KADI SARVA VISHWAVIDYALAYA

B.Sc. Curriculum as per NEP

for Semester 6

W.E.F. June 2025

KADI SARVA VISHWAVIDYALAYA

B.Sc. PROGRAMME –Structure (Basic / Hons.) (NEP)

DURATION OF THE COURSE: 4 YEARS (8 SEMESTER)

B.Sc. Semester VI 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)	MBM313-3C	Medical Microbiology	60	0	4*3 = 12	50	50	100
		MBM314-3C	Microbial Ecology and Geomicrobiology	60	0				
		MBM315-3C	Microbiology Practical-VI	0	120				
		CHM316-3C	Inorganic & Analytical Chemistry -IV	60	0				
		CHM317-3C	Organic & Physical Chemistry -IV	60	0				
		CHM318-3C	Chemistry Practicals-VI	0	120				
		MTM322-3C	Group Theory	60	0				
		MTM323-3C	Operations Research	60	0				
		MTM324-3C	Application of Group Theory and Operations Research	0	120				
		PHM319-3C	Quantum Mechanics	60	0				
		PHM320-3C	Statistical Mechanics and Solid State Physics	60	0				
		PHM321-3C	Physics Practical - VI	0	120				
02	Minor (Select any One)	MBE311-3C	Applied Microbiology	30	60	4	50	50	100
		CHE312-3C	Advanced Analytical Techniques-II	30	60				
		PHE313-3C	Rectifier Circuits and Optical Instruments	30	60				
		MTE314-3C	Artificial Intelligence	30	60				
03	AEC	AEC301-3C	Communication and Soft Skills for Professional Success	30	0	2	25	25	50
03	SEC	SEC315-3C	Internship/Research Project	-	120	4	50	50	100
	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%.

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Microbiology Semester VI Major Course - 14
MBM313-3C– Medical Microbiology

COURSE OUTCOMES:

- CO1: Explain the concept of Epidemiology and Host parasite relationship.
- CO2: Discuss types of infection and mechanism of pathogenesis.
- CO3: Examine modes of action of various antimicrobial agents and analyze how microorganisms develop drug resistance and transmission of drug resistance.
- CO4: Analyze the clinical features, transmission, and control measures of major Bacterial diseases.
- CO5: Evaluate clinical features, transmission, and control measures of major Fungal, Viral and Protozoal diseases.
- CO6: Compare Bacterial, Viral, Fungal, and Protozoal diseases based on their causative agents, transmission modes, affected systems, design treatment and preventive strategies.

TEACHING AND EVALUATION SCHEME:

Course code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Theory	Hrs.	Max Marks		
					CCE	SEE	
MBM313-3C	Medical Microbiology	4	4	2.5	50	50	100

Unit 1: Epidemiology of Infectious Diseases **Teaching Hours: 15 (Weightage 25%)**

- Pathogenesis and its mechanisms
- Concepts of epidemiology
- Types of diseases- Epidemic, pandemic and sporadic
- Types of Infections Based on Epidemiology: Zoonotic Diseases, Opportunistic Infections, Nosocomial Infections.
- Infection: Sources, Portal of Entry, Portal of Exit, Mode of transmission, colonization and growth
- Concept of host-parasite relationship and factors affecting it

Unit 2: Antimicrobial Agents **Teaching Hours: 15 (Weightage 25%)**

- Antibiotics- Mode of action
- Antibacterial, Antiviral, Antiprotozoal and Antifungal drugs
- Development of resistance
- Transmission of drug resistance

Unit 3: Epidemiology of Bacterial Diseases **Teaching Hours: 15 (Weightage 25%)**

- Cause, symptoms, preventive measures and treatment of Bacterial Diseases
  - Anthrax, Pertussis (whooping cough), Typhoid, Rocky Mountain spotted Fever, Plague, Diphtheria
  - Cholera, Strep throat, Chlamydiasis (new)
  - Syphilis, Dental Caries (tooth decay), Tetanus
  - Tuberculosis, Lyme Disease , Peptic Ulcer Disease

Unit 4: Epidemiology of Fungal, Viral and Protozoal Diseases

Teaching Hours: 15 (Weightage 25%)

- Cause, symptoms, preventive measures and treatment of
  - Fungal Disease- Cutaneous mycoses: Dermatophytes, Deep Mycoses: Candidiasis, Aspergillosis
  - Virus Disease - Measles, Mumps, Hepatitis, Rabies, Dengue fever
- Protozoa Disease - Malaria, Amebiasis and Leishmaniasis

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

***SEE:** Semester End Evaluation

Reference Books:

1. Textbook of Microbiology- Ananthanarayanan, R., & Paniker, Publisher: C. K. J. Universities Press, India.
2. Mackie & Mccartney Practical Medical Microbiology- Mackie & Mccartney edited by Collee, J. G., Duguid, J. P., Fraser, A. G., & Marimon, B. P., Elsevier, UK.
3. Kuby Immunology- Thomas J. Kindt, Richard A. Goldsby , Barbara A. Osborne, W.H.Freeman & Co Ltd, USA.
4. Microbiology: An Introduction. Authors- Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Addison-Wesley, USA.

Suggested Reference Books:

1. Epidemiology and Infections- C.E.Gordon Smith, Meadowfield, UK.
2. Lecture Notes in Immunology- I.R. Todd, Wiley-Blackwell, UK.
3. Microbiology in Clinical Practice- D.C. Shanson, Butterworth-Heinemann Ltd, UK.
4. Baily & Scotts diagnostic microbiology- Baron, E.J., Peterson, L.R. and Finegold, S.M, C.V. Mosby Company, USA.
5. Mechanism of Microbial Diseases- Chaechter M. Medoff G. and Eisenstein BC, Lippincott Williams and Wilkins, USA.
6. Medical Microbiology- David Greenwood, Richard CD, Slack, John F Peutherer, Churchill Livingstone, UK.

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	Course Outcome	POs/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Explain the concept of Epidemiology and Host parasite relationship	PO1, PO2, PSO1	U, R	C	5
CO2	Discuss types of infection and mechanism of pathogenesis.	PO3, PO4, PO6, PSO1	U, R, Ap	C, P	10
CO3	Examine modes of action of various antimicrobial agents and Analyze how microorganisms develop drug resistance and transmission of drug resistance	PO3, PO4, PO6, PO8, PSO2	U, E, An	C, P	15
CO4	Analyze the clinical features, transmission, and control measures of major Bacterial diseases	PO1, PO2, PO4, PSO1	U, R, Ap, An	C, P	12
CO5	Evaluate clinical features, transmission, and control measures of major Fungal, Viral and Protozoal diseases	PO1, PO2, PO4, PSO1	U, R, Ap, An	C	12
CO6	Compare Bacterial, Viral, Fungal, and Protozoal diseases based on their causative agents, transmission modes, affected systems, and Design treatment and preventive strategies.	PO1, PO4, PO 8, PSO2	Ap, An, C	C, P	6
	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	3										
CO2			3	3		3					3	
CO3			3	3		3		2			3	
CO4	3	3		3								2
CO5	3	3		3							3	
CO6	3			3				2			3	

3: High, 2: Medium, 1: Low

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Microbiology Semester VI Major Course -15
MBM314-3C– Microbial Ecology and Geomicrobiology

COURSE OUTCOMES:

- CO1: Understand the concept of Environment, Microbial Ecology and Ecosystem.
- CO2: Discuss soil micro flora, role of microbes in formation of soil and biogeochemical cycles.
- CO3: Describe physicochemical characteristics soil, its formation and role of microbes in soil formation.
- CO4: Illustrate Sampling devices for collection of bioaerosol and Air Sanitation.
- CO5: Describe the sources of microorganism in air and air borne pathogens and toxins.
- CO6: Discuss Microbial interaction with other organisms and their applications.

TEACHING AND EVALUATION SCHEME:

Course code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	Examination Scheme			Total Marks
			Theory	Hrs.	Max Marks		
					CCE	SEE	
MBM314-3C	Microbial Ecology and Geomicrobiology	4	4	2.5	50	50	100

Unit 1: Ecology and Environment **Teaching Hours: 15 (Weightage 25%)**

- Introduction to Environment: Structure of earth Environment: Lithosphere, Hydrosphere and Atmosphere.
- Abiotic and Biotic Factors of Environment.
- Deterioration of Environment and Conservation strategies of Environment.
- Microbial ecology and Ecosystem: Introduction and Characteristics, Concept of ecology, Structure, function and types of ecosystem, Food Chain
- Ecological pyramids- pyramid of numbers, pyramid of biomass, pyramid of energy, Flow of energy in ecosystem.
- Ecological succession.
- Concept of Biomes: Terrestrial and Aquatic biomes

Unit-2: Soil Microbiology **Teaching Hours: 15 (Weightage25%)**

- Physicochemical characteristics of soil, soil formation
- Soil microflora: Bacteria, Fungi, Algae, Protozoa, Viruses
- Microorganisms and Formation of Different soils
- Use of Winogradsky column in studying microbial diversity in soil
- Rhizosphere and its significance, Rhizoplane and Phyllosphere
- Various Biogeochemical cycles- N,O,P,C,S,H Cycles

Unit 3: Air Microbiology **Teaching Hours: 15 (Weightage25%)**

- Composition of air. Aerosol and its types, Air flora
- Sources of micro-organisms in air: Droplets, Droplets Nuclei, Infectious dust
- Importance of air borne pathogens and toxins
- Sampling Devices for collection of bioaerosol
- Microbial Survival in air
- Bioaerosol Control
- Air Sanitation
- Concept of Astromicrobiology
- Biosafety in Laboratories
- Biological Agent Classification

Unit 4: Microbial Interactions **Teaching Hours: 15 (Weightage 25%)**

- Concept of Microbial Interactions
- Plant Microbe interaction
- Animal Microbe Interaction
- Microbe- Microbe interaction

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

***SEE:** Semester End Evaluation

Reference Books:

1. Prescott, Harley, and Klein's Microbiology- J. M. Willey, L. M. Sherwood, C. J. Woolverton. McGraw-Hill Higher Education, United States.
2. Principles of Microbiology- R. M. Atlas. McGraw-Hill Higher Education, USA.
3. Microbial Ecology- Fundamentals and applications - Atlas, R.M. and Bartha, Benjamin Cummings (an imprint of Pearson Education), USA.
4. Environmental Microbiology- Maier, Pepper and Gerba, Academic Press, USA.
5. Cell Biology, Genetics, Molecular biology, Evolution and Ecology- Verma and Agrawal. S. Chand & Company Ltd, India

Suggested Reference Books:

1. Environmental Microbiology- P.D. Sharma, CBS Publishers & Distributors Pvt Ltd, India.
2. Environmental Microbiology- K.G. Vijaya, MJP Publishers, India.
3. The nature and properties of soil- Harry buckman and Nyle C. brady, Pearson Education, USA.
4. Introduction to soil Microbiology- Martin Alexander, Krieger Publishing Company, USA.

