Matplotlib.
12. Perform exploratory data analysis (EDA) with any available datasets.

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. "Think Python: How to Think Like a Computer Scientist", Allen B. Downey, Green Tea Press, 2nd Edition.
2. "Programming Python", Mark Lutz, O'Reilly Media, Inc., 4th Edition.
3. "Python Data Science Handbook: Essential Tools for Working with Data", Jake VanderPlas, O 'Reilly Media, Inc., 1st Edition.
4. "Python for Data Analysis", Wes McKinney, O'Reilly Media, Inc.
5. "Python 3 for Absolute Beginners", Tim Hall and J. P. Stacey, Apress.
6. "Beginning Python: From Novice to Professional", Magnus Lie Hetland, Apress, 2nd Edition.
7. "Beginning Python Visualization Crafting Visual Transformation Scripts", Shai Vaingast, Apress, 2nd Edition.

CO	Course outcome	POs /PSOs	Cognitive level	Knowledge category	Class session
CO1	Explain the benefits and uses of data science, types of analytics, and the role of Python and its libraries in data science workflows.	PO1, PO2, PO5, PO7, PSO1, PSO2	U	C	5
CO2	Use NumPy for array creation, manipulation, broadcasting, aggregation, and universal functions.	PO1, PO2, PO3, PO6, PO7, PSO1, PSO2	Ap	C, P	15
CO3	Perform data manipulation using Pandas including indexing, grouping, merging, and time series operations on structured datasets during hands-on sessions.	PO1, PO2, PO3, PO4, PO6, PO7, PSO1, PSO2	Ap	C, P	17
CO4	Perform exploratory data analysis including univariate and bivariate analysis and visualizations using matplotlib.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PSO1, PSO2	An	C, P	15
CO5	Acquire, clean, and transform data using Python from various sources including APIs, and implement data preprocessing techniques.	PO1, PO2, PO3, PO4, PO6, PO7, PSO1, PSO2	Ap, An	P	16
CO6	Implement end-to-end data preparation and analysis using Python libraries through structured lab exercises and case-based exploratory data analysis tasks.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PSO1, PSO2	An	P	22
Total hours of instruction					**90**

KADI SARVA VISHWAVIDYALAYA

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	0	0	3	0	3	0	0	0	3	3
CO2	3	3	3	0	0	3	3	0	0	0	3	3
CO3	3	3	3	3	0	3	3	0	0	0	3	3
CO4	3	3	3	3	3	3	3	0	0	0	3	3
CO5	3	3	3	3	0	3	3	0	0	0	3	3
CO6	3	3	3	3	3	3	3	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Minor Course

PHE305-3C Power Electronics

COURSEOUTCOMES:

- **CO1:** Analyze and simplify complex electrical networks using network theorems and configurations such as T, π, bridged-T, and lattice networks.
- **CO2:** Apply the principles of electrical duality, reciprocity, superposition, and compensation theorems to solve circuit problems involving impedance and transfer functions.
- **CO3:** Explain the working principles and classifications of photoelectric devices, including photoemissive, photoconductive, and photovoltaic cells, and compare their applications.
- **CO4:** Understand the structure, characteristics, and applications of semiconductor devices like SCR, Triac, and Diac in electronic circuits.
- **CO5:** Measure and analyze electrical parameters such as frequency, phase difference, impedance, and voltage gain using instruments like CRO, VTVM, and wave meters.
- **CO6:** Construct and characterize electronic circuits including oscillators, amplifiers, and semiconductor devices (Diac, SCR), and evaluate their performance under various conditions.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
PHE305-3C	Power Electronics	2	4	4

Examination Scheme						Total Marks
Theory			Practical			
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1: Electronics and Photo Electric Devices — **Teaching Hours: 15 (Weightage 25%)**

Principle of duality, Reduction of Complicated network, Conversions between T and π sections, The bridged-T network, The Lattice Network, The Reciprocity theorem, Superposition Theorem, The compensation theorem, Driving point impedance, transfer impedance, The parallel-T network, Illustrative Examples.

Classification of Photoelectric devices, Photoemissive Cells, Photoconductive cells, Photovoltaic cells, Difference Between Photovoltaic and Photoconductive, SCR, Triac, Diac.

Unit 2: Amplifiers — **Teaching Hours: 15 (Weightage 25%)**

Feedback Amplifiers: Concept of Feedback, Negative And Positive Feedback, Advantages And Disadvantages Of Negative Feedback, Voltage (Series And Shunt), Current (Series And Shunt) Feedback Amplifiers. Study of Phase Shift Oscillator, Colpitts Oscillator and Hartley Oscillator, Illustrative Examples.

