JiwaJI University
M.Sc. Environmental Chemistry
Choice Based Credit System
Course Structure, Scheme of Examination & Syllabus
2015 -2017

Semester I

<table>
<thead>
<tr>
<th>Code</th>
<th>Title of Course</th>
<th>Core / Elective</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Total Credits</th>
<th>Marks</th>
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<tr>
<td>EC-101</td>
<td>Fundamentals of Quantitative Analysis and Separation Methods</td>
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Total Credit Value: # 24 (20 + 4 virtual credits)

Semester II
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<td>EC-201</td>
<td>Environmental and Pollution Control</td>
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**Total Credit Value: #24 (20 + 4 virtual credits)**

**SEMESTER III**

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<th>Code</th>
<th>Title of Course</th>
<th>Core / Elective</th>
<th>L</th>
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<th>Marks</th>
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<td>Code</td>
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NOTE: Lecture (L): 1 hr = 1 Credit  Tutorial (T): 2 hr = 1 Credit  Practical (P): 2 hr = 1 Credit

- The generic credits may be obtained from other departments/faculties/Institutes.
- Elective credits may be obtained from same or other departments of the faculty
- Minimum credits be earned for award of degree - 96 Credit (Valid credits -80 + Virtual Credits - 16)
- Minimum credits for promotion to next semester - 12 valid credits/semester
- As part of skill development new product development will be practiced
- Every student would deliver minimum one seminar in a semester which would be evaluated.
- Comprehensive viva is based on all papers of given semester.
- The grading will be made on 10-point scale as described below:

| Letter Grade | Grade Points | Description       | Range of Marks (%)
<table>
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<tr>
<td>O</td>
<td>10</td>
<td>Outstanding</td>
<td>90-100</td>
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<tr>
<td>A+</td>
<td>9</td>
<td>Excellent</td>
<td>80-89</td>
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<tr>
<td>A</td>
<td>8</td>
<td>Very good</td>
<td>70-79</td>
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<tr>
<td>B+</td>
<td>7</td>
<td>Good</td>
<td>60-69</td>
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<td>6</td>
<td>Above Average</td>
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<td>0-34</td>
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<tr>
<td>Ab</td>
<td>0</td>
<td>Absent</td>
<td>Absent</td>
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- The Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) will be calculated as weighted average of valid and virtual credit points secured by the student, except the credits of additional courses, if any. The SGPA and CGPA shall be rounded off up
to 2 decimal places and reported in the grade sheet.

- **SGPA** is a measure of performance of the student in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester, i.e.

\[
SGPA (Si) = \frac{\sum (Ci \times Gi)}{\sum Ci}
\]

where \(Ci\) is the number of credits of the \(i^{th}\) course in a semester and \(Gi\) is the grade point scored by the student in the \(i^{th}\) course.

- **CGPA** is a measure of overall cumulative performance of a student over all the semesters completed. The CGPA is the ratio of total credit points secured by a student in various courses in all the semesters completed and the sum of the total credits of all courses in all the semesters completed, i.e.

\[
CGPA = \frac{\sum (Ci \times Si)}{\sum Ci}
\]

where \(Si\) is the SGPA of the \(i^{th}\) semester and \(Ci\) is the total number of credits in the semester.

- On completing all requirements for award of the degree, the CGPA will be calculated and this value will be indicated on the degree along with Division. The Final degree should also indicate the Division obtained as per follows:

<table>
<thead>
<tr>
<th>Division</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>First division with distinction</td>
<td>The candidate has earned minimum number of credits required for the award of the degree in first attempt with CGPA of 8.00 or above</td>
</tr>
<tr>
<td>First division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 6.50 or above</td>
</tr>
<tr>
<td>Second division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 5.00 or above but less than 6.50</td>
</tr>
<tr>
<td>Pass division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 4.00 or above but less than 5.00</td>
</tr>
</tbody>
</table>

- The student will be promoted to the next semester if he/she secures at least 12 valid credits in a semester. In case the student secures less than 12 valid credits in any semester, then the student will be asked to repeat the entire semester and that semester will be treated as zero semester.