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	Course Outcome	POs/ PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Understand concept of Environment, Microbial Ecology and Ecosystem.	PO1, PO9,PSO1	U, R	C	15
CO2	Discuss soil micro flora, role of microbes in formation of soil and biogeochemical cycles.	PO1, PO2, PO4, PO9, PSO1, PSO2	U, R, Ap	C,P	9
CO3	Describe physicochemical characteristics soil, its formation and role of microbes in soil formation.	PO1, PO4, PO7, PSO1, PSO2	U, R, Cr	C, P	6
CO4	Illustrate sampling devices for collection of bioaerosol and air Sanitation.	PO1, PO6, PO7, PO9, PSO1,PSO2	U, Ap	C, P	10
CO5	Evaluate the sources of microorganism in air and air borne pathogens and toxins.	PO1, PO2, PO3,PO9, PSO1, PSO2	U, R	C, P	5
CO6	Discuss microbial interaction with other organisms and their applications.	PO1, PO2, PO9, PSO1	U, R, An	C	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								3		3	
CO2	3	3		2					3		3	3
CO3	3			2			2				3	3
CO4	3					1	2		3		3	3
CO5	3	3	1						3		3	
CO6	3	3							3		3	

3: High, 2: Medium, 1: Low

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Microbiology Semester VI Major Course -16
MBM315-3C – Microbiology Practical VI

COURSE OUTCOMES:

- CO1: Report and Analyze antibiotic sensitivity patterns of Microorganisms.
- CO2: Perform isolation and identification of clinically important Gram-positive and Gram-negative bacteria using staining and biochemical tests.
- CO3: Analyze and interpret urine analysis and serological tests to detect infection and metabolic disorders.
- CO4: Demonstrate the procedure for isolation of microorganisms from various environmental sources like soil, air, and rhizosphere.
- CO5: Identify and classify soil fungi and actinomycetes based on their morphological and cultural characteristics.
- CO6: Construct and analyze ecological models such as the Winogradsky column to study microbial diversity and interactions.

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	
MBM 315-3C	Microbiology Practical VI	4	8	5	50	50	100

Practicals

Teaching Hours: 60 (Weightage 50%)

1. Antibiotic sensitivity of Gram negative bacteria by disc diffusion/ Cup Borer Method.
2. Antibiotic sensitivity of Gram positive bacteria by disc diffusion/ Cup Borer Method.
3. Antibiotic sensitivity of fungi by disc diffusion/ Cup Borer Method.
4. To study and isolate skin flora.
5. Isolation and identification of Gram negative organisms
   a. *Salmonella typhi, Salmonalla paratyhi A and Salmonella Paratyphi B*
   b. *Pseudomonas spp.*
   c. *Proteus spp.*
   d. *E.coli*
   e. *Enterobacter spp.*
6. Isolation and identification of Gram Positive bacteria
   a. *Staphylococcus aureus*
   o *Bacillus*

7. Physical examination of urine: Color, Appearance, Odor, Specific Gravity, pH.
8. Chemical examination of urine: Heat and acetic acid test for Proteins, Benedict's qualitative test for Glucose, Rothera's test for Ketone Bodies, Hay's surface tension test for Bile Salts, Phenolphthalein Test for Blood.
9. Acid Fast Staining for detection of *Mycobacterium* species responsible for tuberculosis and leprosy.
10. Quantitative WIDAL tube test.
11. Serologic tests for detection of viral hepatitis.

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

12. Study of Winogradsky Column
13. Total Viable count of Garden soil, Desert soil, Coastal Soil.
14. Isolation of Yeast from Soil.
15. Isolation and identification of Fungi belongs to division Zygomycotina (*Mucor* sp., *Rhizopus* sp.) from Soil.
16. Isolation and identification of Fungi belongs to division Ascomycotina (*Aspergillus* sp., *Penicillium* sp., *Fusarium* sp.) from soil.
17. Isolation and identification of Fungi belongs to division Ascomycotina: *Alternaria* sp., *Curvularia* sp.) from soil
18. Isolation of Actinomycetes from soil.
19. Study of Mycorrhiza and lichens through permanent slides.
20. Isolation and study of Rhizospheric bacteria.
21. Study of Air Flora.

***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. Laboratory Exercises in Microbiology- John P. Harley and Lansing M. Prescott. McGraw-Hill Education, USA.
3. Microbiology: A Laboratory Manual- James G. Cappuccino and Chad Wels, 11th Edition, Global edition, Pearson Education, USA.

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	Course Outcome	POs/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Report and Analyze antibiotic sensitivity patterns of Microorganisms.	PO2, PO4, PO6, PO8 PO9, PSO2	U, An	C, P	10
CO2	Perform isolation and identification of clinically important Gram-positive and Gram-negative bacteria using staining and biochemical tests.	PO3, PO4, PO6, PSO1, PSO2	U, Ap,An	C, P	30
CO3	Analyze and interpret urine analysis and serological tests to detect infection and metabolic disorders.	PO2,PO3, PO4, PO6, , PSO2	Ap, An, E	C, P	20
CO4	Demonstrate the procedure for isolation of microorganisms from various environmental sources like soil, air, and rhizosphere.	PO1,PO2, PO3, PO6, , PSO1,PSO2	U, Ap,	C, P	24
CO5	Identify and classify soil fungi and actinomycetes based on their morphological and cultural characteristics.	PO3, PO4, PO6, PSO1, PSO2	Ap, An	C, P	24
CO6	Construct and analyze ecological models such as the Winogradsky column to study microbial diversity and interactions.	PO2, PO4, PO6, PO8 PO9, PSO2	Ap, An, C	C, P	12
	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		3		3		1	1			3
CO2			3	3		3					2	3
CO3		3	3	3		3						3
CO4	1	3	3			3					2	2
CO5			3	3		3					2	3
CO6		3		3		3		1	1			3

3: High, 2: Medium, 1: Low

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Chemistry Semester VI Major Course

CHM316-3C INORGANIC AND ANALYTICAL CHEMISTRY - IV

Course Outcomes:

- CO1: Describe the significance of hybridization in molecular bonding and geometry.
- CO2: Apply Quantum mechanics to predict molecular orbital properties.
- CO3: Analyze structure, bonding, and spectroscopic properties of metal carbonyls.
- CO4: Explain the fundamental terms and principles of Spectroscopic techniques.
- CO5: Discuss the important spectroscopic method of analysis and their applications.
- CO6: Solve spectroscopic numerical problems in chemistry essential for interpreting spectral data.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						CCE	SEE	
CHM316-3C	Inorganic and Analytical Chemistry-IV	4	0	4	2.5	50	50	100

Content:

UNIT	
1	**Quantum Mechanics and Hybridization** **Teaching Hours:15(Weightage25%)** Introduction to Hybridization: Significance in molecular bonding and geometry. Variation Method: Concept and application in molecular systems. Secular Equation: Use in Molecular Orbital Theory to determine energy levels. Stability of H_2^+(M.O.T.): Bond order and stability using M.O.T. Stability of H_2(V.B.T.): Bond formation and stability through Valence Bond Theory. Classical Interaction Energy: Coulombic and exchange interactions in bonding. Hybrid Orbitals : sp, sp^2, sp^3 hybridization and associated bond angles and bond strength. .Pauli's Exclusion Principle: Quantum mechanical explanation in molecular orbitals.

2	**Metal Carbonyl Compounds** **Teaching Hours:15(Weightage25%)** Introduction: Definition, significance, and applications in catalysis and material science. Classification: Mononuclear: Structure and bonding, Polynuclear : Examples of bridging carbonyls. Physical and Chemical properties. Metal-Carbonyl Bonding : V.B.T:σ-donation and π-back bonding, M.O.T : Metald-orbitals interacting with CO. IR Spectroscopy : Identification of terminal and bridging carbonyl groups. Structures of Metal Carbonyls : Mononuclear : $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$,Polynuclear : $Fe_2(CO)_9$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$, $Fe_3(CO)_{12}$,EAN: Calculation for metal atoms in carbonyl complexes.
3	**Fundamentals of Spectroscopy:** **TeachingHours:15(Weightage25%)** Electromagnetic radiations, Wavelength, wave number, frequencies, energy, Electromagnetic spectrum, Absorption and Emission spectra. **UV-Visible Spectroscopy:** Introduction, Absorption law. Beer's-Lambert's Law, Instrumentation, Types of electronic transitions, Chromophore, Auxochrome, Absorptionand Intensity shift, Woodward-Fieser rule for calculating absorption maximumin – Dienes and α-β-unsaturated carbonyl compounds, Applications, Problems / Numerical based on Woodward- Fieser rule and Beer's-Lambert's Law.
4	**Infra-Red (IR) Spectroscopy** **Teaching Hours: 15 (Weightage 25%)** Introduction, Principal of IR spectroscopy, Molecular vibrations, Vibrational frequency-Hooks-Law, Factors influencing vibrational frequency-Fermi resonance, Electronic effect, Hydrogen bonding and Bond angle, Degree of freedom(3N), Number of fundamental vibrations, Important IR frequencies, Instrumentation, Applications and Problems (Spectral and Numerical).

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

***SEE:** Semester End Evaluation

REFERENCEBOOKS

- Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, Richard L.Keiter, OkhilK. Medhi.
- Advanced Inorganic Chemistry byG. D. Tuli, Madan. Basu andSatya Prakash.
- Quantum chemistry by R.K.Prasad 6.ConciseinorganicChemistrybyJ.D.Lee
- Principles of Inorganic Chemistry, Puri, Sharma & Kalia.
- 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.

SUGGESTEDBOOKS

- Valency and Molecular structure by Cartmell and Fowles.
- Quantum mechanics by R K Prasad.

- Spectrometric Identification of Organic compounds – Robert M Silverstein, John Wiley & Sons.
- Quantitative Chemical Analysis : Daniel C. Harris, WHF reeman, NewYork.
- Principles of Analytical Chemistry J.H. Kennedy
- Analytical Chemistry – Principles & Techniques L.G. Hargis
- Principles of Instrumental Analysis : Douglas A. Skoog.,F. James Holler, Stanley R. Crouch, Cengage Learning; 6th Edition.

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	Course Outcome	POs/ PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Describe the significance of hybridization in molecular bonding And geometry.	PO1,PO2, PSO1	R,U,Ap	C	07
CO2	Apply Quantum mechanics to predict molecular orbital properties.	PO1,PO2, PO3, PSO1	U, Ap,An	C,P	08
CO3	Analyze structure, bonding, and spectroscopic properties of metal carbonyls.	PO1,PO2, PO3, PSO1	R,U,Ap, An	C,P	15
CO4	Explain the fundamental terms and principles of Spectroscopic techniques.	PO1, PSO1	R,U,Ap	C	05
CO5	Discuss the important spectroscopic method of analysis and their applications.	PO1,PO2, PO6,PO7, PSO1, PSO2	U, Ap,An	C,P	20
CO6	Solve spectroscopic numerical problems in chemistry essential for interpreting spectral data.	PO1,PO2, PO6, PSO1, PSO2	E,Ap,An	C,P	05
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	2								3	
CO3	3	3	2								3	
CO4	3										3	
CO5	3	3				3	2				3	3
CO6	3	3				3					3	3

3:High,2:Medium,1:Low

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Chemistry Semester VI Major Course

CHM317-3C ORGANIC AND PHYSICAL CHEMISTRY - IV

Course Outcomes:

CO1: Explain the concept of Aromaticity inorganic compounds.
CO2: Discuss the classification, nomenclature and properties of Heterocyclic compounds and their significance in the industry.
CO3: Describe the properties, synthesis and reactions of Heterocyclic compounds. CO4: Apply the concepts of Statistical thermodynamics to study molecular properties.
CO5: Describe the basic fundamental concepts of Polymer Chemistry as Macromolecules and their commercial applications.
CO6: Analyze the important properties of Macromolecules and solve numerical based on them.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Practical hrs Per Week			CCE	SEE	
CHM317-3C	Organic and Physical Chemistry-IV	4	0	4	2.5	50	50	100

CONTENT

UNIT	
1	**Aromaticity** **Teaching Hours:15 (Weightage 25%)** Concept of aromaticity –Structure of Benzene, Kekule Structure, Resonance structure, Orbital picture of Benzene, Huckel's rule for aromaticity, Examples of Aromatic, Anti-aromatic and Non Aromatic compounds, Aromaticityof3-membered, 4-membered, 5-membered, 6-membered, 7-membered, 8-membered ring systems, Craig's rule for polycyclic non-benzenoid compounds, Annulenes.
2	**Heterocyclic Compounds** **Teaching Hours:15 (Weightage 25%)** Classification and nomenclature, Structure, molecular orbital picture and aromatic characteristics of Pyrrole, Furan, Thiophene & Pyridine. Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Thiophene, Pyridine (Hantzsch synthesis). Basic character of Pyridine , Piperidine and Pyrrole with mechanism.