Multistage Amplifiers: Multistage Transistor Amplifiers, R-C- coupled Amplifiers, Transformer Coupled Amplifiers, Direct coupled Amplifiers, Cascade and Cascade.

Operational Amplifiers: Block Diagram Representation of A Typical Op-Amp – Schematic Symbol - A General Purpose.

PracticalTeaching Hours: 60 (Weightage 50%)

1) Velocity of sound in air using CRO
2) Measurement of frequency *f* and phase difference 'θ' of a.c wave using CRO
3) A study of transistorized Hartley Oscillator using CRO/Wave meter
4) I/P and O/P impedance of an R-C CE amplifier at different frequency using VTVM/CRO
5) A study of Transformer coupled Amplifier using VTVM/CRO (voltage gain frequency response and band width)
6) Diac characteristics
7) Characteristic of SCR
8) Negative Feedback Amplifier

Note:

1) New Experiments can be introduced AND / OR replaced as per need by the permission of the Head / Principal of the institute.
2) Hands-on / Project /Model etc. will carried out additionally for the enhancement of related skills.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books

1) Networks, Lines and Fields, J. D.Ryder. Prentice Hall of India.
2) Hand Book of Electronics, Gupta and Kumar, Pragati Prakashan
3) Op Amps and Linear Integrated Circuits, Ramakant A Gayakwad, Pearson Education.
4) Electronics and Radio Engineering, M. L. Gupta, Dhanpat Rai Publication Co.
5) Electronic Devices and Circuits, J B Gupta, S.K. Kataria & Sons
6) The Art of Electronics, P Horowitz, W Hill, Cambridge University Press

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Analyze and simplify complex electrical networks using network theorems and configurations such as T, π, bridgedT, and lattice networks.	PO1, PO2, PO3, PO6 PSO1	An	P	13
CO2	Apply the principles of electrical duality, reciprocity, superposition, and compensation theorems to solve circuit problems involving impedance and transfer functions.	PO1, PO3, PO6 PSO1	Ap	C	12
CO3	Explain the working principles and classifications of photoelectric devices, including photo emissive, photoconductive, and photovoltaic cells, and compare their applications.	PO1, PO3, PO5, PO6 PSO1, PSO2	U, An	C	12
CO4	Understand the structure, characteristics, and applications of semiconductor devices like SCR, Triac, and Diac in electronic circuits.	PO1, PO3, PO6, PO7 PSO1, PSO2	U	C	13

CO5	Measure and analyze electrical parameters such as frequency, phase difference, impedance, and voltage gain using instruments like CRO, VTVM, and wave meters.	PO1, PO3, PO6, PO7 PSO1	Ap, An	P	20
CO6	Construct and characterize electronic circuits including oscillators, amplifiers, and semiconductor devices (Diac, SCR), and evaluate their performance under various conditions.	PO1, PO3, PO6, PO7 PSO1, PSO2	C , E	P	20
				Total hour of Instruction	**90**

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	1	3			3					3	
CO2	3		3			3					3	
CO3	3		3		1						3	3
CO4	3		3			3	3				3	3
CO5	3		3			3	3				3	
CO6	3		3			3	3				3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Minor Course

PHE306-3C Crystal Structure and Nanomaterial Synthesis

COURSEOUTCOMES:

- **CO1:** Differentiate between crystalline and amorphous solids, and describe the fundamental properties of crystal lattices, unit cells, and symmetry elements.
- **CO2:**Analyze crystal structures using Miller indices and interplanar spacing, and apply these concepts to identify and interpret common cubic crystal systems such as SC, BCC, and FCC..
- **CO3:** Explain the fundamental concepts, types, and unique properties of nanomaterials, including the significance of surface area to volume ratio.
- **CO4:** Compare and evaluate various nanomaterial synthesis techniques, including top-down and bottom-up approaches such as ball milling, PVD, CVD, and sol-gel methods, and discuss their applications and environmental implications.
- **CO5:** Perform and analyze experiments related to crystal structures, quantum mechanics, and nanomaterials to determine physical constants such as the lattice constant and Planck's constant.
- **CO6:** Apply theoretical principles to experimental techniques in mechanics, electronics, and modern physics—such as Thevenin's theorem, viscosity measurements, and radioactive decay simulations—to validate physical laws and models.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
PHE306-3C	Crystal Structureand Nanomaterial Synthesis	2	4	4

