



(Bachelor of Science)

B. Sc. Semester –III (Effective from June 2024)

Course Code	<b>US03MACHE01</b>	Title of the Course	<b>Inorganic Chemistry-I</b>
Total Credits of the Course	4	Hours per Week	4
Course Objectives:	To make students familiar with: 1. Inorganic chemistry as an individual subject. 2. Application of inorganic chemistry in various fields. 3. Basic concepts related to acid-base concepts, Non-aqueous solvent, valence bond theory, lanthanides & actinides and chemistry of carbonyl and nitrosyl compounds.		

Course Content		
Unit	Description	Weightage* (%)
1.	<p><b>ACID-BASE AND NON-AQUEOUS SOLVENT</b>  <b><u>ACIDS AND BASES</u></b>            Arrhenius concept-the water ion system, Lowry-Bronsted theory-the proton donor-acceptor system, Conjugate acid-base pairs, Relative strength of acids and bases, Periodic variations of acidic and basic properties, The levelling effect, levelling and differentiating solvents, Utility and limitation of Bronsted concept, Utility and limitation of Bronsted concept, The Lewis concept-the electron donor concept system, Classification of Lewis acids, Classification of Lewis acids and bases in to Hard and Soft Acids and Bases, HSAB principle and stability of the complex A:B, The Usanovich concept-the positive-negative system.</p> <p><b><u>NON-AQUEOUS SOLVENT</u></b>            Classification of solvents, General properties of ionizing solvents (physical and chemical), Chemical reactions, Liquid ammonia as non-aqueous solvent, Solubility of substance in liq. NH<sub>3</sub>, Advantage and disadvantage of using liq. NH<sub>3</sub> as a solvent, Auto-ionization of liq. NH<sub>3</sub>, Chemical reactions occurring in liq. NH<sub>3</sub>, Liquid Sulphur dioxide as solvent, Chemical reactions occurring in liq. SO<sub>2</sub></p>	<b>25%</b>
2.	<p><b>VALANCE BOND THEORY AND ISOMERISM IN COORDINATION COMPOUNDS</b>            Main assumption of VBT, Octahedral complexes- <math>d^2sp^3</math> or <math>sp^3d^2</math>: <math>[Fe(CN)_6]^{4-}</math>, <math>[Fe(F)_6]^{3-}</math>, Tetrahedral complexes- <math>sp^3</math>: <math>[Ni(CO)_4]</math>, <math>[Ni(Cl)_4]^{2-}</math>, Square planar complexes- <math>dsp^2</math>: <math>[Ni(CN)_4]^{2-}</math>, Limitation VBT Structural Isomerism: Conformation isomerism, Ionization isomerism, Hydrate isomerism, Coordination isomerism, Linkage isomerism, Coordination position</p>	<b>25%</b>





	isomerism, Ligand isomerism, Polymerization isomerism. Stereo isomerism: Geometrical isomerism, Geometrical isomerism in 4-coordinated complex compounds, Geometrical isomerism in 6-coordinated complex compounds, distinguish between cis and trans isomers, Optical isomerism in 4-coordinated complex compounds, Optical isomerism in 6-coordinated complex compounds.	
3.	<b>LANTHANIDES AND ACTINIDES</b> <b>LANTHANIDES:</b> Definitions, Position of Lanthanides in periodic table, General properties, Electronic configuration, Oxidation state and oxidation potential Chemistry of +2, +3, and +4 state, Atomic and ionic radii: Lanthanide contraction, Cause of Lanthanide contraction, Consequences of Lanthanide contraction, Color and absorption spectra in Ln+3 ion, Magnetic properties Complex formation, Extraction of Lanthanide from monazite, Separation of individual rare earth elements by modern methods, Solvent extraction method Uses of Lanthanide compounds <b>ACTINIDES:</b> Definition, Position of Actinides in periodic table, General properties of Actinides and their comparison with Lanthanides, Electronic configuration and nature of bonding in Actinide compounds, Oxidation state and oxidation potential, Chemistry of +2, +3, +4, +5, +6, and +7 oxidation state, Atomic and ionic radii: Actinide contraction, Color and absorption spectra of Actinide ions, Magnetic properties, Complex formation, Separation of actinide elements, Solvent extraction method, Ion exchange method.	25%
4.	<b>CHEMISTRY OF METAL CARBONYL AND NITROSYLS</b> <b>METALLIC CARBONYLS:</b> Classification of carbonyls, General methods of preparations, General properties (physical & chemical), Structure and nature of M-CO bonding in carbonyls, Effective atomic number (EAN) rule as applied to metallic carbonyls, 18-electron rule as applied to metallic carbonyls, Some carbonyls (preparation, properties and structure), Nickel tetracarbonyl, Ni(CO) <sub>4</sub> , Iron pentacarbonyl, Fe(CO) <sub>5</sub> , Chromium hexacarbonyl, Cr(CO) <sub>6</sub> , Dimanganesedecarbonyl, Mn <sub>2</sub> (CO) <sub>10</sub> , Dicobaltoctacarbonyl, Co <sub>2</sub> (CO) <sub>8</sub> , Di-ironnonacarbonyl, Fe <sub>2</sub> (CO) <sub>9</sub> , Tri-iron dodecacarbonyl, Fe <sub>3</sub> (CO) <sub>12</sub> . <b>METALLIC NITROSYLS:</b> Some metallic nitrosyls, Sodium nitroprusside, Na <sub>2</sub> [Fe <sub>2</sub> +(CN) <sub>5</sub> (NO <sup>+</sup> )], Nitroso ferrous sulphate, FeSO <sub>4</sub> .NO, Effective atomic number (EAN) rule as applied to metallic nitrosyls.	25%