- The student should not carry more than 5 courses (combining theory and practical) in Ist year, IInd year or IIIrd year to be promoted to the next year.

- Repetition of a theory/practical course is allowed only to those candidates who get F or Ab in the course. The student has to pay the prescribed fee for repeating the course.

- On account of valid reasons, a student may withdraw from a semester. In such case the semester will be treated as zero semester.

- In case of zero semester, the student will not be promoted to the next semester till he/she clears that semester. The UTD may allow such a student to register in the subsequent semester whenever it is offered by the concerned UTD. The student has to pay semester fee again in such cases. If the student withdraws within one month from starting of the semester then
semester fee will not be charged again.

- The practical course can be repeated as and when it is offered.

- Dissertation / project report/ internship of 3-6 credits will be assessed by the internal supervisor, in general, however, UTD may get it assessed by an internal supervisor and an external expert.

- A comprehensive viva-voce of 4 virtual credits will be conducted at the end of each semester of the programme by a board of four examiners, at least ONE of whom shall be external. The grades awarded in the viva-voce shall be shown separately in the grade-sheet.

- The conversion of CGPA in to percentage will be as follow to facilitate its application in other academic matters:

  Equivalent Percentage = CGPA x10

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**Syllabus of M.Sc. Environmental Chemistry (2015-2016)**

**First Semester**

**EC-101: Fundamentals of Quantitative Analysis and Separation Methods**

Unit-I: Concepts involved in Analysis

Role of analytical chemistry, classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, neatness and cleanliness, laboratory operations and practices, good laboratory practices, techniques of weighing, errors, volumetric glassware-cleaning and calibration of glassware, sample preparation – dissolution and decompositions, selecting and handling reagents, laboratory notebooks, safety in the analytical laboratory, calibration and detection limits, proficiency testing.

Unit-II: Separation Techniques -I

(A) Solvent Extraction: Fundamental treatment, theoretical principle, classification, and factors favouring extraction, extraction equilibria, applications.

(B) Solid phase extraction and solid phase micro extraction, applications.

(C) Ion- Exchange: Theories, use of synthetic ion exchange in separation, chelating ion exchange resins, liquid ion exchangers, experimental technique.

Unit-III: Separation Techniques -II

An introduction to chromatographic methods, paper, thin layer and column chromatography, theory
of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration, differential migration rates, band broadening & column efficiency, kinetic variables affecting band broadening, Electrophoresis and capillary electrophoresis.

Unit-IV: Separation Techniques -III
GC, Principle of GC, plate theory for GC, instrumentation for GC, working of GC, Detectors used, applications. HPLC, Principle of HPLC, Components of HPLC, Detectors used, instrumentation, applications in qualitative and quantitative analysis, comparison of GC and HPLC.

Unit-IV: Separation Techniques -IV
Size exclusion chromatography, super critical fluid chromatography, affinity chromatography, HPTLC, Ion chromatography, pyrolytic gas chromatography.

Books Recommended

Syllabus M.Sc. EC.......... (2015-2016)
EC-102: Stereochemistry and Thermo-analytical Methods

Unit-I: Stereochemistry

(A) Conformational analysis: Conformation of n-butane and cyclohexane, stability of conformers and energy profile diagram.

(B) Optical activity: Criteria for optical activity, stereoisomers, enantiomers and diastereomers, erythro and threo isomers, a general idea of symmetry elements.

(C) Racemic Modifications: Conglomerate, racemate and racemic solid solutions, a general idea of stereo selective synthesis.

(D) Resolution of Racemic modifications: by Chemical separation, chromatography, preferential crystallization and asymmetric transformation (a brief idea only).

Unit-II: Solution reactions: fundamental theory


Unit-III: Titrimetric and Gravimetric Methods of Analysis

General principles: Solvents in analytical chemistry, buffers, acid-base equilibria, concentration systems, stoichiometric calculation, acid-base titration, titration curves, acid base indicators, applications of acid-base titration, complexometric titration, metal-ion indicators, precipitation titration, Mohr’s titration, Volhard’s titration, adsorption indicators, Fajan’s titration, titration curves in oxidation-reduction titration, redox indicators, applications of redox titrations

Unit-IV: Thermo-analytical Methods

Thermogravimetry, factors affecting thermogravimetric curves, derivative thermogravimetry (DTG), thermbalances, applications of thermogravimetry, differential thermal analysis, factors affecting DTA curve, instrumentation, applications of DTA.