3	**Statistical Thermodynamics** **Teaching Hours:15 (Weightage 25%)**	Introduction, Thermodynamic probability, Combination and permutation, Sterling approximate formula (No Derivation), Type of Statistics, Boltzmann's most probable distribution, Bose-Einstein Statistics, Fermi-Dirac Statistics, Partition Function, Translational Partition function, Rotational Partition function and Vibrational Partition function
4	**Macromolecules** **Teaching Hours:15 (Weightage 25%)**	Classification of Polymers, Tacticity of polymers. (Optical Isomers), Polymerizationreactionwith example: Addition Polymerization. (Polyethylene, Polystyrene, PVC), Condensation Polymerization (Nylon-66, Dacron), Mechanisms of Polymerization: Anionic Polymerization, Cationic Polymerization, Free radical chain Polymerization Mechanism, Kinetics of Free radical chain Polymerization, Degree of Polymerization, Molar masses of Polymer (Number Average Molar Mass, Weight Average Molar Mass), Determination of Molar Masses of Macro Molecules: Viscosity Method and Light Scattering Method Numerical

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

***SEE:** Semester End Evaluation

REFERENCE BOOKS

- 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
- O.P. Agrawal, Synthetic Organic Chemistry, Krishna Prakashan Media.
- B.K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut
- V.R. Gowariker, N.V. Viswanathan and Sreedhar, Polymer Science, Wiley Easern Ltd., New Delhi, 1986.
- Textbook of physical chemistry– Glasstone
- Textbook of physical chemistry– P. Atkins.
- Advanced physical chemistry– Gurdeepraj.
- Advanced physical chemistry–J.N. Gurtu,A.Gurtu.
- Statistical thermodynemics–M.C. Gupta.
- F.W. Billmeyar, A textbook of polymer science, John Wiley & Sons,1971.
- Principles of polymer science–Bahadur & Shastry.
- Polymer science & technology–Fried.
- Polymer Chemistry – Malcom P.Stevens.

SUGGESTED BOOKS

- Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher.
- Jonathan Clayden, Nick Greeves,S tuart Warren,Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
- Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications.
- Mehta & Mehta, Organic Chemistry, PHI Learning Private Limited.
- Introduction to Polymer Science and Technology, B Y Mustafa Akay
- M. Jenkins, Biomedical Polymers, University Birmingham.U.K.

- Polymer Chemistry, Billmayer.
- Principles of Polymerization, Geroge Odian.
- Introduction to Statistical Thermodynamics, H. Dole.
- Theoretical Chemistry, S.Glasstone, Affiliated East-West Press.
- Polymer Chemistry, P.J.Flory, Cornell University Press.
- Physical Chemistry of Polymers, A. Tager, Mir Publishers.
- Physical Chemistry of Macromolecules, C.Tanford, Wiley Publisher.
- Polymer Chemistry by Gowarikar, NewAge International.
- Introduction to Polymers, Third Edition, Robert J. Young and Peter A. Lovell, CRC Press.
- Statistical Mechanics by Donald A Mc Quarrie, University Science Books.
- Textbook of physical chemistry – W.J. Moore.

	Course Outcome	POs/ PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Explain the concept of Aromaticity in organic compounds.	PO1,PO2, PSO1	U, Ap,An	C,P	15
CO2	Discuss the classification, nomenclature and properties of Heterocyclic compound sand their Significance in the industry.	PO1,PO2, PSO1	R,U,Ap	C,P	07
CO3	Describe the properties, synthesis and reactions of Heterocyclic compounds.	PO1, PSO1	U,Ap	C,P	08
CO4	Apply the concepts of Statistical thermodynamics to study molecular properties.	PO1,PO2, PO3,PO6, PSO1	U, Ap,An	C,P	15
CO5	Describe the basic fundamental concepts of Polymer Chemistry as Macromolecules and their Commercial applications.	PO1,PO2, PO6,PSO1	R,U,Ap, An	C,P	08
CO6	Analyze the important properties of Macromolecules and solvenumerical based on them.	PO1,PO2, PO3, PSO1	E,Ap,An	C,P	07
Total Hours of Instructions					60

JRPatel

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									3	
CO2	3	3									3	
CO3	3										3	
CO4	3	3	2			2					3	
CO5	3	3				2					3	
CO6	3	3	2								3	

3:High,2:Medium,1:Low

A.N.Patel

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester VI Major Course

CHM318-3C CHEMISTRY PRACTICALS - VI

Course Outcomes:

- CO1: Identify, separate and analyze binary organic mixtures with suitable derivatives for confirmation.
- CO2: Synthesize selected organic compounds and understand reaction mechanisms, purification techniques, and yield calculations with proper documentation of observations.
- CO3: Apply chromatography techniques such as TLC and paper chromatography for the separation and identification of pharmaceutical drugs and biomolecules, interpreting retention behavior (Rf values).
- CO4:Implement conductometric, potentiometric, pH-metric, and colorimetric titration techniques for the accurate determination of acid-base strength, solubility products, and concentrations of chemical solutions.
- CO5: Analyze chemical kinetics and distribution phenomena to determine reaction orders, distribution coefficients, and dimerization behavior in two-phase systems.
- CO6: Measure physical properties such as viscosity, specific rotation, and entropy of vaporization, and interpret results to derive molecular weight, concentration, and thermodynamic parameters.

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Practical hrs Per Week		Hrs.	Max Marks		
						CCE	SEE	
CHM318-3C	Chemistry Practicals-VI	0	8	4	5	50	50	100

CONTENT

A. Organic Practicals **Practical Hrs 60 (Weightage 50%)**

1. Qualitative Analysis (Minimum10)

Analysis of an organic mixture containing two components (one component should be water soluble). Use $NaHCO_3$, NaOH, HCl for Separation /or using distillation process for separation and identification with the preparation of suitable derivatives.

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

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

Solid-Solid,Solid-Liquid,Liquid-Liquid.[Liquidcomponentmustbeneutralinnature]

2. Synthesis of Organic Compounds (Minimum 03)

1) Preparation of p-amino benzoic acid from p-nitrobenzoic acid
2) Preparation of anthraquinone from anthracene.
3) Preparation of 3-methyl – 1 – phenyl pyrazol-5-one from phenyl hydrazine and acetoacetic ester.
4) Preparation of benzoquinone from hydroquinone.
5) Preparation of benzhydrol from Benzophenone

3.Chromatography

1) Analysis of the following drugs (i) Aspirin (ii) Paracetamol (iii) Ibuprofen by thin layer chromatography.
2) To separate and identify a mixture of carbohydrates by ascending paper chromatography.

B. Physical Practicals (Minimum8) **Practical Hrs60 (Weightage50%)**

Instruments, Kinetics & Distributions

1. To determine normality and amount of HCl and CH_3COOH in the given solution by Conductometric titration against NaOH solution.
2. To determine the solubility product and solubility of sparingly soluble salts $PbSO_4$ by Conductometry.
3. To determine Normality and amount of each acid in the given mixture of $HCl+CH_3COOH$ by pH metrically.
4. To determine the strength of strong and weak acid in a given mixture by Potentiometric titration using 0.1 N NaOH
5. To determine the Molecular wt. of high polymer (i.e. polystyrene) by viscosity measurement.
6. To determine the concentration of unknown solution from given $KMnO_4$ solution by Colourimetry.
7. To determine the order of the reaction between $K_2S_2O_8$ and KI.
8. To determine the order of the reaction between H_2O_2 and HI.
9. To determine the distribution coefficient of Iodine between $CCl_4/CHCl_3$& water at a given temperature.
10. To study the distribution of Benzoic acid between Benzene and water at room temperature and prove the dimerization of Benzoic acid in Benzene.
11. Determination of viscosity of given different percentage aqueous solutions of glycerin and determination of concentration of unknown solution, using viscometer.
12. Determination of specific rotation of given substance by preparing 10%, 5% and 2.5% solutions of cane sugar and determination of concentration of its unknown solution by polarimeter.
13. To calculate entropy of vaporization of given liquid by kinetic approach.

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

***SEE:** Semester End Evaluation

REFERENCE BOOK

- V. K. Ahluwalia and Sunita Dhingra, Comprehensive Practical Organic Chemistry: Qualitative Analysis, Universities Press (India) Pvt. Ltd., Hyderabad, 2000.
- Vogel's Textbookof Practical Organic Chemistry', fifth edition Published by ELBS with Longman publishers Pvt. Ltd, Singapore, 1989.
- Arthur, I. V. Quantitative Organic Analysis, Pearson.
- Advanced Practical Chemistry by Jagdamba Singh, Pragati Edition
- Practical Physical Chemistry, A.M. James and F.E.Prichard, Longman.
- Findley's Practical Physical Chemistry, B.P .Lavitt ,Longman.
- Physical Method in Chemistry, R.S. Drago ,Saunders College.

KADI SARVA VISHWAVIDYALAYA

SUGGESTEDBOOKS

- Practical Physical Chemistry, S.R. Palit and S.K.De, Science.
- Experimental Physical Chemistry, R.C. Das and B.Behera, Mc Graw Hill.
- Nirav College Practical Chemistry, Nirav Prakashan
- College Practical Chemistr yby Patel and Turakhia, Himalaya Publishing House
- Practical Physical Chemistry, S.R. Palit and S.K. De, Science.

	Course Outcome	POs/ PSOs	CL Cognitive Level	Knowledge Category	Class Session
CO1	Identify, separate and analyze binary organic mixtures with suitable derivatives for confirmation.	PO1, PO2,PSO2	Ap,An	C,P	24
CO2	Synthesize selected organic compounds and understand reaction mechanisms ,purification techniques, and yield calculations with proper documentation of observations.	PO1, PO2,PO3, PSO2	Ap,An	C,P	16
CO3	Apply chromatography techniques such as TLC and paper chromatography for the separation and identification of pharmaceutical drugs and biomolecules, interpreting Retention behavior (Rfvalues).	PO1, PO2,PO6, PO7, PSO2	U, Ap,An	C,P	12
CO4	Implement conductometric, potentiometric, pH-metric, and colorimetric titration techniques for the accurate determination of acid-basestrength, solubility products, and Concentrations of chemical solutions.	PO1,PO2, PO7,PSO2	U, Ap,An	C,P	22
CO5	Analyze chemical kinetics and distribution phenomena to determine reaction orders, distribution coefficients, and dimerization Behavior in two- phase systems.	PO1,PO2, PO6,PO7, PSO2	E,Ap,An	C,P	20
CO6	Measure physical properties such as viscosity, specific rotation, and entropy of vaporization, and interpret results to derive molecular weight, concentration, and thermodynamic parameters.	PO1,PO2, PO3,PSO2	E,Ap,An	C,P	26
	Total Hours of Instructions				120

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										3
CO2	3	3	2									3
CO3	3	3				2	3					3
CO4	3	3					3					3
CO5	3	3				2	3					3
CO6	3	3	2									3

3:High,2:Medium,1:Low

JCNPatel

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester VI – Major Course

MTM322-3C Group Theory

Course Outcomes:

- **CO1:** Understand relations, equivalence relations, binary operations, and modular arithmetic in integers.
- **CO2:** Define and analyze algebraic structures like semigroups, monoids, and groups with examples.
- **CO3:** Explore subgroups, cyclic groups, cosets, and apply Lagrange's theorem.
- **CO4:** Work with permutations, their types, and symmetric and alternating groups.
- **CO5:** Understand normal subgroups, quotient groups, and their properties.
- **CO6:** Apply group homomorphism's, isomorphism's, and related theorems including Cayley's and fundamental homomorphism theorem.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM322-3C	Group Theory	4	4	2.5	50	50	100

Unit 1 **Teaching Hours: 18**

Relation, Equivalence relation, Binary operations, Division algorithm for integers, Congruence modulo relation in Z, Algebraic structure, Semi group, Monoid, Definition and examples of group, Elementary properties of group, Theorems on group, Finite groups and their tables.