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3).	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of acids and bases, non-aqueous solvent, valence bond theory, various types of hybridization, lanthanides and actinides, metal carbonyls and metal nitrosyls.
2.	Apply knowledge in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References
1.	Selected Topic in Inorganic Chemistry, 8 <sup>th</sup> - edition, By Wahid U. Malik, G. D. Tuli And R. D. Madan.
2.	Advance Inorganic Chemistry (Volume –II) By: Satya Prakash, G. D. Tuli, S.K. Basu, R. D. Madan.

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)  
B. Sc. Semester – III (Effective from June 2024)

Course Code	<b>US03MACHE02</b>	Title of the Course	<b>Physical Chemistry</b>
Total Credits of the Course	4	Hours per Week	4
Course Objectives:	To make students familiar with: 1. Physical chemistry as a subject. 2. Historic development and scope of physical chemistry. 3. Basic concepts related to states of matter, chemical thermodynamics, colligative properties, electrolytes in solutions.		

Course Content		
Unit	Description	Weightage* (%)
1.	<b>STATES OF MATTER : Gaseous state</b> The Gas Laws, Kinetic Molecular Theory of Gases, Deviation of Real Gases from Ideal Behaviour, Effect of Temperature and Explanation for the deviation, Vander Waals Equation of State, Discussion of Vander Waal's Equation, Critical Constants of Gas, Determination of Critical Pressure, Temperature and Volume, Relation Between Vander Waal's Constant and Critical Constants, Numerical.	<b>25%</b>
2.	<b>CHEMICAL THERMODYNAMICS</b> Introduction, Terminology of Thermodynamics, state function, thermal equilibrium, Thermodynamic process, First law of thermodynamics, Enthalpy, work, Thermochemistry, Molar heat at constant volume and constant pressure, Kirchhoff's equation, Criteria for spontaneous process, Reversible and Irreversible process, Relation between $q_{rev}$ and $q_{irr}$ , Numerical	<b>25%</b>
3.	<b>COLLIGATIVE PROPERTIES OF DILUTE SOLUTIONS</b> Colligative Properties, Vapour Pressure Lowering, Determination of Molar Mass of Solute, Measurement of Vapour Pressure Lowering , The Boiling Point Elevation, Derivation of Equation and Measurement of Boiling Point Elevation The Freezing Point Depression, Derivation of Equation For Molar Mass, Measurement Of Freezing Point Depression, Numerical	<b>25%</b>





4.	<b>ELECTROLYTES IN SOLUTION</b> Specific Conductance, Molar Conductance, Conductance and Electrolytic Dissociation, Colligative Properties And Electrolytic Dissociation, Electrolysis Transference Numbers, Ionic Mobilities, Applications, Ionic Strength, Dissociation Of Weak Electrolytes.	<b>25%</b>
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Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3).	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concept of Gaseous state of matters, Chemical thermodynamics, Colligative properties of dilute solutions, Electrolytes in solution.
2.	Apply this knowledge in further studies of third year B.Sc. chemistry course.





Suggested References:

Sr. No.	References
1.	Principles of Physical Chemistry by Puri, Sharma and Pathania. 38 <sup>th</sup> Edition.
2.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25 <sup>th</sup> Edition.
3.	Physical Chemistry by G. M. Barrow, 5 <sup>th</sup> Edition.
4.	Textbook of physical chemistry by P.L. Soni, O.P. Dharmarha, U. N. Dash.
5.	University chemistry by Bruce H Mahan.
6.	Principles of Physical chemistry, S. H. Marron, Karl. F. Prutton.
7.	Physical Chemistry, Ira Levine.

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)  
B. Sc. Semester – III (Effective from June, 2024)

Course Code	<b>US03MACHE03</b>	Title of the Course	<b>Chemistry Practical-I</b>
Total Credits of the Course	4	Hours per Week	8
Course Objectives:	To make students familiar with: 1. Practical aspects of inorganic chemistry. 2. Hands on experience of binary mixture of inorganic compounds and volumetric titration. 3. Basic concepts related to practical inorganic chemistry.		