Differential scanning calorimetry, theory, instrumentation, applications of DSC, thermometric titration, principle, classification, instrumentation and applications of thermometric titration.

Unit-V: Principles of Gravimetric Analysis

Stoichiometry of gravimetric reactions, formation and properties of precipitates, precipitation from homogeneous solution, nucleation, organic precipitations, applications of gravimetric analysis.
Books Recommended

Syllabus M.Sc. EC............ (2015-2016)
Unit-I: Colorimetry and Spectrophotometry

An introduction to spectrophotometric methods, a brief idea of wave properties of electromagnetic radiation, theory of spectrophotometry and colorimetry, conjugated dienes, Woodward Fieser rules for calculating absorption maxima in dienes, transition probability, types of absorption bands, types of electronic transitions, chromophores, auxochromes, absorption and intensity shift, limitations of Beer's Law, classification of methods of colour measurement, instrumentation single beam and double beam, photometric error, applications of spectrophotometry to inorganic and organic compounds (quantitative calculations), spectrophotometric titration.

Unit-II: Other Spectro-analytical techniques

(A) Introduction, general principle, instruments for nephelometry and turbidimetry, applications of nephelometry and turbidimetry to analytical chemistry.

(B) Dispersion Refractometry and Flame photometry

(C) Polarometry, circular dichroism (CD) and optical rotatory dispersion (ORD).

Unit-III: Emission Spectroscopy

Elementary idea of emission spectroscopy, introduction, elementary theory, instrumentation, types of flames, interferences, factors affecting flame photometry, applications to qualitative and quantitative analysis, limitations.

Unit-IV: Fluorescence and Phosphorescence Spectrophotometry

Theory of fluorescence and phosphorescence, quantum yield, factors affecting fluorescence and phosphorescence, relation between concentration and intensity, instrumentation, applications, an elementary idea of chemiluminescence.

Unit-V: Kinetic of Slow and Fast reactions (An elementary study keeping in view its applications in analytical chemistry)

(A) Rates of chemical reaction, expression for reaction rate, rate constants, order of reaction, methods for determination of order of reaction, Arrhenius equation, Collision theory, failure of collision theory, Absolute reaction rate theory, unimolecular reactions, mathematical formulation of Lindemann’s theory, catalysed reactions, Theory of homogenous catalysed reactions, kinetics of enzyme catalysed reactions, elementary idea of micellar catalysis.

(B) Study of fast reactions by stopped flow method, relaxation methods, flash photolysis method, photochemical reactions, kinetics of photochemical combination of hydrogen and chlorine, branched chain reactions, oscillatory reactions, applications of kinetic methods in finding out optimum conditions for different reactions.
Books Recommended


Syllabus M.Sc. EC............ (2015-2016)
EC-104: Electro-analytical Methods of Analysis

Unit-I: Fundamentals

Electrochemical cells, solution structure, potential in electroanalytical cells, Nernst equation, electrode potential the ideal polarized and non-polarized electrodes, faradiac reaction, variables in electrochemical cells, factors affecting electrode reaction rate and current, decomposition potential, back potential and voltage.

Unit-II: Potentiometry

Introduction, reference electrodes, indicator electrodes, ion-selective electrodes and their applications in chemical analysis, instrumentation and measurement of cell unit, direct potentiometry, potentiometric titration, applications.

Unit-III: Polarography

Direct current polarography, basic principle, instrumentation, advantages and disadvantages of dropping mercury electrode, different kinds of limiting currents, components of polarographic waves, reversible and irreversible waves, pulse and A.C. polargraphy, applications of polarography to inorganic and organic compounds, elementary idea of stripping voltammetry, amperometric titrations.