Unit 2 **Teaching Hours: 10**

Subgroups, Normalizer and Centralizers, Order of a group, Order of an element, Cyclic group, Cosets and its properties, Lagrange's theorem and its applications.

Unit 3 **Teaching Hours: 19**

Permutation, Cycle, Transposition, Even and odd permutation, Order of a permutation, Inverse of a permutation, Symmetric and Alternating groups, Normal subgroup, Quotient group.

Unit 4 **Teaching Hours: 13**

Homomorphism of group: Definition and examples, Kernal of Homomorphism, Definition and examples of Isomorphism, Fundamental theorem of homomorphism, Caley's theorem, Automorphism of groups.

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

*SEE: Semester End Evaluation

Reference Books:

1. "Contemporary Abstract Algebra" Joseph A. Gallian, CRC Press, Taylor & Francis Group.
2. "Abstract Algebra", I. H. Sheth, Prentice Hall of India (PHI) Publication.
3. "Topics in Algebra", I. N. Herstein, Wiley Eastern Ltd.
4. "Basic Algebra Vol I & II", N. Jacobson, Hindustan Publishing company.
5. "A text book of Modern Algebra", Shanti Narayan, S. Chand & Co.
6. "Basics Abstract Algebra", P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, Cambridge University Press.
7. "Advanced Abstract Algebra", S. K Pundir, Krishna Prakashan Media (P) Ltd., Meerut.
8. "Algebra", Maclane Saunders and Birkhoff Garrett, MacMillan, New York.

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Understand relations, equivalence relations, binary operations, and modular arithmetic in integers.	PO1, PO2, PO3, PSO1, PSO2	R, U, Ap,	C, P	8
CO2	Define and analyze algebraic structures like semigroups, monoids, and groups with examples.	PO1, PO2, PO3, PSO1, PSO2	R, U, An	C, P	10
CO3	Explore subgroups, cyclic groups, cosets, and apply Lagrange's theorem.	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap, An, E	C, P	10
CO4	Work with permutations, their types, and symmetric and alternating groups.	PO1, PO2, PO3, PO4, PSO1, PSO2	R, U, Ap, E	C, P	10
CO5	Understand normal subgroups, quotient groups, and their properties.	PO1, PO2, PO3, PO6, PSO1, PSO2	R,U, Ap	C, P	9
CO6	Apply group homomorphism's, isomorphism's, and related theorems including Cayley's and fundamental homomorphism theorem.	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	R, Ap, E, C	C, P	13
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	3
CO2	3	3	3	0	0	0	0	0	0	0	3	3
CO3	3	3	3	0	0	3	0	0	0	0	3	3
CO4	3	3	3	2	0	0	0	0	0	0	3	3
CO5	3	3	3	0	0	3	0	0	0	0	3	3
CO6	3	3	3	2	0	3	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester VI - Major Course

MTM323-3C Operations Research

Course Outcomes:

- **CO1:** Explain the nature, scope, assumptions, and limitations of linear programming models used in Operations Research.
- **CO2:** Formulate and solve linear programming problems using the Simplex method, Two-phase method, and Big-M method.
- **CO3:** Construct and interpret the dual of a linear programming problem and solve using the Dual Simplex Method.
- **CO4:** Apply integer programming techniques such as Gomory's methods and the Branch and Bound method to obtain optimal integer solutions.
- **CO5:** Solve transportation and assignment problems using standard algorithms including the MODI and Hungarian methods.
- **CO6:** Analyze sequencing problems and determine optimal job schedules for different machine-job configurations.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM323-3C	Operations Research	4	4	2.5	50	50	100

Unit 1 Linear Programming Problem **Teaching Hours: 15**

Nature and scope of Operations Research, Introduction of Linear Programming Problem (LPP), Assumption of an LP model, Advantages and Limitations of linear programming, Feasible, Infeasible and Basic solutions, Standard form of an LPP, Simplex Algorithm, Two-Phase method, Big-M method.

Unit 2 Duality in Linear Programming and Integer Linear Programming **Teaching Hours: 20**

Symmetric Dual form, Rules for constructing the dual form, Duality theorem, Dual simplex method, All integer programming problem, Mixed integer programming problem, Gomory's all integer programming algorithm, Gomory's mixed integer programming algorithm, Branch and bound method.

Unit 3 Transportation and Assignment Problems **Teaching Hours: 15**
Mathematical formulation of a transportation problem, North-West corner method, Least cost method, Vogel's approximation method, MODI method, Unbalanced transportation problem, Degeneracy in Transportation problem, Prohibited transportation route, Maximization transportation problem. Mathematical formulation of assignment problem, Hungarian method for solving assignment problem, Maximization case in assignment problem, Unbalanced assignment problem, Restrictions on assignments.
Unit 4 Sequencing Problems **Teaching Hours: 10**
Notations, Terminology, Assumptions of sequencing problem, Processing n jobs through two machines, Processing n jobs through three machines, Processing n jobs through m machines, Processing two jobs through m machines.

Reference Books:

1. "Operations Research Theory and Applications", J.K. Sharma, Macmillan Publishers India Ltd.
2. "Operations Research", Nita H. Shah, Ravi M. Gor, HardikSoni, PHI Learning Private Limited.
3. "Optimization Methods in Operations Research and System Analysis", K.V. Mittal, C. Mohan, New Age International Publishers.
4. "Operations Research", Pradeep Jha, McGraw Hill Education.
5. "Operations Research (Principles and Practice)", Pradeep PrabhakarPai, Oxford University, Press.
6. "Operations Research", P. Rama Murthy, New Age International Publishers.
7. "Operations Research", R. K. Gupta, Krishna Prakashan Media (P) Ltd.

KADI SARVA VISHWAVIDYALAYA

CO	Course outcome	POs/PSOs	Cognitive level	Knowledge category	Class session
CO1	Explain the nature, scope, assumptions, and limitations of linear programming models used in Operations Research.	PO1, PO2, PO5, PSO1	R, U	C	5
CO2	Formulate and solve linear programming problems using the Simplex method, Two-phase method, and Big-M method.	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap,	C, P	10
CO3	Construct and interpret the dual of a linear programming problem and solve using the Dual Simplex Method.	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap,	C, P	10
CO4	Apply integer programming techniques such as Gomory's methods and the Branch and Bound method to obtain optimal integer solutions.	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	U, Ap, An	C, P	10
CO5	Solve transportation and assignment problems using standard algorithms including the MODI and Hungarian methods.	PO1, PO2, PO3, PO6, PSO1, PSO2	U, Ap, An,	C, P	15
CO6	Analyze sequencing problems and determine optimal job schedules for different machine-job configurations.	PO1, PO2, PO3, PO4, PO6, PSO1, PSO2	Ap, C, E	C, P	10
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	1	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	2	0	3	0	0	0	0	3	3
CO5	3	3	3	0	0	3	0	0	0	0	3	3
CO6	3	3	3	2	0	3	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Mathematics Semester VI – Major Course

MTM324-3C Applications of Group Theory and Operations Research

Course Ootcomes:

- **CO1:**Analyze and solve problems on relations, equivalence relations, groupoids, semigroups, monoids, groups, and subgroups through examples in lab sessions.
- **CO2:**Determine the order of elements and verify Lagrange's theorem through structured examples in group theory.
- **CO3:**Solve and interpret examples related to permutations, permutation groups, homomorphism's, and isomorphism's in group theory
- **CO4:**Formulate and solve linear programming problems using the Simplex algorithm, two-phase method, Big-M method, and duality concepts through computational examples.
- **CO5:**Apply Gomory's cutting plane methods and Branch-and-Bound techniques to solve integer and mixed-integer programming models using lab-based scenarios.
- **CO6:**Solve transportation, assignment, and sequencing problems using North-West Corner, Least Cost, Vogel's, MODI, Hungarian, and job-processing techniques on practical datasets.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Practical Per Week		Hrs.	Max Marks		
					CCE	SEE	
MTM324-3C	Applications of Group Theory and Operations Research	8	4	5	50	50	100

Unit 1 Applications of Group Theory **Teaching Hours: 60**

1. Examples on relation and equivalence relation.
2. Examples on groupoid, semi groups and monoids.
3. Examples on group.
4. Examples on sub-group.
5. Examples on order of an element.
6. Examples on Lagrange's theorem.
7. Examples on permutation and permutation group.
8. Examples on homomorphism.
9. Examples on isomorphism.

Unit 2 Applications of Operations Research **Teaching Hours: 60**

1. Examples on simplex algorithm.
2. Examples on two-phase method.
3. Examples on Big-M method.
4. Examples on Primal –Dual.
5. Examples on dual simplex method.
6. Examples on Gomory's all integer programming algorithm.
7. Examples on Gomory's mixed integer programming algorithm.
8. Examples on Branch and bound method.
9. Examples on North-West corner and Least cost method
10. Examples on Vogel's approximation method.
11. Examples on MODI method.
12. Examples on Hungarian method for solving assignment problem.
13. Examples on processing n jobs through two machines
14. Examples on processing n jobs through three machines.
15. Examples on processing n jobs through m machines.
16. Examples on processing two jobs through m machines.

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

*SEE: Semester End Evaluation

Reference Books:

1. "Contemporary Abstract Algebra" Joseph A. Gallian, CRC Press, Taylor & Francis Group.
2. "Abstarct Algebra", I. H. Sheth, Prentice Hall of India (PHI) Publication.
3. "Topics in Algebra", I. N. Herstein, Wiley Eastern Ltd.
4. "Basic Algebra Vol I & II", N. Jacobson, Hindustan Publishing company.
5. "A text book of Modern Algebra", Shanti Narayan, S. Chand & Co.
6. "Basics Abstract Algebra", P.B. Bhattacharya, S. K. Jain, S. R. Nagpaul, Cambridge University Press.
7. "Advanced Abstract Algebra", S. K Pundir, Krishna Prakashan Media (P) Ltd., Meerut.
8. "Algebra", Maclane Saunders and Birkhoff Garrett, MacMillan, New York.
9. "Operations Research Theory and Applications", J. K. Sharma, Macmillan Publishers India Ltd.
10. "Operations Research", Nita H. Shah, Ravi M. Gor, Hardik Soni, PHI Learning Private Limited.
11. "Optimization Methods in Operations Research and System Analysis", K. V. Mittal, C. Mohan, New Age International Publishers.
12. "Operations Research", Pradeep Jha, McGraw Hill Education.
13. "Operations Research", P. Rama Murthy, New Age International Publishers.
14. "Operations Research", R. K. Gupta, Krishna Prakashan Media (P) Ltd.

CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Analyze and solve problems on relations, equivalence relations, groupoids, semigroups, monoids, groups, and subgroups through examples in lab sessions.	PO1, PO2, PO3, PO6. PSO1, PSO2	An, E	C, P	16
CO2	Determine the order of elements and verify Lagrange's theorem through structured examples in group theory.	PO1, PO2, PO3, PO6. PSO1, PSO2	An, E	C, P	22
CO3	Solve and interpret examples related to permutations, permutation groups, homomorphism's, and isomorphism's in group theory	PO1, PO2, PO3, PO6. PSO1, PSO2	Ap, An, E	C, P	22
CO4	Formulate and solve Linear Programming Problems using the Simplex Algorithm, Two-Phase Method, Big-M Method, and duality concepts through computational examples.	PO1, PO2, PO3, PO4, PO6. PSO1, PSO2	Ap, E	C, P	20
CO5	Apply Gomory's cutting plane methods and Branch-and-Bound techniques to solve integer and mixed-integer programming models using lab-based scenarios.	PO1, PO2, PO3, PO4, PO6. PSO1, PSO2	Ap, E	C, P	20
CO6	Solve transportation, assignment, and sequencing problems using North-West Corner, Least Cost, Vogel's, MODI, Hungarian, and job-processing techniques on practical datasets.	PO1, PO2, PO3, PO4, PO5, PO6. PSO1, PSO2	Ap, E	C, P	20
Total hours of Instruction					**120**

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	3	0	0	0	0	3	3
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	1	3	0	0	0	0	3	3

3:High, 2:Medium, 1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester VI - Major Course

PHM319-3C Quantum Mechanics

COURSEOUTCOMES:

- **CO1:** Apply the Schrödinger equation to various potential models such as finite wells and harmonic oscillators.
- **CO2:** Solve the Schrödinger equation in 3D and analyze hydrogen atom wavefunctions and energy levels.
- **CO3:** Interpret quantum angular momentum and use operator formalism including commutators and Pauli matrices.
- **CO4:** Analyze and simulate quantum systems using numerical/computational methods.
- **CO5:** Interpret physical meaning of eigenvalues and eigenfunctions in quantum systems.
- **CO6:** Integrate concepts of wave-particle duality, uncertainty, and probability in physical problem-solving

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination cheme			Total Marks
		Theory PerWeek		Hrs.	Max Marks		
					CCE	SEE	
PHM319-3C	Quantum Mechanics	4	4	2.5	50	50	100

Unit 1: General discussion of bound states in an arbitrary potential

Teaching Hours: 15 (Weightage 25%)

Continuity of wave function, boundary conditions and emergence of discrete energy levels. Application to energy eigen states for a particle in a finite square potential well, Momentum space wavefunction, Time evolution of Gaussian Wave packet, Superposition Principle, linearity of Schrodinger Equation, General solution as a linear combination of discrete stationary states, Observables as operators, Commutator of position and momentum operators, Ehrenfest's theorem.

Unit 2: Harmonic oscillator

Teaching Hours: 15 (Weightage 25%)

Energy eigen values and eigen states of a 1-D harmonic oscillator using algebraic method (ladder operators) and using Hermite polynomials. Zero point energy and uncertainty principle.

Unit-3 Schrödinger Equation in three dimensions

Teaching Hours: 15 (Weightage 25%)

Probability and probability densities in 3D. Schrödinger equation in spherical polar coordinates, its solution for Hydrogen atom solution using separation of angular and radial variables, Angular momentum operator, quantum numbers and spherical harmonics. Radial wave functions from Frobenius method; shapes of the probability densities for ground and first excited states; Orbital angular momentum quantum numbers l and ml, s, p, d shells.

Unit-4 Angular momentumTeaching Hours: 15 (Weightage 25%)

Commutation relations of angular momentum operators; concept of spin and total angular momentum; ladder operators, eigenvalues, eigenvectors; Pauli matrices; addition of angular momenta.

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

*SEE: Semester End Evaluation

Reference Books

1) Quantum Mechanics: Theory and Applications, A. Ghatak and S. Lokanathan, 6th edition, 2019, Laxmi Publications, New Delhi.
2) Introduction to Quantum Mechanics, D. J. Griffith, 2nd edition, 2005, Pearson Education.
3) A Textbook of Quantum Mechanics, P. M. Mathews and K. Venkatesan, 2nd edition, 2010, McGraw Hill.
4) Quantum Mechanics, B. H. Bransden and C. J. Joachain, 2nd edition, 2000, Prentice Hall
5) Quantum Mechanics: Concepts and Applications, 2nd edition, N. Zettili, A John Wiley and Sons Ltd. Publication

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session (Hrs)
CO1	Apply the Schrödinger equation to various potential models such as finite wells and harmonic oscillators.	PO1, PO2, PO3, PO6 PSO1, PSO2	Ap	P	12
CO2	Solve the Schrödinger equation in 3D and analyze hydrogen atom wavefunctions and energy levels.	PO1, PO2, PO3 PSO1, PSO2	An	C	7
CO3	Interpret quantum angular momentum and use operator formalism including commutators and Pauli matrices.	PO1, PO2, PO3 PSO1	U	C	13
CO4	Analyze and simulate quantum systems using numerical/computational methods.	PO3, PO4, PO6, PO7 PSO2	An	P	8
CO5	Interpret physical meaning of eigenvalues and eigenfunctions in quantum systems.	PO1, PO2, PO6 PSO1	U	C	14
CO6	Integrate concepts of wave-particle duality, uncertainty, and probability in physical problem-solving	PO1, PO2, PO3, PO6 PSO1, PSO2	An	C	6
				Total hour of Instruction	**60**

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					3	3
CO2	3	3	3								3	3
CO3	3	3	3								3	
CO4			3	1		3	1					3
CO5	3	3				3					3	
CO6	3	3	3			3					3	3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester VI - Major Course

PHM320-3C Statistical Mechanics and Solid-State Physics

COURSE OUTCOMES:

- **CO1:** Interpret classical probability distributions and their physical relevance.
- **CO2:** Explain macroscopic and microscopic states using phase space and ensemble theory.
- **CO3:** Analyze crystal structures and X-ray diffraction techniques using reciprocal lattice concepts.
- **CO4:** Apply free electron models and Fermi-Dirac statistics to solids.
- **CO5:** Evaluate real-world thermodynamic systems using statistical mechanics.
- **CO6:** Connect theoretical concepts to experimental solid-state phenomena.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory PerWeek		Hrs.	Max Marks		
					CCE	SEE	
PHM320-3C	Statistical Mechanics and Solid State Physics	4	4	2.5	50	50	100

Unit 1: Probability Distributions **Teaching Hours: 15 (Weightage 25%)**

Binomial Distribution: Mean Value and Fluctuations, Stirling Approximation, Poission Distribution: Mean Value and Standard Deviation, Gaussian Distribution: Standard Deviation, Illustrative Examples. Maxwell Distribution: Velocity, Momentum, Energy and some Significant Mean Values.

Unit 2: Macroscopic and Microscopic States **Teaching Hours: 15 (Weightage 25%)**

Macroscopic States, Microscopic States, Phase Space, μ-space, τ-space, Postulates of equal a priori probabilities, Ergodic Hypothesis, Density Distribution in Phase Space, Liouville Theorem, Illustrative Examples.

Unit-3 Reciprocal lattice and determination of crystal structure
Teaching Hours: 15 (Weightage 25%)

Reciprocal Lattice, Bragg Law, Laue's Interpretation of X-ray Diffraction by Crystals, Construction of Reciprocal Lattice, Relation between Real Lattice Vector & Reciprocal Lattice Vector, Application to some Crystal lattice, Analysis of X-ray Diffraction pattern of crystals, Measurement of Diffraction pattern of crystal – The Ewald Construction & Experimental methods, Determination of Lattice Constants, Selection of Incident Beam, Field Ion Microscopy, Illustrative Examples.

Unit-4 Free electron theory of metals **Teaching Hours: 15 (Weightage 25%)**

The Drude Model, Electrical and Thermal conductivity of metals, Lorentz modification of Drude Model, Fermi-Dirac Distribution Function, The Sommerfield Model, The Density of States, The free electron gas at 0 K, Energy of electron gas at 0 K, The Electron Heat Capacity, Thermoelectric Effects, Illustrative Examples

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

*SEE: Semester End Evaluation

Reference Books

1) Fundamentals of Statistical Mechanics, B. B. Laud, New Age International Pvt. Ltd.
2) Fundamentals of Statistical and Thermal Physics, F. Reif, Sarat Book House
3) Statistical Mechanics, R. K. Pathria, Paul D. Beale, Academic Press Inc
4) Elements of Solid State Physics, J P Shrivastava, PHI Learning
5) Introduction to Solid State Physics, C. Kittel, (Eight Edition) John Wiley and Sons
6) Solid State Physics, Ashcroft and Mermin, CENGAGE

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session (Hrs)
CO1	Interpret classical probability distributions and their physical relevance.	PO1, PO2, PO6 PSO1, PSO2	U	C	8
CO2	Explain macroscopic and microscopic states using phase space and ensemble theory.	PO1, PO2, PO3 PSO1	U	C	13
CO3	Analyze crystal structures and X-ray diffraction techniques using reciprocal lattice concepts.	PO1, PO2, PO6, PO7 PSO1, PSO2	An	C	12
CO4	Apply free electron models and Fermi-Dirac statistics to solids.	PO1, PO3, PO6 PSO1	Ap	P	8
CO5	Evaluate real-world thermodynamic systems using statistical mechanics.	PO1, PO2, PO3, PO6 PSO1, PSO2	E	C	12
CO6	Connect theoretical concepts to experimental solid-state phenomena.	PO1, PO2, PO6, PO7 PSO2	Ap	P	7
				Total hour of Instruction	**60**

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	3
CO2	3	3	3								3	
CO3	3	3				3	2				3	3
CO4	3		3			3					3	
CO5	3	3	3			3					3	3
CO6	3	3				3	2					3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Physics Semester VI - Major Course

PHM321-3CPhysics Practical - VI

COURSE OUTCOMES:

- **CO1:** Perform experiments on optical interference and diffraction (e.g., Newton's Rings, F.P. Etalon).
- **CO2:** Determine mechanical, thermal, and electrical properties using precise instruments.
- **CO3:** Evaluate experimental data and validate physical principles using error analysis.
- **CO4:** Develop lab skills using G.M. Counter, Maxwell's Bridge, and Michelson interferometer.
- **CO5:** Interpret and analyze characteristics of solar cell, waveforms, and circuit components.
- **CO6:** Demonstrate ethical lab practices, teamwork, and scientific reporting.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Practical PerWeek		Hrs.	Max Marks		
					CCE	SEE	
PHM321-3C	Physics Practical - VI	8	4	5	50	50	100

Unit-I Teaching Hours: 60(Weightage 50%)

1) Young modulus 'y' by Koening method.
2) Optical Lever
3) Viscosity by Log decrement
4) I-V Characteristic of solar cell and determination of F.F, V.F. &n.
5) G.M. Counter (Comparison of Intensities)
6) To determine air gap 't' between two plates of F.P. Etalon and determination of wavelength
7) Newton's Ring (Determination of Wave length of Light).
8) To determine λ and $d\lambda$ of sodium light using Michelson interferometer

Unit-II Teaching Hours: 60(Weightage 50%)

1) Mutual induction 'M' of two coil using B.G.
2) High resistance 'R' using leakage method
3) Maxwell's Bridge
4) Solenoid Inductor
5) Susceptibility of $FeCl_3$ using Quienk's method
6) A study of Half subtractor and Full subtractor
7) To determine frequency of AFO using Wein bridge
8) Determination of wavelength of light by Lloyd's mirror.

