

Re-Accredited 'B++' 2.86 CGPA by NAAC

**VEER NARMAD SOUTH GUJARAT UNIVERSITY**

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

**વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી**

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

Tel. +91 - 261 - 2227141 to 2227146, Toll Free . 1800 2333 011, Digital Helpline-No.- 0261 2388888

E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

## **-: પરિપત્ર :-**

યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫-૨૬ થી અમલમાં આવનાર B.Sc. Chemistry Sem.-3 માં IKS નો ૨ ક્રેડિટના અભ્યાસક્રમને પેપર-૫ માં સામેલ કરવા સંદર્ભે રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૨૮/૦૩/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંક:૦૪ થી નીચે મુજબ કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૩૦/૦૪/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંક:૧૯ થી કરેલ ભલામણ સ્વીકારી એકેડેમિક કાઉન્સિલની તા.૦૫/૦૫/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંક: ૮૬ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

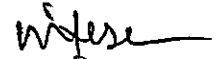
### **વિજ્ઞાન વિદ્યાશાખાની તા.૩૦/૦૪/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંક:૧૯**

:: આથી ઠરાવવામાં આવે છે કે, રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૨૮/૦૩/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંક:૦૪ થી કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ ૨૦૨૫-૨૬ થી અમલમાં આવનાર B.Sc. Chemistry Sem.-3 માં IKS નો ૨ ક્રેડિટના અભ્યાસક્રમ પેપર-૫ માં સામેલ કરી કુલ ૪ ક્રેડિટનો Physical Chemistry નો સુધારેલ અભ્યાસક્રમ મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/સિલેબસ/૧૧૯૯૭/૨૦૨૫

તા.૩૧-૦૫-૨૦૨૫

  
કુલસચિવ

પ્રતિ,

૧) યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓ.

.....આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારું.

૨) ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા.

૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારું.

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# VEER NARMAD SOUTH GUJARAT UNIVERSITY



UNDER GRADUATE PROGRAMME  
IN  
CHEMISTRY  
UNDER FACULTY OF SCIENCE  
3 (YEARS DEGREE) AND 4 (YEARS HONOURS)

S. Y. B. Sc. Sem. - III

**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**  
**UNDER GRADUATE PROGRAMME IN CHEMISTRY MAJOR/MINOR/SEC**  
**3 (YEARS DEGREE) AND 4 (YEARS HONOURS)**  
**B. Sc. – Sem. – III and IV CHEMISTRY**

<b>Programme Outcomes</b>	<p><b>PO-01: <u>Scientific Knowledge &amp; Conceptual Understanding</u>:</b> Develop a strong foundation in scientific principles, theories, and concepts across disciplines, fostering interdisciplinary learning, advance knowledge, and problem-solving abilities.</p> <p><b>PO-02: <u>Analytical &amp; Critical Thinking</u>:</b> Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses, and real-world problems, leading to evidence-based conclusions.</p> <p><b>PO-03: <u>Research &amp; Inquiry-based Learning</u>:</b> Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation.</p> <p><b>PO-04: <u>Laboratory &amp; Technical Skills</u>:</b> Gain hands-on experience with laboratory techniques, instrumentation, and computational tools relevant to scientific research and industry applications.</p> <p><b>PO-05: <u>Digital &amp; Computational Literacy</u>:</b> Utilize digital tools, computational techniques, and emerging technologies such as AI, bioinformatics, and statistical modelling to enhance scientific learning and problem-solving.</p> <p><b>PO-06: <u>Environmental &amp; Societal Responsibility</u>:</b> Understand the role of science in addressing environmental, health and societal challenges, promoting sustainability and ethical responsibility.</p> <p><b>PO-07: <u>Effective Communication &amp; Collaboration</u>:</b> Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams.</p> <p><b>PO-08: <u>Innovation &amp; Entrepreneurship</u>:</b> Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management.</p> <p><b>PO-09: <u>Lifelong Learning &amp; Professional Growth</u>:</b> Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers.</p> <p><b>PO-10: <u>Ethical Leadership &amp; Value-based Education</u>:</b> Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.</p>
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<b>Programme Specific Outcomes</b>	<b>PSO1</b>	:	Define the fundamental concepts in ancient Indian metallurgical chemistry, and Ayurvedic organic principles and physical chemistry.						
	<b>PSO2</b>	:	Establish a range of practical skills to conduct and infer scientific experiments independently and in groups.						
	<b>PSO3</b>	:	Applied the key concepts, theoretical models and standard methodologies to solve problems related to physical Chemistry.						
	<b>PSO4</b>	:	Apply procedures to the solution of unawared types of challenges.						
	<b>PSO5</b>	:	Exhibit skills leading to employability in chemistry and associated industries.						
	<b>PSO6</b>	:	Comprehend interdisciplinary links between ancient Indian scientific knowledge and present-day chemical sciences to inspire research innovations.						
	<b>PSO7</b>	:	Possess the level of aptitude in subject required for post-graduations as well as for pursuing research in pure and applied chemistry and related inter-disciplinary subjects.						
	<b>PSO8</b>	:	Design sustainable chemical solutions by integrating traditional Indian practices with contemporary scientific approaches to address local and societal needs.						
<b>Mapping of PO and PSO</b>		<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>	<b>PSO7</b>	<b>PSO8</b>
	<b>PO1</b>	✓		✓		✓	✓	✓	✓
	<b>PO2</b>		✓	✓	✓		✓	✓	
	<b>PO3</b>		✓		✓		✓	✓	✓
	<b>PO4</b>		✓		✓	✓		✓	
	<b>PO5</b>		✓	✓		✓		✓	
	<b>PO6</b>	✓			✓	✓			✓
	<b>PO7</b>		✓		✓	✓		✓	
	<b>PO8</b>	✓		✓	✓	✓	✓		✓
	<b>PO9</b>	✓		✓		✓		✓	
	<b>PO10</b>	✓	✓			✓	✓		✓