Examination Scheme						
Theory			Practical			Total Marks
Hrs.	Max Marks		Hrs.	Max Marks		
	CCE	SEE		CCE	SEE	
2	25	25	2.5	25	25	100

Unit 1: Crystal Structure **Teaching Hours: 15 (Weightage 25%)**

Crystalline and Amorphous Solids, Crystal Lattice and Crystal Structure, Translational Symmetry, Space, Unit Cell and Primitive Cell, Symmetry Elements in Crystals, The Seven Crystal Systems, Coordination Number, Some importance of crystal structure, Simple Cubic Structure, Body Centered Cubic Structure, Face Centered Cubic Structure, Wigner-Seitz Cells, Miller Indices, The inter planner spacing of a set of crystal planes, Illustrative examples

Unit 2: Nanomaterial Synthesis **Teaching Hours: 15 (Weightage 25%)**

Introduction, Basic idea of nanomaterials, Types of nanomaterials, synthesis of nano structured material, top-down approach in nanomaterial synthesis, bottom-up process synthesis of nanoparticles, Mechanical Grinding/Ball Milling Method, PVD method, CVD method, Sol-gel method, Nanotechnology and environment, Surface area to volume ratio property, Properties of nanomaterials, Applications of nanomaterials.

Practical

Teaching Hours: 60 (Weightage 50%)

1) Study the X-ray diffraction (Powder) Pattern and determine the lattice constant of SC/FCC/BCC structure.
2) Analyze the electron diffraction pattern of Aluminium crystal and verify de – Broglie relation by calculating the wavelength and momentum of an electron. Hence verify the value of Planck's constant.
3) Understanding of nanomaterial state.
4) Simulation of Radioactive Decay process.
5) Verification of Thevenin's theorem.
6) Bar Pendulum: Determination of 'K' and 'g'.
7) Absorption co-efficient of liquid using photocell
8) Viscosity of a fluid using coaxial viscometer.

Note:

1) New Experiments can be introduced AND / OR replaced as per need by the permission of the Head / Principal of the institute.
2) Hands-on / Project /Model etc. will be carried out additionally for the enhancement of related skills.

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books

1) Introduction to Solid State Physics, C. Kittle, John Willey
2) Elements of Solid State Physics, J P Shrivastava, PHI Learning
3) Introduction to Solid State Physics, C. Kittel, (Eight Edition) John Wiley and Sons
4) Solid State Physics, Ashcroft and Mermin, CENGAGE
5) Undergraduate Physics Vol III, A B Bhattacharya, New Central Book Agency (P) Ltd
6) Engineering Physics by G. Vijayakumari, S. Chand, New Delhi
7) Engineering Physics by V. Rajendran, McGraw Hill Education, New Delhi
8) Engineering Physics by G. Aruldas, PHI Learning, New Delhi

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Differentiate between crystalline and amorphous solids, and describe the fundamental properties of crystal lattices, unit cells, and symmetry elements.	PO1, PO2, PO3 PSO1	U	C	12
CO2	Analyze crystal structures using Miller indices and interplanar spacing, and apply these concepts to identify and interpret common cubic crystal systems such as SC, BCC, and FCC.	PO1, PO2, PO3 PSO1, PSO2	Ap, An	C, P	13
CO3	Explain the fundamental concepts, types, and unique properties of nanomaterials, including the significance of surface area to volume ratio.	PO1, PO3, PO6 PSO1	U	C	14

CO4	Compare and evaluate various nanomaterial synthesis techniques, including topdown and bottomup approaches such as ball milling, PVD, CVD, and solgel methods, and discuss their applications and environmental implications.	PO1, PO2, PSO1, PSO2	An, E	C, P	11
CO5	Perform and analyze experiments related to crystal structures, quantum mechanics, and nanomaterials to determine physical constants such as the lattice constant and Planck's constant.	PO1, PO3, PO6, PO7 PSO1, PSO2	Ap, An	P	20
CO6	Apply theoretical principles to experimental techniques in mechanics, electronics, and modern physics—such as Thevenin's theorem, viscosity measurements, and radioactive decay simulations—to validate physical laws and models.	PO1, PO3, PO6, PO7 PSO1, PSO2	Ap, An	P	20
				Total hour of Instruction	**90**

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	2	3								3	
CO2	3	2	3								3	3
CO3	3		3			3					3	
CO4	3	2									3	3
CO5	3		3			3	3				3	3
CO6	3		3			3	3				3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Microbiology Semester V SEC (Skill Enhancement Course)

SEC311-3C – Virology

COURSE OUTCOMES:

- CO1: Describe the structural features, classification systems, and sub-viral entities associated with viruses.
- CO2: Explain the methods of virus cultivation using in vivo and in vitro systems, including identification of cytopathic effects.
- CO3: Illustrate the replication cycles of bacteriophages, plant viruses, and animal viruses with suitable examples.