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

***SEE:** Semester End Evaluation

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

KADI SARVA VISHWAVIDYALAYA

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session (Hrs)
CO1	Perform experiments on optical interference and diffraction (e.g., Newton's Rings, F.P. Etalon).	PO1, PO2, PO6 PSO1	Ap	P	20
CO2	Determine mechanical, thermal, and electrical properties using precise instruments.	PO1, PO3, PO6 PSO1, PSO2	Ap	P	20
CO3	Evaluate experimental data and validate physical principles using error analysis.	PO2, PO3, PO6 PSO1, PSO2	E	P	20
CO4	Develop lab skills using G.M. Counter, Maxwell's Bridge, and Michelson interferometer.	PO1, PO3, PO7 PSO1	Ap	P	20
CO5	Interpret and analyze characteristics of solar cell, waveforms, and circuit components.	PO1, PO3, PO6, PO7 PSO1, PSO2	An	P	20
CO6	Demonstrate ethical lab practices, teamwork, and scientific reporting.	PO2, PO6, PO8 PSO2	U	C, 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
CO4	3		3				2				3	
CO5	3		3			3	2				3	3
CO6		3				3		1				3

3:High,2:Medium,1:Low

KADI SARVA VISHWAVIDYALAYA

Microbiology Semester VI Minor Course

MBE311-3C- Applied Microbiology

COURSE OUTCOMES:

- CO1: Classify biofertilizers, biopesticides, and genetically modified crops based on their microbial components and applications.
- CO2: Explain the microbial processes involved in the bioconversion of agro-waste to value-added products.
- CO3: Describe the principles and applications of enzyme immobilization, biosensors, biopolymers, and biofilms.
- CO4: Develop skills to isolate different types of agriculturally important microorganisms from soil and plant samples.
- CO5: Demonstrate enzyme and cell immobilization techniques and their significance in biotechnology.
- CO6: Quantify the production of extracellular polymeric substances and develop skills to isolate polyhydroxybutyrate producing bacteria.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Credit	Teaching Scheme (Hrs. Per Week)	
			Theory	Practical
MBE311-3C	Applied 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

Unit1: Microorganisms in Agriculture **Teaching Hours: 15 (Weightage 25%)**

- Biofertilizers- Nitrogen fixers, PSB, KSB, PGPR, Siderophores and Mycorrhiza.
- Biopesticides- Biopesticides based on fungi (*Trichoderma sp.*); bacteria (*Bacillus thuringenesis* toxin) and viruses.
- Genetically modified crops.
- Bioconversion of Agrocellulosic waste to Value added products: Bioethanol, Biodiesel, Biogas technology, Microbial hydrogen production, Concept of gasohol, Organic acids

Unit-2: Advanced Microbial applications **Teaching Hours: 15 (Weightage 25%)**

- Immobilization of enzymes and cells; Methods for Immobilization; applications of immobilized enzymes.
- Overview of Biosensors and Biochips
- Biopolymers: Properties, Production and Applications ; Xenthan, Dextran and Levan
- Bioplastics; Production and Applications; PHA and PHB
- Biofilms formation: merits- demerits and Control

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

1. Isolation of Pesticide degrading microorganisms.
2. Study Immobilization of enzymes and cells.
3. Isolation of symbiotic nitrogen fixing Bacteria (*Rhizobium)* from Root nodule.
4. Isolation of Non symbiotic nitrogen fixing Bacteria from soil rhizosphere.
5. Isolation and study of Phosphate Solubilizing Bacteria.
6. Isolation and study of Potassium Solubilizing Bacteria.
7. Isolation and study of EPS producing Bacteria.
8. Extraction and Quantification of EPS.
9. Isolation and study of PHB producing Bacteria.

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

***SEE:** Semester End Evaluation

Reference Books:

1. Agriculture Microbiology- G. Rangaswami and D.J. Bagyaraj, PHI Learning Pvt. Ltd., India
2. Microbial Ecology: Fundamentals and applications- Atlas, R.M. and Bartha, Addison-Wesley Publishing Company, London.
3. Microbial Biotechnology: Fundamentals of Applied Microbiology- Alexander N. Glazer and Hiroshi Nikaido, Cambridge University Press, UK.
4. Prescott, Harley, and Klein's Microbiology- J. M. Willey, L. M. Sherwood, C. J. Woolverton. McGraw-Hill Higher Education, USA.
5. Experimental Microbiology- Patel R.J. and Patel R.K., Volume I and II, 9th Edition, Aditya Publisher, India.

Suggested Reference Books:

1. Industrial Microbiology- L.E. Casida Jr., Publisher- New Age International Publishers, India.
2. A Textbook of Practical Microbiology- R.C. Dubey and D.K. Maheshwari, Publisher- S. Chand & Company Ltd., India.
3. Laboratory Exercises in Microbiology- John P. Harley and Lansing M. Prescott, McGraw-Hill Education, USA.

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	Course Outcome	POs/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Classify biofertilizers, biopesticides, and genetically modified crops based on their microbial components and applications.	PO1, PO2, PO9, PSO1	U, R	C	10
CO2	Explain the microbial processes involved in the bioconversion of agro-waste to value-added products.	PO1, PO2, PO3, PO6, PO9, PSO1	U, R,	C, P	12
CO3	Describe the principles and applications of enzyme immobilization, biosensors, biopolymers, and biofilms.	PO2, PO3, PO4, PO6, PO9, PSO1	U, R	C, P	8
CO4	Develop skills to isolate different types of agriculturally important microorganisms from soil and plant samples.	PO1, PO3, PO6, PO9, PSO2	U, Ap,	P	48
CO5	Demonstrate enzyme and cell immobilization techniques and their significance in biotechnology.	PO3, PO6, PSO1, PSO2	U, Ap	C, P	6
CO6	Quantify the production of extracellular polymeric substances and develop skills to isolate polyhydroxybutyrate producing bacteria.	PO2, PO3, PO6, PO7, PSO2	U, C, An	C, P	6
	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	3							3		3	
CO2	3	3	3			3			3		3	
CO3		3	3	1		3			3		3	
CO4	3		3			3			3			3
CO5			3			3					3	3
CO6		3	3			3	1					3

3: High, 2: Medium, 1: Low

KADI SARVA VISHWAVIDYALAYA

Chemistry Semester VI Minor Course

CHE312-3C Advanced Analytical Techniques - II

Course Outcomes:

- CO1: Discuss the concepts involved in various analytical techniques.
- CO2: Explain the principle, theories and applications of volumetric analysis.
- CO3: Discuss the principle, theories and applications of gravimetric analysis.
- CO4: Explain the principle and mechanism of different electrochemical techniques.
- CO5: Implement volumetric analysis to measure the different unknown values of a chemical substance to work effectively in various fields of chemistry.
- CO6: Apply Potentiometric and Conductometric analysis to understand electrochemical reactions.

Course Code	Course Title	Teaching Scheme		Credits
		Theory hrs Per Week	Practical hrs Per Week	
CHE312-3C	Advanced Analytical Techniques-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	**Concepts involved in Analysis** **Teaching Hours: 15 (Weightage 25%)** Scope of analytical chemistry (dyes, drugs, forensic, agriculture, food and nutrition), classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, Accuracy, Precision, errors and its causes and way for minimization. **Volumetric Analysis** PrimaryandSecondarystandards,Principlesofvolumetricanalysis,Acid–basetitration, types of acid-base titration (Theoretical aspects of titration curves and end point evaluation) Titration in non-aqueous solvents, Complexometric titrations, Precipitation titrations(Mohr'smethod,Volhard'smethod,Fajan'smethod),Redoxtitrations-Indicators used in each type.
2	**Gravimetric Analysis:** **Teaching Hours:15 (Weightage 25%)** General principle, Types of gravimetric analysis, Steps of Gravimetric analysis. Precipitation Gravimetric Analysis: Completeness of Precipitation, Weighing Form, Calculation, Application of Gravimetric Analysis. **Electrochemical analysis / Instrumental Methods** Potentiometry: pH metry, principle, instrumentation and mechanism of pH by glass electrode. Conductometry and types of electrodes and explanationof the nature of titration curves.

3	**Practicals (Minimum12)** **TeachingHours:60 (Weightage50%)** **A) Volumetric Titrations** 1. Preparationofstandardsolutionofsuccinicacidandstandardizationof NaOH/KOH solution. 2. Preparation of standard solution of $Na_2S_2O_3$ and standardization of I_2 solution. 3. Preparation of standard solution of EDTA and estimation of Ca^{+2}/Mg^{+2} in $CaCl_2$ / $MgCl_2$ solution. 4. Preparation of standard solution of Oxalic acid and standardization of $KMnO_4$ solution. 5. Preparation of standard solution of $K_2Cr_2O_7$ and standardization of $FeSO_4$ solution. **B)Demonstrations** 2. Preparation of standard stock solution by w/v method and their different dilutions. (Prepare 0.05N and 0.025N NaOH solution from given 0.1N NaOH solution.) 3. Preparation of standard stock solution of HCl by v/v method and their different dilutions. 4. Melting point and Boiling point of an organic compound. 5. Calibration of burette and Pipette. **C) Conductometric titrations** 1. To determine the strength of the given mixture of acids by conductometric titrations (HCl / CH_3COOH vs NaOH) 2. To determine the strength of the given strong acid / base by conductometric titrations (HClVsNH_4OH) **D) pH metric titrations** 1. Calibration ofpH meter using 4 pH buffer solution and determine the strength of the given acid/base using pH metric titrations (HCl Vs NaOH) 2. To determine the Dissociation constant of the acid of mixtures of CH_3COONa and CH_3COOH by pHmeter **E) Potentiometric titrations** 1. Determine the normality and amount of NaCl in given solution by potentiometric method. **F) Gravimetric analysis** **1.** Determination of sulphate ions as barium sulphate. 2. Determination of copper and nickel involving volumetric and gravimetric methods.

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

***SEE:** Semester End Evaluation

REFERENCE BOOKS

- Quantitative Chemical Analysis–by Daniel C.Harris,5th Edition, W.H. Freeman and Company, New York.
- Analytical Chemistry– by GaryD. Christian, 6thEdition, JohnWiley and SonsInc. New Jersey.
- Principles of Instrumental Analysis–by Douglas A.Skoog,3rd Edition, Holt-Saunders International Edition.

- InstrumentalMethodsofChemicalAnalysis-byGalenW.Ewing,4th Edition,
- Quantitative chemical analysis byA.I.Vogel (Longman Series).
- Basic Concepts of Analytical Chemistry-by S.M.Khopkar, New Age International Publishers.
- Instrumental methods of chemical analysis (Analytical Chemistry) – by Gurdeep Chatwal, Himalaya Publication.
- Advanced Practical Chemistry by Jagdamba Singh,Pragati Edition
- College Practical Chemistry by Pate land Turakhia, Himalaya Publishing House

SUGGESTED BOOKS

Instrumental Methods of Chemical Analysis – by Galen W.E wing, 4th Edition, International Student Edition.