*Asst. Prof.*

# VEER NARMAD SOUTH GUJARAT UNIVERSITY

**Programme Name:** Bachelor of Science Semester - III

**About Programme:**

**Teaching and Evaluation Scheme:**

## Structure

Course Category	Course code	Course title	Marksheet title in English	Level of Course	Teaching hours per week		Exam duration		Credit		Internal marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
Major	CH-MJ-301	Chemistry Paper - III [Inorganic Chemistry]	Chemistry Paper - III [Inorganic Chemistry]	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-302	Chemistry Paper - IV [Organic Chemistry]	Chemistry Paper - IV [Organic Chemistry]	300	02	04	01	04	02	02	25	25	25	25	50	50
Major	CH-MJ-303	Chemistry Paper - V [Physical Chemistry]	Chemistry Paper - V [Physical Chemistry]	300	04	00	02	00	04	00	50	00	50	00	50	00

*Asst. Prof.*

**VEER NARMAD SOUTH GUJARAT UNIVERSITY**  
**S. Y. B. Sc. – SEM – III CHEMISTRY (MAJOR)**  
**PAPER - CH-MJ-303**  
**Physical Chemistry (Major) (4 Credits Theory)**  
**As per NEP 2020**  
**To be implemented from the Academic year 2025-26**

<b>Course Subject Code</b>	CH-MJ-303								
<b>Subject Title</b>	Physical Chemistry (Theory)								
<b>Credits</b>	04								
<b>Teaching per week</b>	04 Hours								
<b>Effective from</b>	2025-2026								
<b>Purpose of Course</b>	To explore India's ancient contributions to chemistry and metallurgy through the lens of Prof. P. C. Ray's pioneering work, and to build a foundational and applied understanding of reaction kinetics, photochemistry, and electrochemistry with relevance to both historical and modern contexts.								
<b>Objective of Course</b>	Students will study ancient metallurgical techniques and Ayurvedic chemistry, learn the principles of chemical kinetics and photochemistry, and apply electrochemical concepts such as conductance, transport numbers, and ionic equilibria through both theoretical and problem-based learning.								
<b>Course Outcomes</b>	<p><b>CO1-Remembering:</b> After completing this course, Students will able to recall Prof. P. C. Ray's contributions and ancient metallurgical techniques, and document them through practical demonstrations, experiments, or group-based activities.</p> <p><b>CO2-Understanding:</b> Students will develop an understanding of Ayurvedic chemistry and traditional technologies, connecting ancient Indian science to present-day chemical principles.</p> <p><b>CO3-Application:</b> Students will develop an understanding of Ayurvedic chemistry and traditional technologies, connecting ancient Indian science to present-day chemical principles.</p> <p><b>CO4-Analysis:</b> Students will gain the ability to analyse scientific data on photochemical and electrochemical reactions, identifying factors that affect reaction behaviours.</p> <p><b>CO5-Evaluation:</b> Students will evaluate traditional and modern electrochemical practices through experimental work and collaborative analysis, drawing evidence-based conclusions about their scientific and societal impact.</p> <p><b>CO6-Creation:</b> After studying this course, students will be able to synthesize ideas from ancient Indian science and modern chemistry to propose innovative, sustainable chemical solutions.</p>								
<b>Mapping Between COs and PSOs</b>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1	✓	✓	✓		✓	✓		✓
	CO2	✓		✓	✓		✓	✓	✓
	CO3	✓	✓	✓	✓	✓		✓	
	CO4	✓		✓	✓	✓	✓	✓	
	CO5	✓	✓	✓	✓	✓	✓		✓
	CO6	✓			✓	✓	✓	✓	✓

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**Program Name: S. Y. B. Sc. Sem. – III**  
**CH-MJ-303 (Physical Chemistry)**