TEACHING AND EVALUATION SCHEME:

Course code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Theory	Hrs.	Max Marks CCE	Max Marks SEE	
SEC311-3C	Virology	2	2	2	25	25	50

Unit 1 Introduction to viruses and sub-viral entities **Teaching Hours: 15 (Weightage 50%)**

- General characteristics and structural organization of virus
- Classification of viruses: ICNV and Cryptogram system of viral classification
- Cultivation of viruses
  - Cultivation in animal
  - Cultivation in embryonated eggs
  - In vitro culture: cell lines, primary and secondary cell lines, continuous cell lines, cytopathic effects
- Sub-viral entities: viroids, virusoids, prions, introduction to persistent, latent and slow viruses, oncogenic viruses

Unit 2 Bacteriophages, plant viruses and animal viruses **Teaching Hours: 15(Weightage 50%)**

- Lytic cycle (T4 Phage)
  - One step growth curve experiment, burst size
  - Phage adsorption and penetration, intracellular development, early and late events, replication of phage chromosome, phage morphogenesis (assembly) and release
- Single stranded DNA and RNA phages: ΦX174 and MS2.
- Lysogenic cycle (lambda phage): Mechanism of establishment, induction, and replication.
- Plant Viruses: Introduction and replication of plant viruses (TMV)
- Animal viruses: Introduction and replication (adsorption, penetration, uncoating, replication, synthesis and assembly, and release) of animal viruses in general (HIV)

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

***SEE:** Semester End Evaluation

Reference Books:

1. Microbiology. Author-Pelczar MJ, Chan ECS and Krieg NR, Publisher Tata McGraw-Hill, India.
2. Prescott, Harley, and Klein's Microbiology, J. M. Willey, L. M. Sherwood, C. J. Woolverton, 7th Edition (2008), McGraw Hill Higher Education- USA.
3. Principles of Microbiology, R. M. Atlas, 2nd Edition (Indian Edition) (2015), McGraw Hill Education (India) Private Limited–New Delhi.
4. Basic Virology, Wagner E K, Hewlett N J, Bloom D C and Camerini D, Publisher-Wiley-Blackwell, USA.

Suggested Reference Books:

1. Virology: Principles and Applications- John Carter and Venetia A. Saunders, 2nd Edition, Wiley, UK.
2. Principles of Virology, ane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatziioannou, Anna Marie Skalka, 2020 Edition, ASM Press & Wiley, USA.
3. Textbook of Microbiology- Ananthanarayanan, R., & Paniker, Publisher: C. K. J. Universities Press, India.

	Course Outcome	POs/ PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Describe the structural features, classification systems, and sub-viral entities associated with viruses.	PO1, PO2, PO6, PSO1	U, R	C	8
CO2	Explain the methods of virus cultivation using in vivo and in vitro systems, including identification of cytopathic effects.	PO1, PO3, PO6, PSO2	U, R	C, P	10
CO3	Illustrate the replication cycles of bacteriophages, plant viruses, and animal viruses with suitable examples.	PO2, PO3, PO4, PSO1, PSO2	U, E, Ap	C, P	12
	Total hour of Instruction				**30**

Mapping of COs with POs & PSOs

CO	PO										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3				3					3	
CO2	3		3			3						3
CO3		3	3	2		3					3	3

3: High, 2: Medium, 1: Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester V Skill Enhancement Course

SEC312-3C INDUSTRIAL CHEMISTRY - III

Course Outcomes:

- CO1:Describe the elementary concept of Industrial unit operations and unit process.
- CO2: Demonstrate industrial unit operations and unit processes via drying operation and nitration process.
- CO3: Identify and classify the effluent treatment and waste management in industry.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks CCE	Max Marks SEE	
SEC 312-3C	Industrial Chemistry - III	2	0	2	2	25	25	50