Unit-IV: Conductometry and Coulometry

Conductometry as an analytical tool, applications of direct conductometric measurements, basis of conductometric titrations, applications of conductometry titration, constant current and controlled potential electro-gravimetry, separation of metals, coulometry at controlled potential, coulometry at constant current, applications.

Unit-V: Voltammetry

AC polarography, current sampled (TAST) polarography, normal pulse and differential pulse polarography, stripping voltammetry, linear sweep and cyclic voltammetry, chronopotentiometry, chronoamperometry.

Books Recommended

Syllabus M.Sc. EC............. (2015-2016)
Second Semester

EC-201: Environmental and Pollution Control

M.M.: 60

Unit-I: Air Pollution
Atmospheric pollution, classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols, sampling of gaseous pollutants, analysis of $SO_\text{x}$, $NO_\text{x}$, CO, CO$_2$, hydrocarbons, effects of air pollutants on animals, ozone layer, chlorofluorocarbons, acid rain, greenhouse effect.

Unit-II: Water Pollution
Sampling and preservation of water, physical examination of water-number, alkalinity, TDS, conductivity, temperature, odour, turbidity, hardness, chemical examination of water-determination of carbonates and bicarbonates, sulphate, chloride and fluoride, nitrite and nitrate, iron, manganese, silica, cadmium, arsenic, chromium, lead, mercury, biological examination of water-dissolved oxygen, BOD, COD, MPN. Organic pollutant analysis-phenols and detergents.

Unit-III: Water treatment
Quality of water, standards of raw and treated water, objectives of waste water treatment, A brief idea of sedimentation, coagulation and flocculation, filtration, disinfection of water, activated sludge process, trickling filters, sludge treatment and disposal.


Unit-V: (A) Soil Pollution

(B) Noise Pollution
Sources, measurement, effects and control.

Books Recommended

Syllabus M.Sc. EC............ (2015-2016)
Unit-I: Atomic Absorption and Emission Spectroscopy.

Theory of atomic spectroscopy, the origin of spectral transition, the populations of energy levels, the factors influencing spectral width, atomic absorption spectroscopy (AAS), instrumentation, interferences, applications, various non-flame emission sources, applications of atomic emission spectroscopy, comparison of atomic emission and atomic absorption methods, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), instrumentation of ICP-AES, applications of ICP-AES, Comparison of ICP-AES with AAS.

Unit-II: Infrared Spectroscopy

Theory of Infrared absorption, vibrational modes, vibrational coupling, Near IR Spectroscopy, instrumentation, dispersive and non-dispersive instrument, FTIR, sampling techniques qualitative applications and interpretation of spectra, quantitative applications. A brief idea of Raman spectroscopy.

Unit-III: Nuclear Magnetic Resonance Spectroscopy

Theory of NMR, chemical shift and spin-spin splitting, relaxation process of saturation, environmental effects on NMR spectra, instrumentation, CW or FT NMR instrument, Rules governing the interpretation of first order spectra, applications to quantitative analysis.

Unit-IV: Carbon-13 NMR

Historical development, proton decoupling-broad band, Off-resonance and pulsed or gated decoupling, nuclear overhauser enhancement, polarization transfer experiments-DEPT and INEPT chemical shifts, spin-spin coupling impacts, application of $^{13}$C NMR to structure determination, two-dimensional NMR spectroscopy, principle, the COSY experiment, the COSY experiment with double quantum filter (COSY-DQF), the NOESY experiment, three-dimensional NMR experiment, APT and INADEQUATE techniques.

Unit-V: Mass Spectrometry

Theory of mass spectrometry, practical considerations, ion production, depletion of ions, ion detector, calibration, other ionization techniques: chemical ionization, fast atom bombardment (FAB), and electrospray, interpretation of the mass spectrum of the compound, Mc Lafferty rearrangement, Mass analyzers, determination of molecular formula, nitrogen rule, general fragmentation modes, applications of mass spectrometry.

Books Recommended

**203: New trends in Instrumentation**

**M.M.:60**

**Unit-I: Statistical Treatment of Data-I**

Types of errors, accuracy and precision, rounding off, significant figures, normal distribution of errors, statistical treatment of finite samples (mean, median, range & average deviation), t-test, confidence interval of the mean, standard error of a mean, test of significance, comparison of two means, F-test, rejection of data, Q-test, bivariate data, Quality control charts, relationship between variables, correlation & regression, principle of least squares.