- Principles of Instrumental Analysis–by Douglas A.Skoog, 3rd Edition, Holt- Saunders International Edition.
- Quantitative Analysis- by Day and Underwood, Prentice-Hall
- Pharmaceutical Analysis volume 1-by Kasture, Mahadik, Nirali Prakashan
- Instrumental methods of chemical analysis (Analytical Chemistry), Dr.H.Kaur, Pragati Prakashan.
- Nirav College Practical Chemistry, Nirav Prakashan

CO	**Course Outcome**	**POs/ PSOs**	**CL Cognitive Level**	**Knowledge Category**	**Class Session**
CO1	Discuss the concepts involved in various analytical techniques.	PO1,PO2, PSO1	U,R,Ap	C	05
CO2	Explain the principle, theories and applications of volumetric analysis.	PO1,PO3, PO6, PSO1	U, Ap,An	C,P	10
CO3	Discuss the principle, theories and applications of gravimetric analysis.	PO1,PO3, PO6, PSO1	U, Ap,An	C,P	08
CO4	Explain the principle and mechanism of different electrochemical techniques.	PO1,PO2, PO6, PSO1	U,Ap,	C,P	07
CO5	Implement volumetric analysis to measure the different unknown values of a chemical substance to work effectively in various fields of chemistry.	PO1,PO3, PO6,PO7, PSO2	E,An,Ap	C,P	40
CO6	Apply Potentiometric and Conductometric analysis to understand electrochemical reactions.	PO1,PO2, PO6,PO7, PSO2	E,An,Ap	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	2									2	
CO2	3		3			3					2	
CO3	3		3			3					2	
CO4	3	2				3					2	
CO5	3		3			3	3					3
CO6	3	2				3	3					3

3:High,2:Medium,1:Low

S.G.Patel

KADI SARVA VISHWAVIDYALAYA

Physics Semester VI - Minor Course

PHE313-3C Rectifier Circuits and Optical Instruments

COURSE OUTCOMES:

- **CO1:** Understand and evaluate the characteristics of half-wave, full-wave, and bridge rectifiers, including parameters such as output voltage, current, efficiency, ripple factor, and regulation.
- **CO2:** Describe the working principles and applications of inductor, capacitor, choke-input, and C-L-C filters and solve related numerical problems.
- **CO3:** Explain Rayleigh's criterion, limit of resolution, and derive the expressions for resolving power of instruments like telescopes, microscopes, prisms, and diffraction gratings.
- **CO4:** Analyze the interdependence between resolution and magnification, and suggest ways to enhance the resolution of various optical instruments.
- **CO5:** Construct and analyze half-wave and full-wave rectifier circuits with and without filters, and calculate regulation efficiency to evaluate circuit performance.
- **CO6:** Accurately determine physical quantities such as light wavelength, capacitance, and resolving power of optical devices through experimental methods like Edser-Butler fringes, Schering and DeSauty bridges, and optical resolving power setups.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
PHE313-3C	Rectifier Circuits and Optical Instruments	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 Rectifier Circuits **Teaching Hours: 15 (Weightage 25%)**

The Half Wave Rectifier - Output Voltage, Output Current, RMS values, Efficiency, Ripple factor, Regulation, The Full Wave Rectifier - Output Voltage, Output Current, RMS values, Efficiency, Ripple factor, Regulation, The Bridge Rectifier. The Inductor filter, The Capacitor filter, The Choke input filter, C-L-C Filter, related Problems

Unit 2: Optical Instruments **Teaching Hours: 15 (Weightage 25%)**

Resolving Power, Rayleigh's Criterion, Limit of resolution of the eye, Limit of resolution of a convex lens, Resolving Power of Optical Instrument, Conditions for Resolutions according to Lord Rayleigh, Resolving Power of a telescope, Relation between magnifying power of telescope, resolving power of a microscope, ways of increasing resolution, Magnification versus resolution, resolving power of a Prism, Resolving Power of a Plane transmission grating. Illustrative Examples.

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

1) P-N Junction diode as Half Wave Rectifier (i) Without filter (ii) With Series inductor Filter (iii) With Shunt Capacitor Filter. Calculation of percentage of regulation.
2) P-N Junction diode as Full Wave Rectifier (i) Without filter (ii) With Series inductor Filter (iii)With Shunt Capacitor Filter. Calculation of percentage of regulation
3) Wavelength of light using an Edser-A diffraction pattern
4) Value of capacitance C using Schering Bridge.
5) Capacity of two capacitors (C1/C2) by DeSauty method
6) Resolving power of telescope
7) Resolving power of prism.
8) Resolving power of grating

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) Basic Electronics by B. L. Theraja, S.Chand, New Delhi
2) Principals of Electronics – by V K Mehta & Rohit Mehta, S. Chand, New Delhi
3) A Textbook of OPTICS, N. Subrahmanyam, Brijlal, M.N. Avadhanulu, S.Chand, New Dehi
4) Optics by Ajay Ghatak, McGraw Hill
5) Physical Optics and Lasers by J.P. Agrawal, Pragati Prakashan
6) Physical Optics and Lasers by Tripathi and Singh, Kedar Nath Ram Nath

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session (Hrs)
CO1	Understand and evaluate the characteristics of half-wave, full-wave, and bridge rectifiers, including parameters such as output voltage, current, efficiency, ripple factor, and regulation.	PO1, PO2, PO6, PO7 PSO1	E	C	15
CO2	Describe the working principles and applications of inductor, capacitor, choke-input, and C-L-C filters and solve related numerical problems.	PO1, PO3 PSO1	U	C	11
CO3	Explain Rayleigh's criterion, limit of resolution, and derive the expressions for resolving power of instruments like telescopes, microscopes, prisms, and diffraction gratings.	PO1, PO2, PO3 PSO1, PSO2	U	C	14
CO4	Analyze the interdependence between resolution and magnification, and suggest ways to enhance the resolution of various optical instruments.	PO2, PO4, PO6 PSO1, PSO2	An	C	10
CO5	Construct and analyze half-wave and full-wave rectifier circuits with and without filters, and calculate regulation efficiency to evaluate circuit performance.	PO1, PO3, PO6 PSO1, PSO2	Ap	P	20
CO6	Accurately determine physical quantities such as light wavelength, capacitance, and resolving power of optical devices through experimental methods like Edser-Butler fringes, Schering and DeSauty bridges, and optical resolving power setups.	PO1, PO6, PO7 PSO1, PSO2	Ap	P	20
				Total hour of Instruction	**90**

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		3								3	
CO3	3	3	3								3	3
CO4		3		1		3					3	3
CO5	3		3			3					3	3
CO6	3					3	2				3	3

3:High,2:Medium,1:Low

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Mathematics Semester VI - Minor Course

MTE314-3C Artificial Intelligence

Course Outcomes:

- **CO1:** Explain the fundamentals of Artificial Intelligence, intelligent agents, agent architectures, and environment models.
- **CO2:** Apply uninformed and informed search methods to solve structured problem scenarios using defined search strategies.
- **CO3:** Construct knowledge representations using propositional and first-order logic and perform logical inference through standard procedures.
- **CO4:** Analyze reasoning under uncertainty using probabilistic models including Bayesian Networks, Markov Models, and utility-based approaches.
- **CO5:** Demonstrate the structure and functioning of neural networks and implement learning techniques to solve classification and prediction tasks.
- **CO6:** Develop solutions to well-defined problems using AI programming concepts involving logic-based systems, search mechanisms, and optimization techniques.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits
		Theory Per Week	Practical Per week	
MTE314-3C	Artificial Intelligence	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**

Introduction of Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, Intelligent Agents, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Solving problems by searching, Search issues in the design of search programs, Un-informed search techniques: BFS, DFS; Informed/(Heuristic) Search Techniques: Generate-And-Test, Hill Climbing, Best-First Search.

Unit 2

Teaching Hours: 15

Knowledge Representation & Reasoning: Reasoning and logic, Prepositional logic, First order logic, Using first-order logic, Inference in first-order logic, Forward and Backward Chaining.Resolution

Uncertain Knowledge and Reasoning: Probabilistic reasoning, Bayesian Networks, Hidden Markov Models (HMM), Utility theory.

Neural Networks: Introduction to neural networks, Neural networks architecture, How do artificial neural networks learn, Types of artificial neural networks, Applications of artificial neural networks.

Computer vision: Introduction to computer vision, Applications of computer vision.

Practicals

Teaching Hours:60

1. Write a Program to Implement Breadth First Search.
2. Write a Program to Implement Depth First Search.
3. Write a Program to Implement Tic-Tac-Toe game.
4. Write a Program to Implement 8-Puzzle problem.
5. Write a Program to Implement Water-Jug problem.
6. Write a Program to Implement Travelling Salesman Problem.
7. Write a Program to Implement Tower of Hanoi.
8. Write a Program to Implement Monkey Banana Problem.
9. Write a Program to Implement Alpha-Beta Pruning.
10. Write a Program to Implement 8-Queens Problem.
11. Consider the following genealogical tree:
    a. father (a,b).
    b. father (a,c).
    c. father (b,d).
    d. father (b,e).
    e. father (c,f).
12. Implementing above Brother Relationship in a Genealogical Tree and Identify Cousin Relationships, Determine Grandson Relationships and Find Descendant Relationships in a Family Tree.

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

*SEE: Semester End Evaluation

Reference Books:

1. "Artificial Intelligence – A Modern Approach", Stuart Russell, Peter Norvig, Pearson Education.
2. "Artificial Intelligence", Elaine Rich and Kevin Knight, McGraw-Hill.
3. "Introduction to Artificial Intelligence", E. Charniak and D. McDermott, Pearson Education.
4. "Artificial Intelligence and Expert Systems", Dan W. Patterson, Prentice Hall of India.

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CO	Course outcome	POs / PSOs	Cognitive level	Knowledge category	Class session
CO1	Explain the fundamentals of Artificial Intelligence, intelligent agents, agent architectures, and environment models.	PO1, PO2, PSO1, PSO2	R, U	C	10
CO2	Apply uninformed and informed search methods to solve structured problem scenarios using defined search strategies.	PO1, PO2, PO3, PO7, PSO1,PSO2	U, Ap	C, P	18
CO3	Construct knowledge representations using propositional and first-order logic and perform logical inference through standard procedures.	PO1, PO2, PO6, PSO1, PSO2	U, Ap, E	C, P	15
CO4	Analyze reasoning under uncertainty using probabilistic models including Bayesian Networks, Markov Models, and utility-based approaches.	PO1, PO2, PO3, PO6, PO7, PSO1, PSO2	U, An	C, P	10
CO5	Demonstrate the structure and functioning of neural networks and implement learning techniques to solve classification and prediction tasks.	PO1, PO3, PO4, PO7, PSO1, PSO2	U, Ap	C, P	15
CO6	Develop solutions to well-defined problems using AI programming concepts involving logic-based systems, search mechanisms, and optimization techniques.	PO1, PO3, PO4, PO7, PSO1, PSO2	Ap	C, P	22
Total hours of Instruction					90

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	3
CO2	3	3	3	0	0	0	3	0	0	0	3	3
CO3	3	3	0	0	0	2	0	0	0	0	3	3
CO4	3	3	3	0	0	2	3	0	0	0	3	3
CO5	3	0	3	3	0	0	3	0	0	0	3	3
CO6	3	0	3	3	0	0	3	0	0	0	3	3

3:High, 2:Medium, 1:Low

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Ability Enhancement Course – Semester 6

AEC301-3C Communication and Soft Skills for Professional Success

Course Outcomes:

CO 1: Illustrate the skills to enhance employability and apply them for successful participation in trainings, internships, and job interviews.

CO 2: Demonstrate the essentials of written and professional communication based incritical thinking and leadership skills.

CO 3: Discuss fundamental research concepts and identify essential skills for conducting academic research.

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Per Week		Hrs.	Max Marks		
					CCE	SEE	
AEC 301-3C	Communication and Soft Skills for Professional Success	2	2	2	25	25	50

Unit 1: Preparing for the world of work **Teaching Hours: 14 (Weightage 46%)**

- Application letter and Cover letter (1 hr)
- Resume crafting-types of layouts
  - Components,
  - Preparing resume based on a relevant job notification (3 hr)
- Group discussion (1 hr)
  - Difference between GD and debate,
  - Importance pf GD,
  - Process of GD, Do's and Don'ts of participating in GD
- Personality traits to be evaluated(2 hr)
  - Dynamics of group behavior/group etiquette and mannerism,
  - Types, opening, summarizing and some tips
- Job interview, Stages& types of Job Interviews (2 hr)
- Preparation, performance and follow- up (Includes some group practice and role play) (3 hr)
- Body language, Do's and Don'ts of body language, Body language in an interview, Negotiation (2 hr)

Unit 2: Professional skills **Teaching Hours: 08 (Weightage 27 %)**

- Communication by writing and speaking: Case study, Task Based Expressional Skills check, Overview of written and spoken expressions (2 hr)
- Steps to be followed for written and oral expressions (10 steps)(2 hr)
- Critical thinking: case study, Task Based Expressional Skills check(1 hr)
- Definition, importance, and seven-step plan for critical thinking (1 hr)
- Leadership skills, Trust & Empowerment, Connection & Learning, Leadership & Culture(2 hr)

Unit 3: Basic skills in research and documentation Teaching Hours: 08 (Weightage 27 %)

- Characteristics of Research, Various data collection tools and techniques (1 hr)
- Proposals(3 hr)
  - Purpose of writing a proposal,
  - Importance and types of Technical Proposals,
  - Structure of a proposal
- Preparing and using questionnaires and schedules, Advantages, difference between the Two (1 hr)
- Using graphics in presentations and research *(includes practical graphics and their interpretation)* Common terms, reasons to use, general guidelines for using them (1 hr)
- Table, bar graph, pie chart (1 hr)
- Organizational chart graphics and writing and presenting their summary(1 hr)
  - Practical tasks of generating the graphics with the help of AI

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

***SEE:** Semester End Evaluation

Referencebooks, articles & Online Sources:

Books:

Cullen, Pauline, Vanessa Jakeman, and Michael French. *The Official Cambridge Guide to IELTS Academic*. Cambridge UP, 2014.

