Format for syllabus of Skill development course (I Semester)

Title of course - **SKILLS ON CHEMICAL WASTE MANAGEMENT**	
Nodal Department of HEI to run course	
Broad Area/Sector	INDUSTRIAL WASTE MANAGEMENT
Sub Sector-	Skills on Chemical Waste Management
Nature of course – Independent / Progressive	Progressive
Name of suggestive Sector Skill Council	Chemical and Petro Chemical Sector Skill Council
Aliened NSQF level	4
Expected fees of the course –Free/Paid	
Stipend to student expected from industry	--
Number of Seats-	
Couse Code-	Credits- 03 (1 Theory, 2 Practical)
Max Marks… 100… Minimum Marks…	
Name of proposed skill Partner (Please specify, Name of industry, company etc. for Practical/ training/ internship/ OTJ)	
Job prospect- Expected Fields of Occupation where student will be able to get job after completing this course in (Please specify name/type of industry, company etc.)	• Chemical store Manager in industries and College, hospital, school Laboratories • Manager waste treatment plant • Manager QC/QA in different industries • Technician in Thermal Power Plant • Supervisor in Pharma Company • QC Manager in Pharma company, chemical industries etc.

Syllabus					
Unit	Topics	General/ Skill component	Theory/ Practical/ OTJ/ Internship/ Training	No. of theory hours (Total- 15 Hours= 1 credit)	No of Hours (Total- 60 Hours = 2 credits)
I	• Introduction of waste, focussing on metal deduction	Managerial skill on Waste treatment/ water treatment	PRACTICALS: Qualitative Analysis	02	16
II	• Sampling and handling of Industrial waste	Supervisory and technician skill for pharma/chemical industries	PRACTICALS: Sampling and digestion	02	12
III	• Principles of Industrial waste treatment	Managerial (QA/QC) skill for cement /plastic/textile industries /waste treatment plant industries etc	PRACTICALS: Physical parameters of waste	02	12
IV	• Radioactive Waste and its disposal • Conductivity and its measurements	Technician skill/ Radioactive waste handling expertise for nuclear power plant	PRACTICALS: Conductivity measurement of different samples	04	16
V	• Potentiometric measurements • Electro analytical methods	Technician skill for sugar cement pharma steel/iron foundries	pH measurement & Electrochemical	04	04

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			measurements		
VI	• Sustainability and the Chemical Industry	QC managerial skill for cosmetic/pharma/steel/polymer/textile/food and dairy products	THEORY: Recycle of wastes	01	04

Suggested readings:

1) Industrial Chemistry by B.K Sharma, By Krishna Publications, GOEL Publishing House,
2) Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut.
3) Environmental Chemistry by A. K.De , New Age International Publishers, (9th edition)
4) Water Pollution by V.P. Kudesia, 4th edition, (latest) Pragati Prakashan, Meerut.
5) Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education, sixth edition
6) Potentiometric Water Analysis, Second Edition, Midgley and Torrance, John Wiley and Sons Ltd
7) Electroanalytical Chemistry, Principle, Best Practices and Case studies, by Gary A. Mabbott, Wiley

Suggested Digital Platforms/web links for reading:
https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters
https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352
https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
https://pubs.acs.org/doi/abs/10.1021/ie900135u

Suggested OJT/Internship/ Training/ Skill partner:

Suggested Continuous Evaluation Methods: Unit Tests and Semester exams

Course Pre-requisites:

- No pre-requisite required, open to all.
- To study this course, a student must have the subject **CHEMISTRY** in class 12th/certificate/diploma.
- If progressive, to study this course a student must have passed previous courses of this series.

Suggested equivalent online courses: -------

Any remarks/ suggestions: ----------

Notes:

- Number of units in Theory/ Practical may vary as per need
- Total credits/semester-3 (it can be of more credits, but students will get only 3 credits/semester or 6 credits/semester
- Credits for Theory =01 (Teaching Hours=15)
- Credits for Internship/OJT/Training/Practical=02 (Training hours =60)

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Format for syllabus of Skill development course (II Semester)

Title of course- **SKILLS FOR RECOVERY AND REUSE OF METALS FROM INDUSTRIAL WASTE**	
Nodal Department of HEI to run course	
Broad Area/Sector	Waste Management
Sub Sector-	Skills for Recovery of metals from Industrial waste
Nature of course – Independent / Progressive	Progressive
Name of suggestive Sector Skill Council	Chemical and Petro Chemical Sector Skill Council
Aliened NSQF level	5
Expected fees of the course -Free/Paid	
Stipend to student expected from industry	-
Number of Seats-	
Couse Code-	Credits- 03 (1 Theory, 2 Practical)
Max Marks…100… Minimum Marks…	
Name of proposed skill Partner (Please specify, Name of industry, company etc. for Practical/ training/ internship/ OTJ)	
Job prospect- Expected Fields of Occupation where student will be able to get job after completing this course in (Please specify name/type of industry, company etc.)	• Manager – Waste Management in waste treatment plant • Technician in any chemical laboratory of national repute or treatment plant • Entry level Management role in waste treatment plant & recycling industry • Environmental Analyst • Industrial Waste Analyst/Technician • Industrial Waste Treatment Plant Technician/Supervisor