**Unit-II: Statistical Treatment of Data-II**

Overview of quantitative analysis of drugs, validation of analytical procedure in pharmaceutical formulation (LOD, LOQ, Robustness, Specificity, Accuracy, Precision, Selectivity, Linearity, Ruggedness, Reproducibility, Repeatability), Recovery analysis, Error bars, Study design.

**Unit-III: Statistical Treatment of Data-III**

Chi square, ANOVA-1 way classification, ANOVA-2 way classification, Lotka-Voltra Model and Leslie’s matrix model, Box model and Gaussian Plume Model, normal distribution, skewness.

**Unit-IV: Spectro-analytical methods of analysis**


**Unit-V: Photoelectron Spectroscopy**

Ultraviolet (U.V.) and X-ray Photoelectron Spectroscopy, basic concepts and applications. Concept of AUGER Photoelectron Spectroscopy and applications. Determination of kinetic energy of an electron by using different methods, Difference between AUGER and Fluorescence phenomenon.

**Books Recommended**


**Syllabus M.Sc. EC............ (2015-2016)**
EC -204: Fundamental of Organic Reactions

Unit-I: Nucleophilic substitution

Mechanism of SN1 and SN2 reactions, SN1 and SET mechanism, The neighboring group mechanism, Effects of substrate structure, Attacking nucleophile, Leaving group and reaction medium on SN1 and SN2 reactions, Benzyne reaction, Evidences infavour of benzyne reaction.

Unit-II: Electrophilic substitution

Electrophilic substitution reaction of benzyne, Nitration halogenations, Sulphonation, Friedel craft reaction, Energy profile diagram, The ortho/ para ratio, IPSO attack, Diazonium coupling reaction, Gattermann-koch reaction, Vilsmeir reaction.

Unit-III: Elimination reaction

Mechanism of E-1, E-2 and E1CB reactions, Difference between substitution and elimination reactions, Saytzeff rule, The Hoffmann rule, Effects of substrate structure, Nature of base, Nature of solvents and temperature on elimination reactions.

Unit-IV: Addition reaction

Electrophilic additions, Markovnikov’s rule, Peroxide effect, Hydroboration, sharpless asymmetric epoxidation, Regio and chemoselectivity, Diel’s – Alder reaction, ozonolysis, Hydrogenation of alkene and alkynes, Mechanism of Aldol, Claisen, Perkin and Benzoin condensations.

Unit-V: Free radicals

Stability of free radicals, Polymerization, halogenations of alkanes via chain reaction, Bromination by N- bromo succinimide (NBS), Addition of halogens and halogen acids, Autooxidation, Sandmeyer reaction, Hansdiecker reaction, Free radical rearrangement reaction.

Books Recommended


Syllabus M.Sc. EC............ (2015-2016)
Third Semester

EC-301: Industrial Waste and Water Treatment  M.M.: 60

Unit-I: An Introduction to Source, Characteristics and Treatment of Industrial Waste

Undesirable waste characteristics, sources and characteristics of waste water, industrial waste survey, waste characteristics - estimation of organic content, water reuse and in-plant waste control, idea of different technologies for the treatment of industrial waste water and the basis for the selection of treatment technology.

Unit-II: Treatment of Industrial Wastes

Different steps in the treatment of industrial waste (equalization, neutralization, sedimentation, oil separation, flotation, coagulation), sources and removal of heavy metals e.g. As, Ba, Cd, Cu, F, Fe, Rb, Mn, Hg, Ni, Se, Ag & Zn)

Unit-III: Advance Water Treatment of Industrial Waste - I

Aeration, air stripping of volatile organics (VOC), biological oxidation - removal of organics (sorption, stripping, biodegradation), nitrification and de-nitrification.

Unit-IV: Advance Water Treatment of Industrial Waste - I

Lagoons and stabilization basins, membrane processes, trickling filtration, adsorption, ion exchange, chemical oxidation, sludge dewatering and disposal.