Course Content	
Practical	Description
1.	<b>Practical - I: Inorganic Mixture :</b> Four radicals. It may include two positive Radicals and two negative radicals.(At least Ten mixtures) $Cd^{+2}$ , $Cu^{+2}$ , $Bi^{+3}$ , $Fe^{+2}$ , $Zn^{+2}$ , $Al^{+3}$ , $Ni^{+2}$ , $Mn^{+2}$ , $Ba^{+2}$ , $Sr^{+2}$ , $Ca^{+2}$ , $Mg^{+2}$ , $NH_4^+$ , $K^+$ , $Cl^-$ , $Br^-$ , $I^-$ , $NO_3^-$ , $CO_3^{-2}$ , $S^{-2}$ , $PO_4^{-3}$ , $BO_3^{-3}$ , $SO_4^{-2}$ , $CrO_4^{-2}$ , $Cr_2O_7^{-2}$ etc.
2.	<b>Practical - II : Volumetric Titration</b> (By self-preparation of solution of titrant): (i) Estimation of copper by iodometric method. (ii) Determination of total hardness of water sample. (iii) Determination of nickel by back titration. (iv) Determination of nitrite by back titration. (v) Estimation of Aniline (vi) Determine the Unsaturation.
3.	<b>Paper chromatography.</b>
4.	<b>Viva-voce exam.</b>

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr.No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Practical, practical journal, Viva-voce exam, Attendance (As per CBCS R.6.8.3).	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about separation and identification of inorganic mixture.
2.	Know about preparation of standard solutions, paper chromatography and Volumetric Titration. This will improve practical skills of students.

Suggested References:	
Sr. No.	References
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5 <sup>th</sup> Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri.
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad.
4.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla.

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)

B. Sc. Semester –III (Effective from June 2024)

Course Code	<b>US03IDCHE01</b>	Title of the Course	<b>Inorganic Chemistry-II</b>
Total Credits of the Course	2	Hours per Week	2
Course Objectives:	To make students familiar with: 1. Inorganic chemistry as an individual subject. 2. Application of inorganic chemistry in various fields. 3. Basic concepts related to Chemistry of metal carbonyl and nitrosyls, lanthanides & actinides.		

Course Content		
Unit	Description	Weightage* (%)
1.	<b>CHEMISTRY OF METAL CARBONYL AND NITROSYLS</b> <b>METALLIC CARBONYLS:</b> Classification of carbonyls, General methods of preparations, General properties (physical & chemical), Structure and nature of M-CO bonding in carbonyls, Effective atomic number (EAN) rule as applied to metallic carbonyls, 18-electron rule as applied to metallic carbonyls, Some carbonyls (preparation, properties and structure), Nickel tetracarbonyl, Ni(CO) <sub>4</sub> , Iron pentacarbonyl, Fe(CO) <sub>5</sub> , Chromium hexacarbonyl, Cr(CO) <sub>6</sub> , Dimanganesedecacarbonyl, Mn <sub>2</sub> (CO) <sub>10</sub> , Dicobaltoctacarbonyl, Co <sub>2</sub> (CO) <sub>8</sub> , Di-ironnonacarbonyl, Fe <sub>2</sub> (CO) <sub>9</sub> , Tri-iron dodecacarbonyl, Fe <sub>3</sub> (CO) <sub>12</sub> . <b>METALLIC NITROSYLS:</b> Some metallic nitrosyls, Sodium nitroprusside, Na <sub>2</sub> [Fe <sub>2</sub> +(CN) <sub>5</sub> (NO <sup>+</sup> )], Nitroso ferrous sulphate, FeSO <sub>4</sub> .NO, Effective atomic number (EAN) rule as applied to metallic nitrosyls.	<b>50%</b>
2.	<b>LANTHANIDES AND ACTINIDES</b> <b>LANTHANIDES:</b> Definitions, Position of Lanthanides in periodic table, General properties, Electronic configuration, Oxidation state and oxidation potential Chemistry of +2, +3, and +4 state, Atomic and ionic radii: Lanthanide contraction, Cause of Lanthanide contraction, Consequences of Lanthanide contraction, Color and absorption spectra in Ln <sup>+3</sup> ion, Magnetic properties Complex formation, Extraction of Lanthanide from monazite, Separation of individual rare earth elements by modern methods, Solvent extraction method Uses of Lanthanide	<b>50%</b>





	compounds <b>ACTINIDES:</b> Definition, Position of Actinides in periodic table, General properties of Actinides and their comparison with Lanthanides, Electronic configuration and nature of bonding in Actinide compounds, Oxidation state and oxidation potential, Chemistry of +2, +3, +4, +5, +6, and +7 oxidation state, Atomic and ionic radii: Actinide contraction, Colour and absorption spectra of Actinide ions, Magnetic properties, Complex formation, Separation of actinide elements, Solvent extraction method, Ion exchange method.	
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Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
2.	University Examination	100 %

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of metal carbonyl and nitrosyls compounds, and chemistry of lanthanides and actinides series.
2.	Apply knowledge in further studies of third year B.Sc. chemistry course.