CONTENT

Unit	
1	**Unit Processes in organic chemicals manufacture (Weightage 50%)** **Teaching hours:15** Elementary concepts of Unit operation and Unit Process, Flow sheet preparation and elements of process flow diagram, Symbols, abbreviations and rules for Flow sheetpreparation.Typicalflowdiagramofsingleunitprocess.Ideaofflowdiagram of multiple processes. Continuous Vs Batch operations. Raw materials, intermediates, end products, by products and waste. Unit operation-drying asanExample-Introduction, free moisture, bound moisture, dryingcurve,equipment-traydryer,rotarydryer,flashdryer,fluidbeddryer,drum dryer and spray dryer. Unit process-nitration as an Example-Introduction, nitrating agents, mechanism and nitration of paraffin hydrocarbons - benzene to nitrobenzene, m-dinitrobenzene.
2	**Effluent Treatment and Waste Management (Weightage 50%)** **Teaching hours:15** Effluent Treatment and waste Management: Principle and equipments for aerobic, anaerobic treatment, adsorption, filtration, sedimentation. Bag'filters, Electrostatic precipitator, mist eliminitors, wet scrubbers. Solid waste management and Industrial safety.

***CCE:** Continuous and Comprehensive Evaluation: It consists of Assignments / Seminars / Presentations / Quizzes / Surprise Tests.

***SEE:** Semester End Evaluation

REFERENCEBOOKS

- Unit process in Organic Synthesis by P.M. Groggins,Tata Mcgraw Hill Publishing Company Ltd.
- Comprehensive Industrial Chemistry-P.G.More, Pragati Prakashan
- Industrial Chemistry-B.K. Sharma, Goel Publishing House
- McCabe, Smith & Harriott, Unit Operations of Chemical Engineering, 5th edition, McGraw – Hill Inc., New York

SUGGESTEDBOOKS

- Shreve'sChemicalProcessIndustries-byGeorgeT.Austin.Mcgraw-HillBook Company, Inc. New York
- Outline of Chemical Industries- Dryden East-West Press Pvt. Ltd
- Riegel's Hand book of Industrial Chemistry-J.A. Kent, C B S Publishers, New Delhi.
- K.A.Gavhane, Unit – Operations I and II, Nirali Prakashan, Pune–2010.
- Perry's Chemical Engineers' Handbook – he McGraw- Hill Companies, Inc.

	Course Outcome	POs/PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Describe the elementary concept of Industrial unit operations and unit process.	PO1,PO2, PSO1	U,R	C	05
CO2	Demonstrate industrial unit operations and unit processes via drying operation and nitration process.	PO1, PO2, PO3,PSO1	U,R,Ap	C,P	10
CO3	Identify and classify the effluent treatment and waste management in industry.	PO1, PO9, PO10,PSO1, PSO2	U,An, Ap	C,P	15
Total Hours of Instructions					**30**

Mapping of Cos with Pos and PSOs

CO	PO										PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3									3	
CO2	3	3	2								3	
CO3	3								3	3	3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester V - Skill Enhancement Course

SEC313-3C Non-Destructive Testing Techniques

COURSEOUTCOMES:

- **CO1:** Define and explain the importance of Non-Destructive Testing (NDT), identify various types of NDT techniques, and describe their advantages and limitations in different application areas.
- **CO2:** Understand and analyze the working principles and applications of fundamental NDT methods such as visual inspection and liquid penetrant testing.
- **CO3:** Describe the principles, operational procedures, and practical uses of advanced NDT inspection techniques, including ultrasonic testing, eddy current testing, magnetic particle detection, and X-ray radiography.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits	ExaminationScheme			TotalMarks
					Hrs.	MaxMarks		
		Theory PerWeek	Practical Per week			CCE	SEE	
SEC313-3C	Non-Destructive Testing Techniques	2	0	2	2	25	25	50

Unit 1: Introductionof Non -Destructive Testing (NDT) **Teaching Hours: 15 (Weightage 50%)**

Definition of Non-Destructive Testing, Need for NDT Techniques and its Applications, Types of NDT Techniques, Benefits from Non-Destructive Testing, Nature of Flaws, Various Steps involved in Non-Destructive Testing, Uses of NDT Techniques for Applications other than Flaw Detection.
Visual Inspection; Principle, working, applications
Liquid Penetrant Testing; Principle, working, applications

Unit 2: NDT Inspection Methods **Teaching Hours: 15 (Weightage 50%)**

Ultrasonic Testing; Principle, working, applications
Eddy Current Testing; Principle, working, applications
Magnetic Particle Flaw Detection; Principle, working, applications
X-ray Radiography: Principle, working, applications