Syllabus effective from June 2025

<b>Unit – 1</b>		
	<p><b>Prof. P. C. Ray: A Pioneer in Reviving Ancient Indian Metallurgy and Chemistry</b></p> <p><b>Contribution:</b> Prof. Prafulla Chandra Ray, the "Father of Indian Chemistry," highlighted India's advanced metallurgical practices and linked ancient mining and metalworking techniques showcasing India's scientific achievements and inspiring modern research.</p> <ul style="list-style-type: none"> <li>• Wootz steel: The rise and fall of a great Indian technology.</li> <li>• Mining and ore extraction.</li> <li>• Metal and metal working technology.</li> <li>• Gold extraction process.</li> <li>• Zinc production.</li> <li>• Copper mining and extraction process.</li> <li>• Extraction of copper for Ayurvedic purposes.</li> <li>• Copper alloys, Mercury, Lead and silver.</li> <li>• Iron and steel in India.</li> </ul>	<b>15 h</b>
<b>Unit – 2</b>		
	<p><b>Panchmahabhuta and organic compounds</b></p> <ul style="list-style-type: none"> <li>• Introduction to Ayurveda &amp; Organic Chemistry.</li> <li>• Chemical composition of Ayurvedic herbs.</li> <li>• Scientific validation of Ayurvedic Principles.</li> <li>• Applications &amp; Future directions.</li> </ul>	<b>15 h</b>
<b>Unit – 3</b>		
	<p><b>[A] Theories of reaction rate</b></p> <ul style="list-style-type: none"> <li>• Derivation of Arrhenius equation.</li> <li>• Collision theory of reaction rate.</li> <li>• Energy of activation including determination.</li> <li>• Effect of catalysis on energy activation.</li> <li>• Numerical problems.</li> </ul> <p><b>[B] Photochemistry</b></p> <ul style="list-style-type: none"> <li>• Introduction of photochemistry.</li> <li>• Basics of electromagnetic radiations and photons.</li> <li>• Thermal and photochemical law (Grothus Draper's law (b) Lambert-Beer's law, (c) Einstein's law of photochemical equivalence.</li> <li>• Quantum yield or quantum efficiency, Numerical.</li> <li>• Primary and secondary photochemical reactions.</li> <li>• Factors affecting quantum yield (i.e. temperature, light intensity and inert gases), isomeric changes, polymerization.</li> <li>• Photosensitization.</li> <li>• Photophysical process (Fluorescence, phosphorescence), chemiluminescence.</li> <li>• Factors affecting fluorescence and phosphorescence.</li> </ul>	<b>6 h</b>  <b>9 h</b>

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Unit - 4		
	<p><b>Electrolytes</b></p> <ul style="list-style-type: none"> <li>• Ions in solution, Formation of ions in solution.</li> <li>• Metallic conductance.</li> <li>• Electrolytic conductance, Electrolysis.</li> <li>• Migration of ions.</li> <li>• Transport number of ions and its determination by moving boundary method.</li> <li>• Numerical problems.</li> <li>• Kohlrausch law of ionic conductance.</li> <li>• Application of Kohlrausch law to               <ol style="list-style-type: none"> <li>(a) Determination of degree of dissociation of weak electrolyte.</li> <li>(b) Determination of equivalent conductivity of weak electrolyte at infinite dilution.</li> <li>(c) Determination of solubility and solubility product of sparingly soluble salts.</li> <li>(d) Determination of ionic product of water.</li> </ol> </li> <li>• Numerical problems</li> </ul>	15 h

**Reference books:**

- 1) A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D. by Prof. P. C. Ray, (1902) published by The Bengal Chemical and Pharmaceutical Works.
- 2) History of Science and Technology in Ancient India: Volume II – Metal Technology by Debiprasad Chattopadhyaya (1986) published by Firma KLM, Calcutta.
- 3) The Rustless Wonder: A Study of the Iron Pillar at Delhi
- 4) Introduction to Indian knowledge system concepts and Applications by B. Mahadevan, Vinayak Rajat Bhatt, Nagendra Pavana R. N.
- 5) Baldev Upadhyaya, Samskrita Sastrom ka Itihas, Chowkhambha, Varansi, 2010.
- 6) D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds. A Concise History of Science of India, 2nd edition, University press, Hyderabad, 2010.
- 7) Astangahrdaya Vol. 1 Sutrasthana and Sarirasthana, Translated by K. R. Srikantha Murthy, Vol 1 Krishnadas Academy, Varansi, 1991.
- 8) Dharampal, Some aspects of earlier Indian Society and polity and their relevance today, New quest Publications, Pune, 1987.
- 9) Dharampal, Indian science and technology in the eighteenth century; Some contemporary European accounts, Dharampal classic series, Rashtrottana Sahitya, Bengaluru, 2021
- 10) Physical chemistry by Gurdeep Raj.
- 11) Physical chemistry by K.L. Kapoor
- 12) Advance physical chemistry by D.N. Bajpai
- 13) A textbook of physical chemistry by A. S. Negi & Anand
- 14) A textbook of physical chemistry by S. C. Khetpal & Yogesh Sharma.
- 15) Physical chemistry by Puri, Sharma, and Pathania
- 16) Elemental physical chemistry by Glasston & Lewis
- 17) Physical chemistry by B.K. Sharma
- 18) Essential of physical chemistry by Bahl, Tuli & Bahl
- 19) Physical chemistry by P.L. Soni & O.P. Dharmraj.
- 20) Physical chemistry by K.K. Sharma & L.K. Sharma.

*Asst. Prof.*