Suggested References:

Sr. No.	References
1.	Selected Topic in Inorganic Chemistry, 8th-edition, By Wahid U. Malik, G. D. Tuli And R. D. Madan.
2.	Advance Inorganic Chemistry (Volume –II) By: Satya Prakash, G. D. Tuli, S.K. Basu, R. D. Madan.

On-line resources to be used if available as reference material.

On-line Resources: Google books, INFLIBNET, Google Web.

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(Bachelor of Science) B. Sc. Semester – III (Effective from June 2024)

Course Code	<b>US03IDCHE02</b>	Title of the Course	<b>Chemistry Practical-II</b>
Total Credits of the Course	2	Hours per Week	4
Course Objectives:	To make students familiar with: 1. Practical aspects of inorganic chemistry. 2. Hands on experience of binary mixture of inorganic compounds. 3. Basic concepts related to practical inorganic chemistry.		

Course Content	
Unit	Description
1.	<b>Inorganic Mixture:</b> Four radicals. It may include two positive Radicals and two negative radicals. (At least ten mixtures) $Cd^{+2}$ , $Cu^{+2}$ , $Bi^{+3}$ , $Fe^{+2}$ , $Zn^{+2}$ , $Al^{+3}$ , $Ni^{+2}$ , $Mn^{+2}$ , $Ba^{+2}$ , $Sr^{+2}$ , $Ca^{+2}$ , $Mg^{+2}$ , $NH_4^+$ , $K^+$ , $Cl^-$ , $Br^-$ , $I^-$ , $NO_3^-$ , $CO_3^{-2}$ , $S^{-2}$ , $PO_4^{-3}$ , $BO_3^{-3}$ , $SO_4^{-2}$ , $CrO_4^{-2}$ , $Cr_2O_7^{-2}$ etc.
2.	<b>Viva voce exam</b>

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3) Internal Continuous Assessment in the form of Practical, Viva-voce, practical journal, Attendance (As per CBCS R.6.8.3).	---
2.	University Examination	100 %





Course Outcomes: Having completed this course, the learner will be able to

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| 1. | Learn about separation and identification of inorganic mixture. |
| 2. | This will improve practical skills of students.                 |

Suggested References:

Sr. No.	References
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5 <sup>th</sup> Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad
4.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science)  
B. Sc. Semester – IV (Effective from June 2024)

Course Code	<b>US03SECHE01</b>	Title of the Course	<b>Water Analysis Practical</b>
Total Credits of the Course	2	Hours per Week	4

Course Objectives:	To make students familiar with: 1. To develop the skill of chemical and instrumental methods of analysis. 2. Practical aspects of water analysis.
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Course Content	
Practical	Description
	<ol style="list-style-type: none"><li>1. To determine colour of given water sample by Platinum Cobalt/ Forel Ule Colour Scale method.</li><li>2. To measure the pH of an unknown water sample with the help of a pH meter.</li><li>3. To determine the conductivity of water sample conductometrically.</li><li>4. To determine turbidity of given water sample.</li><li>5. To determine Total dissolved solids and Total solids of given water sample.</li><li>6. To determine Acidity of given water sample.</li><li>7. To determine Alkalinity of given water sample.</li><li>8. To determine Hardness of given water sample.</li><li>9. To determine Chlorides of given water sample.</li><li>10. To determine Sulphate of given water sample.</li><li>11. To determine Fluorides of given water sample.</li></ol>
	<b>Viva-voce exam.</b>

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	--
2.	Internal Continuous Assessment in the form of Practical, Viva-voce exam, Attendance (As per CBCS R.6.8.3).	---
3.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Develop the skill of analysis of water along with knowledge of chemical and instrumental analysis. This will be beneficial them for ready to join as a quality control chemist.
2.	Improve practical skills of students.

Suggested References Books:	
Sr. No.	References Books
1.	Instrumental Method of Chemical Analysis, by B K Sharma, 2014, ISBN: 978-81-8283-673-0, Goel Publishing House.
2.	Soil Analysis Handbook of Reference Methods, by J. Benton Jones Jr. (Editor) ISBN-13: 978-0849302053.
3.	Hand Book of Water, Air and Soil Analysis by Anand Dev Gupta, International E – Publication.
4.	Vogel's Textbook of Quantitative Chemical Analysis –Vth Edition, by G H Jeffery, J Bassett, R C Denney, Longman Sci. & Tech. Publication.

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web

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