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books

1) Non-Destructive Testing Techniques, Ravi Prakash, New Academic Science.
2) Practical Non-destructive Testing – Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House
3) Non-destructive testing, R. Hatmshaw, London: E. Arnold
4) Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, HAL, Bangalore
5) Non-destructive testing, Warren J. McGonnagle, Gordon Breach, Science Publishers Ltd

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session
CO1	Define and explain the importance of Non-Destructive Testing (NDT), identify various types of NDT techniques, and describe their advantages and limitations in different application areas.	PO1, PO2, PO3 PSO1	U	C	8
CO2	Understand and analyze the working principles and applications of fundamental NDT methods such as visual inspection and liquid penetrant testing.	PO1, PO2, PO3 PSO1	U, An	C, P	7
CO3	Describe the principles, operational procedures, and practical uses of advanced NDT inspection techniques, including ultrasonic testing, eddy current testing, magnetic particle detection, and Xray radiography.	PO1, PO3, PO7 PSO1, PSO2	U, Ap	C, P	15
				Total hour of Instruction	**30**

Mapping of Cos with Pos & PSOs

COs	POs										PSOs	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	3								3	
CO2	3	3	3								3	
CO3	3		3				3				3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester V - Skill Enhancement Course

SEC314-3C Mathematical Logic

Course Outcomes:

- **CO1:** Construct accurate truth tables and classify compound propositions as tautologies, contradictions, or contingencies.
- **CO2:** Translate between English sentences and quantified logical expressions involving predicates, quantifiers, and logical equivalence laws.
- **CO3:** Apply formal proof techniques including direct proof, contraposition, and contradiction to validate logical statements.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory Per Week	Practical Per week		Hrs.	Max Marks CCE	Max Marks SEE	
SEC314-3C	Mathematical Logic	2	0	2	2	25	25	50

Unit 1 **Teaching Hours: 15**

Proposition, Negation, Conjunction, Disjunction and exclusive or of propositions and their truth tables, Conditional Statement and its truth table, Converse, Contrapositive and Inverse of conditional statement, Biconditional statement and its truth table, Truth table of compound propositions, Precedence of logical operator.Tautology, Contradiction, Contingency, Logical equivalence of compound propositions, Laws for logical equivalence.

Unit 2 **Teaching Hours: 15**

Introduction of predicates, Universal quantifier, Existential quantifier, Uniqueness quantifier, Negation of quantified expression, Nested quantifiers, Order of quantifiers, Translating English sentences into logical expressions, Translating logical expressions into English language, Rules of inference, Resolution principle.Direct proofs, Proof by contraposition, Trivial proofs, Proof by contradiction, Mistakes in proofs.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books:

1. "Discrete Mathematical Structures with Applications to Computer Science", J. P. Tremblay, R. Manohar, Tata McGraw Hill Publishing Company Limited.
2. "Discrete Mathematics Theory and its Applications", D. S. Malik and M. K. Sen, Cengage Learning Asia Private Limited.
3. "Discrete Mathematics and Its Applications with Combinatorics and Graph Theory", Kenneth H Rosen, McGraw Hill Education (India) Private Limited.
4. "Introduction to Mathematical Logic", Elliott Mendelson, CRC Press Taylor & Francis Group.
5. "Mathematical Logic", Joseph R. Shoenfield, Addison-Wesley Publishing, Company.

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Construct accurate truth tables and classify compound propositions as tautologies, contradictions, or contingencies.	PO1, PO2, PO6, PSO1, PSO2	R, Ap, An	C, P	8
CO2	Translate between English sentences and quantified logical expressions involving predicates, quantifiers, and logical equivalence laws.	PO1, PO2, PO5, PO6, PSO1, PSO2	U, Ap	C, P	12
CO3	Apply formal proof techniques including direct proof, contraposition, and contradiction to validate logical statements.	PO1, PO2, PO3, , PO5,PO6, PSO1, PSO2	R, Ap	C, P	10
Total hours of instruction					30

Mapping of COs with POs & PSOs

CO	PO										PSO	
	1	2	3	4	5	6	7	8	9	10	1	2
CO1	3	3	0	0	0	3	0	0	0	0	3	0
CO2	3	3	0	0	3	3	0	0	0	0	3	3
CO3	3	3	2	0	3	3	0	0	0	0	3	3

3:High, 2:Medium, 1:Low