Unit-V: Waste Water Reuse and Recovery

Treatment, disposal, reuse and recovery of trade waste from (1) Textile Manufacture (2) Distilleries (3) Sugar (4) Paper and Pulp mills (4) Tanneries (5) Food Processing industries (6) Fertilizer Industry.

Books Recommended

EC 302: Environmental Toxicology and Environmental Impact Assessment

Unit - I: An Introduction to Impact Assessment

Introduction to EIA, impact assessment methodologies, environmental inventory, environmental impact assessment (planning and management), environmental indices and indicators for describing the affected environment, EIA guidelines, introduction to environmental impact statement, assessment of chlorofluorocarbons and carbon dioxide on the overall environment changes in stratospheric ozone.

Unit – II: A study of Impact Assessment -I

Assessment of impacts on the surface water environment, identification of surface water quality or quality impacts, impact prediction, identification and incorporation of mitigation measures, background information on the soil environment, ground water quantity and quality, conceptual approach for addressing soil and ground water environment impacts, identification of the types and quantities of air pollutants and of their impacts, impact prediction, identification and incorporation of mitigation measures.

Unit -III: A study of Impact Assessment-II

Prediction and assessment of impact on the noise environment, prediction and assessment of impacts on the biological environment; a brief idea of prediction and assessment of impacts on the cultural and socioeconomic environment, preparation of reports of the environmental impact study findings.

Unit - IV: Some Case Studies of Environmental Impact Assessment and Sustainable development.
(A) A brief idea of environmental impacts of oil, natural gas, coal, hydroelectric development, nuclear power, thermal power project, mining & mineral processes.
(B) Concept and strategies of sustainable development, environmental priorities of sustainable development in India.

Unit - V: Environmental Toxicology

(A) Toxicology and Pharmacokinetics: One-Compartment Model, Two-Compartment Model, Applications to Toxicology Testing, Toxic effects and dose response relationship a brief idea of carcinogens and non-carcinogens, Biotransformation, Biomarker, Xenobiotics, Toxicity due to Hydrocarbons and pesticides.

(B) Impact of Toxic Chemical on Enzymes: Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, cyanide

Books Recommended
7. Colin Baird, Environmental chemistry four the d i t i o n, W. H. freeman and company New York.
8. Frank A. Barile, Principles of toxicology Testing John's University Queens, New York

E.C 303: Energy and Environmental Geochemistry  M.M.: 60

Unit-I: Energy, Man and Environment

(A) Energy and energy science: Law of conservation of energy, different forms of energy, fuel and energy resources and forms of energy (conventional and renewable resources for electrical generation), national energy strategies and national energy plan, energy management, conservation and audit.

(B) Alternative and renewable energy sources: Wind energy and wind turbine power plants, energy from ocean, geothermal energy and power plant, nuclear energy – fission and fusion principle and energy resources.

Unit-II: Solar Energy

(A) Introduction, Sun as a source of energy, solar radiation and its spectral characteristics, solar radiation measurements, solar collectors, solar photovoltaic, solar energy storage system, solar ponds, applications of solar energy.

Unit-III: Biomass Energy Resources

Biomass energy resources, resources of conversion of biomass into useful energy, raw biomass material for conversion to biogas, biogas generator (factors affecting biodegradation or generation of gas) significance of biogas plants in India's energy strategy, biogas plants, fuel properties and utilization of biogas, biomass as source of energy.

Unit- IV: Other Energy Sources and Pollution Control

(A) Chemical Energy Sources: Fuel cells, principle of operation of a fuel cell (also theory), classification and types of fuel cells, advantages and disadvantages of fuel cells, conversion efficiency of fuel cells, applications of fuel cells.

(B) Pollution Control of Major Pollutants: Pollution from use of energy: combustion products of fossil fuels, methods of controls of major pollutants - SO\(_x\) [Flue gas desulphurization (FGD) systems], removal of NO\(_x\) from flue gas (De-NO\(_x\) system)

Unit V: Mineral Resources and Environmental Hazards

(A) Types of mineral deposits, mineral and rock resources, new methods in mineral exploration, marine mineral resources, conservation of mineral resources, impacts of mining activities.