Kothari, C. R. *Research Methodology: Methods and Techniques*. 2nd ed., New Age International, 2004.

Kumar, Sanjay, and Pushpa Lata. *Communication Skills*. Oxford UP, 2011.

Mitra, Barun. *Personality Development and Soft Skills*. Oxford UP, 2012.

Padmaja, T. V. S. *Technical Communication: A Practical Approach*. Pearson, 2009.

Sherfield, Robert, Rhonda Montgomery, and Patricia Moody. *Cornerstone: Developing Soft Skills*. Pearson, 2018.

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Online Source:

1. https://hbr.org/2016/03/the-most-important-leadership-competencies-according-to-leaders-around-the-world

2. TheMostImportantLeadershipCompetencies,AccordingtoLeadersAroundtheWorld by Sunnie Giles, March 201, Harvard Business Review

Link:

https://www.researchgate.net/profile/Sunnie-%20Giles/publication/323229010_The_Most_Important_Leadership_Competencies_Accordi%20ng_to_Leaders_Around_the_World/links/5a876a6daca272017e5aba03/The-Most-%20Important-Leadership-Competencies-According-to-Leaders-Around-the-%20World.pdf?origin=publication_detail&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9ka%20XJlY3QiLCJwYWdlIjoicHVibGljYXRpb25Eb3dubG9hZCIsInByZXZpb3VzUGFnZSI6%20InB1YmxpY2F0aW9uIn19&cf_chl_tk=9rdqFKHM8zdiqmeuYnFAGv11FqgO1oFaVd%20CKkgLSJVs-1743220188-1.0.1.1-%20LCA4.1fPWL750edVGms51Ff7AQ8UdKplBecHdJYz.Hc&__cf_chl_tk=v1N7EbLmIHGHKLMqCQ1rix7ojHDbH8ha4I9D1dK7FEU-1748338192-1.0.1.1-2JhfpmeW50eX_d2RBd3wEwFJ6HLF6tZkWta1WEKgmTA

	Course Outcome	Pos/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO 1	Illustrate the skills to enhance employability and apply them for successful participation in trainings, internships, and job interviews.	PO1, PO2, PO3, PO4, PO5, PO7	U, Ap, C	C, P	14
CO 2	Demonstrate the essentials of written and professional communication based incritical thinking and leadership skills.	PO3, PO4, PO5, PO8	U, Ap, An	C, P	08
CO 3	Discuss fundamental research concepts and identify essential skills for conducting academic research.	PO2, PO3, PO4, PO5, PO6, PO7, PO8	U	C	08
Total hour of instruction					**30**

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Mapping of Cos with Pos & PSOs

Co	PO																PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CO1	3	3	3	3	3		3											
CO2			3	3	3			3										
CO3		3	3	3	3	2	3	3										

3:High,2:Medium,1:Low

CO		POs												PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	1	2	3	4
CO1	14	Y	Y	Y	Y	Y		Y									
CO2	08			Y	Y	Y			Y								
CO3	08		Y	Y	Y	Y	Y	Y	Y								
CO4																	
	30	14		30	30	30	8	22	16								
		3		3	3	3	2	3	3								

Note: less than 5 %=0; 5-25%=1; 25-40%=2; Greater than 40%=3

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Microbiology Semester VI SEC (Skill Enhancement Course)

SEC315-3C INTERNSHIP

COURSE OUTCOMES:

- CO1: Apply theoretical knowledge with the real-world situation by experiential learning.
- CO2: Develop skills by hands-on experience via project based learning.
- CO3: Analyze and evaluate problems to recommend useful solutions.
- CO4: Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.
- CO5: Develop relevant skills in technology use for career advancement.
- CO6: Describe the elementary concept of Industrial unit operations and unit process.

Subject Code	Subject Title	Teaching Scheme (Total Hrs.)		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Internship hrs			*CCE	*SEE	
SEC 315-3C	Internship/ Research Project	0	120	4	—	50	50	100

- Internship should be conducted in the area of Major discipline.
- Internship should be conducted via any one of the following way:
  1. 120 Hrs. Internship/ industrial training with certification from competent authority.
  2. 120 Hrs. Research project/PoC developments at academic institute certified by Head of the institute.
  3. 120 Hrs. Field work/ Field training certified by relevant authority.

	Course Outcomes	POs/ PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Apply theoretical knowledge with the real-world situation by experiential learning.	PO2, PO3, PO6, PO7, PSO1	Ap	P	
CO2	Develop skills by hands-on experience via project based learning.	PO2, PO3, PO4, PO6, PO7, PSO2	C	P	
CO3	Analyze and evaluate problems to recommend useful solutions.	PO2, PO3, PO6, PO9, PSO2	An, E	P	
CO4	Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.	PO4, PO5, PO10, PSO2	Ap, C	P	
CO5	Develop relevant skills in technology use for career advancement.	PO6, PO7, PO8, PSO2	Ap, C	P	
CO6	Describe the elementary concept of Industrial unit operations and unit process.	PO1, PO3, PO9, PSO1, PSO2	U, Ap	P	
	Total hour of Instruction				**120**

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Chemistry Semester VI Skill Enhancement Course

SEC315-3C INTERNSHIP

Course Outcomes:

- CO1: Apply theoretical knowledge with the real-world situation by experiential learning.
- CO2: Develop skills by hands-on experience via project based learning.
- CO3: Analyze and evaluate problems to recommend useful solutions.
- CO4: Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.
- CO5: Develop relevant skills in technology use for career advancement.
- CO6: Describe the elementary concept of Industrial unit operations and unit process.

Subject Code	Subject Title	Teaching Scheme (Total Hrs.)		Credits	Examination Scheme			Total Marks
					Hrs.	Max Marks		
		Theory hrs Per Week	Internship hrs			*CCE	*SEE	
SEC 315-3C	Internship/ Research Project	0	120	4	—	50	50	100

- Internship should be conducted in the area of Major discipline.
- Internship should be conducted via any one of the following way:

1. 120 Hrs. Internship/ industrial training with certification from competent authority.
2. 120 Hrs. Research project/PoC developments at academic institute certified by Head of the institute.
3. 120 Hrs. Field work/ Field training certified by relevant authority.

	Course Outcomes	POs/PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Apply theoretical knowledge with the real-world situation by experiential learning.	PO2,PO3, PO6,PO7, PSO1	Ap	P	
CO2	Develop skills by hands-on experience via project based learning.	PO2,PO3, PO4, PO6, PO7,PSO2	Cr	P	
CO3	Analyze and evaluate problems to recommend useful solutions.	PO2,PO3, PO6,PO9, PSO2	An,E	P	
CO4	Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.	PO4,PO5, PO10, PSO2	Ap,Cr	P	
CO5	Develop relevant skills in technology use For career advancement.	PO6,PO7, PO8,PSO2	Ap,Cr	P	
CO6	Describe the elementary concept of Industrial unit operations and unit process.	PO1,PO3, PO9, PSO1, PSO2	U,Ap	P	
	Total hour of Instruction				120

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Mathematics Semester VI - Skill Enhancement Course

SEC315-3C Internship

Course Outcomes:

- **CO1:** Apply theoretical knowledge with the real-world situation by experiential learning.
- **CO2:** Develop skills by hands-on experience via project based learning.
- **CO3**: Analyze and evaluate problems to recommend useful solutions.
- **CO4:** Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.
- **CO5:** Develop relevant skills in technology use for career advancement.
- **CO6:** Describe the elementary concept of Industrial unit operations and unit process.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Theory hrs Per Week	Internship hrs		Hrs.	Max Marks		
						CCE	SEE	
SEC 315-3C	Internship	0	120	4	—	50	50	100

- Internship should be conducted in the area of Major discipline.
- Internship should be conducted via any one of the following way:
  1. 120 Hrs. Internship/ industrial training with certification from competent authority
  2. 120 Hrs. Research project/PoC development at academic institute certified by Head of the institute.
  3. 120 Hrs. Field work/ Field training certified by relevant authority.

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CO	Course Outcomes	POs/ PSOs	CL Cognitive level	Knowledge Category	Class Session
CO1	Apply theoretical knowledge with the real-world situation by experiential learning.	PO2, PO3, PO6, PO7, PSO1	Ap	P	
CO2	Develop skills by hands-on experience via project based learning.	PO2, PO3, PO4, PO6, PO7, PSO2	Cr	P	
CO3	Analyze and evaluate problems to recommend useful solutions.	PO2, PO3, PO6, PO9, PSO2	An, E	P	
CO4	Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.	PO4, PO5, PO10, PSO2	Ap, Cr	P	
CO5	Develop relevant skills in technology use for career advancement.	PO6, PO7, PO8, PSO2	Ap, Cr	P	
CO6	Describe the elementary concept of Industrial unit operations and unit process.	PO1, PO3, PO9, PSO1, PSO2	U, Ap	P	
	Total hour of Instruction				**120**

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Physics Semester VI - Skill Enhancement Course

SEC315-3C Internship/Research Project

COURSE OUTCOMES:

- **CO1:** Apply theoretical knowledge with the real-world situation by experiential learning.
- **CO2**: Develop skills by hands-on experience via project based learning.
- **CO3**: Analyze and evaluate problems to recommend useful solutions.
- **CO4:** Build connections and gain practical knowledge with professionals and researchers
- in the field and identify career paths.
- **CO5:** Develop relevant skills in technology use for career advancement.
- **CO6:** Describe the elementary concept of Industrial unit operations and unit process.

TEACHING AND EVALUATION SCHEME:

Course Code	Course Title	Teaching Scheme		Credits	Examination Scheme			
						Max Marks		
		Theory Hrs per Week	Internship (Hrs)		Hrs.	CCE	SEE	Total Marks
SEC315-3C	Internship/ Research Project	0	120	4	--	50	50	100

- Internship should be conducted in the area of Major discipline.
- Internship should be conducted via any one of the following way:
  1. 120 Hrs. Internship/ industrial training with certification from competent authority
  2. 120 Hrs. Research project/PoC development at academic institute certified by Head of the institute.
  3. 120 Hrs. Field work/ Field training certified by relevant authority.

CO	Course Outcomes (COs)	Mapped POs/PSOs	CL Cognitive level	KC Knowledge Category	Class Session (Hrs)
CO1	Apply theoretical knowledge with the real-world situation by experiential learning.	PO2, PO3, PO6, PO7, PSO1	Ap	P	
CO2	Develop skills by hands-on experience via project based learning.	PO2, PO3, PO4, PO6, PO7, PSO2	Cr	P	
CO3	Analyze and evaluate problems to recommend useful solutions.	PO2, PO3, PO6, PO9, PSO2	An, E	P	
CO4	Build connections and gain practical knowledge with professionals and researchers in the field and identify career paths.	PO4, PO5, PO10, PSO2	Ap, Cr	P	
CO5	Develop relevant skills in technology use for career advancement.	PO6, PO7, PO8, PSO2	Ap, Cr	P	
CO6	Describe the elementary concept of Industrial unit operations and unit process.	PO1, PO3, PO9, PSO1, PSO2	U, Ap	P	
				Total hour of Instruction	120