(B) Hydrological hazards: Floods and drought

Atmospheric hazards: Severe storms, temperature extreme and wild fires

Technological hazards: Bhopal Gas Tragedy and Chernobyl

Seismic hazards: Earthquake and volcanoes

Books Recommended


EC-304 Atmospheric Chemistry  
M.M.: 60

Unit-I: Chemical composition and Meteorological aspects of air pollutants

Earth atmosphere, particles, aerosols and clouds, ozone, cyclic processes including carbon cycle, oxygen cycle, nitrogen cycle, sulphur cycle. Temperature lapse rate and stability, adiabatic lapse rate, atmospheric stability, Inversion, Plume behavior and Gaussian plume. Wind velocity and turbulence.

Unit-II: Photochemistry

Photochemical change, photo-dissociation and photo-ionization, reaction of electronically excited species, adiabatic process and the correlation rules.

Application of kinetics to atmosphere (bimolecular reactions, unimolecular and trimolecular reactions, liquid phase reactions, multi-step reaction scheme).

Unit-III: Ozone in Earth’s Stratosphere

Chemistry of oxygen, Chapman layers, influence of trace constituents, natural sources and sinks of catalytic species, heterogeneous chemistry.

Ionization mechanisms, chemistry of the specific region (F-region processes, E-region processes, D-region positive ion chemistry, D-region negative ion chemistry), a brief idea of ion in stratosphere and troposphere. Solar proton events, solar ultra violet irradiance, El Nino, volcanoes, halocarbon, polar ozone holes consequence of ozone perturbation

Unit-IV: Earth Troposphere

Brief Introduction to Troposphere, sources, sinks and transport. Oxidation and transformation: Photochemical chain Initiation, oxidation steps, importance of NOX, The reaction of OH+ CO

Unit-V: Air Modelling and current carbon trends

Air modelling, air monitoring, Chemistry of carbon dioxide in atmosphere, CO2 sequestration, Carbon trading, Carbon footprint

Books Recommended


Syllabus M.Sc. EC............. (2015-2016)
Fourth Semester

EC 401: Environmental Laws and Management  

Unit - I: Pollution Control Through Laws - I


Unit - II: Pollution Control Through Laws - II


Unit - III: Environmental Management [ISO 14000]

Principles and elements for successful environmental management, elements of environmental management, creating an environmental management system, environmental management commitment and policy, leadership in an environmental management system, environmental management system audit, steps for registration to ISO14000. Preparing environmental management system for an organization.

Unit - IV: Natural Resources and Their Conservation

Types of natural resources and the need for their conservation, soil conservation, forest resources, deforestation, desertification, afforestation and protection of forestry, water resource management, a brief idea of rain water harvesting, wet land conservation, waste land and their reclamation, introduction to biodiversity and conservation of biodiversity in India, protection area network (National park, Sanctuary and Biosphere reserve).

Unit – V: Hazardous Waste Management

Definition of hazardous waste, the relationship of toxicology to hazardous waste management, approach to hazardous waste pollution prevention and reduction, the effectiveness for treatment of hazardous waste, transportation and treatment of hazardous waste, environmental audits and site assessment hazardous substance and risk assessment. Solid waste management, e-waste, nuclear waste, biomedical waste management.

Books Recommended


EC-402: Organic Pollutants

Unit-I: Pesticides-I

Organochlorine insecticides, DDT, accumulation and the fate of organochlorine in biological systems, chlorinated cyclopentadiene, detection of pesticides by gas chromatography, organophosphate and carbamate insecticides, biocides, new generation pesticides.

Unit-II: Pesticides-II

Herbicides, triazine herbicides, phenoxy herbicides, dioxine contamination of herbicides and wood preservatives, polychlorinated biphenyls (PCBs), furan contamination of PCBs, toxicology of PCBs, trioxins and furans, biodiesel, biofertilizers.

Unit-III

(A) Polynuclear aromatic hydrocarbons (PAHs) as pollutants, mechanism of PAH carcinogenic, environmental estrogens.

(B) A brief idea of the following: Recycling of household and commercial waste, recycling of paper, recycling of tire, recycling of plastics, green chemistry, bioremediation, phytoremediation.

Unit-IV: Mutagenic Pollutants

Mutation, effect of mutations, induction of mutation (UV-light), ionizing radiations, chemical mutagens, metabolism of chemical carcinogens.

Unit-V: Electrochemistry in Pollution Control

Electrochemistry of water splitting, large-scale solar hydrogen production, fixing of CO₂, electro chemical removal of wastes (waste water, SO₂, removal of metals, destruction of nitrates, organic wastes, sewage disposal).

Books Recommended

EC – 105 and 106
1st semester
Practical Examinations

One day 6-8 hrs. (Each course)
Two exercises to be given in each examination

M.M.: 100

CLASICAL
1. Neutralization titration
   (a) Determination of Acidity.
   (b) Determination of free carbon dioxide.
   (c) Determination of alkalinity.

2. Complexometric titration
   (a) Determination of temporary and permanent hardness.
   (b) Determination of total, calcium and magnesium hardness.

3. Precipitation titration
   (a) Determination of chloride.

4. Redox titration
   (a) Determination of ferrous iron.
   (b) Determination of copper.

INSTRUMENTAL
1. Spectrophotometric/ Colorimetric determination
   (a) Determination of nickel.
   (b) Determination of hexavalent chromium.

2. Conductometric determination
   (a) Determination of strength of acid against standard alkali.
   (b) Find out the strength of mixture of acids in an unknown mixture.

3. pH metric determination
   (a) Determination of strength of acid against standard alkali.
   (b) Find out the strength of mixture of acids in an unknown mixture.

4. Chromatographic determination
   (a) Identification of a sample compound and its separation from a binary mixture by
      (i) Paper chromatography (ii) Thin layer chromatography and(iii)Electrophoresis.

SEPARATION TECHNIQUES
1. Determination of the distribution coefficient of iodine between CCL₄ and water.

Syllabus M.Sc. EC............. (2015-2016)
One day 6-8 hrs. (Each course)
Two exercises to be given in examination

CLASSICAL
1. Physio-chemical analysis of water
   (a) Determination of total dissolved and suspended solids.
   (b) Determination of residual chlorine.
   (c) Determination of chlorine demand.
   (d) Determination of bicarbonate and carbonate alkalinity.
   (e) Find out the concentration of sulphite.

2. Measurement of organic pollutant in the water
   (a) Determination of Dissolved Oxygen (DO).
   (b) Determination of Biological Oxygen Demand (BOD).
   (c) Determination of Chemical Oxygen Demand (COD).

INSTRUMENTAL
1. Spectrophotometric/ Colorimetric determination
   (a) Determination of nitrite.
   (b) Determination of phosphate.
   (c) Determination of sulphide.

2. Conductometric determination
   (a) Determination of strength of alkali against standard acid.
   (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

3. pH metric determination
   (a) Determination of strength of alkali against standard acid.
   (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

4. Determination of oil and grease in water sample by gravimetric method.

Syllabus M.Sc. EC............ (2015-2016)
EC – 305 and 306  
3rd semester  
Practical Examinations  

M.M.: 100

One day 6-8 hrs. (Each course)  
Two exercises to be given in examination

CLASSICAL
2. Determine the saponification value of given oil sample.  
3. Determination of Iodine Value in given oil sample.

INSTRUMENTAL
1. Spectrophotometric/ Colorimetric determination  
   (b) Find out the composition of binary mixture calorimetrically.  
   (c) Determination of nitrate.  
   (d) Determination of sulphide.  
   (e) Determination of copper.  
   (f) Determination of iron.  
   (g) Determination of Ammonia Nitrogen.  

2. Measurement of different parameters in soil  
   a) Determination of Ash.  
   b) Determination of moisture.  
   c) Faecal coliform test & Total coliform test.  
   d) NPK Value in soil.

3. Determination of sulphate by Turbidometric method.  


5. Determination of adsorption isotherm of acetic acid from aqueous solution by using activated charcoal.

Syllabus M.Sc. EC.......... (2015-2016)