Syllabus

Unit	Topics	General/ Skill component	Theory/ Practical/ OTJ/ Internship/ Training	No. of theory hours (Total-15 Hours= 1 credit)	No of Hours (Total-60 Hours=2 credits)
I	• Types of Industries generating liquid and solid waste Sources, and quantum of Waste generated from industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating Industries, Dairy, Sugar, Paper, Distilleries, Steel Plants, Refineries, Fertilizer, Mining, and Thermal Power Plants. • Identification and segregation of waste containing metals	Different types of Waste identification skill/Lab Technician skill for any testing labs in India Waste handling expert in waste treatment plant	PRACTICALS: Quantitative analysis Determination of physical parameters of wastewater and solid waste. a) Temperature b) Colour c) Odour d) pH	03	16
II	• Four "Rs"- Reuse, Rework, Reduce, Recycle	Managerial skill in minimizing wastes	PRACTICALS: Handling of different kinds of wastes and reuse. BOD, COD, & OD measurement	02	08
III	• Processes / methods of metal extraction from Industrial wastes	Skill to analyse waste and value recovery from it	PRACTICAL: Wastewater analysis and its treatment including primary, secondary, and tertiary treatment	02	12

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IV	• Health Hazards associated with different kinds of pollutants • E- Waste in India	Managerial skill in solid waste management	PRACTICALS: Study of physico-chemical characteristics of e waste.	02	08
V	• Bioremediation of biphenyls, aliphatic, aromatic, asphalts hydrocarbon components, heavy metals and metalloids present in industrial waste.	Waste handling expertise	PRACTICAL: Soil Sampling and its digestion Physico-chemical characteristics of soil	03	08
VI	• Sustainability and the Chemical Industry • Chromatography and separation Techniques	expertise in handling sophisticated instruments for any Pharma/ Chemical companies/Testing Labs etc	PRACTICALS: TLC and Paper chromatographic techniques	03	08

Suggested readings:

1) Industrial Chemistry by B.K Sharma, Krishna Publications, GOEL Publishing House
2) Environmental Soil Chemistry, by Donald Sparks, 2nd edition, Academic Press
3) Environmental Chemistry by A .K. De, New Age International Publisher, (9th edition)
4) Vogel's Text Book of Quantitative Analysis, fifth edition, Longman scientific & technical
5) Hand book of solid waste management, second edition, McGraw-Hill education.
6) Techniques and Practice of Chromatography, by Raymond P W Scott, CRC Press

Suggested Digital Platforms/web links for reading:

https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters
https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352
https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
https://pubs.acs.org/doi/abs/10.1021/ie900135u
https://www.epa.gov/sites/production/files/2016-03/documents/industrial-waste-guide.pdf
https://www.researchgate.net/publication/340365467_A_golden_period_for_environmental_soil_chemistry
https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions

Suggested OJT/Internship/ Training/ Skill partner:

Suggested Continuous Evaluation Methods: Tests, and semester exams

Course Pre-requisites:

- No pre-requisite required, open to all.
- To study this course, a student must have the subject **CHEMISTRY** in class 12th/certificate/diploma.
- If progressive, to study this course a student must have passed previous courses of this series.

Suggested equivalent online courses:

Any remarks/ suggestions:

Notes:

- Number of units in Theory/ Practical may vary as per need
- Total credits/semester-3 (it can be of more credits, but students will get only 3 credits/semester or 6 credits/semester
- Credits for Theory =01 (Teaching Hours=15)
- Credits for Internship/OJT/Training/Practical=02 (Training hours =60)

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Format for syllabus of Skill development course (III Semester)

Title of course- **RECOVERY AND REUSE OF METALS FROM INDUSTRIAL WASTE**	
Nodal Department of HEI to run course	
Broad Area/Sector	Waste Management
Sub Sector-	Value recovery from waste of electroplating industry/ battery industries/ pickling sludge
Nature of course – Independent / Progressive	Progressive
Name of suggestive Sector Skill Council	Chemical and Petro Chemical Sector Skill Council
Aliened NSQF level	6
Expected fees of the course -Free/Paid	
Stipend to student expected from industry	
Number of Seats-	
Couse Code-	Credits- 03 (1 Theory, 2 Practical)
Max Marks…100… Minimum Marks…	
Name of proposed skill Partner (Please specify, Name of industry, company etc. for Practical/ training/ internship/ OTJ)	
Job prospect- Expected Fields of Occupation where student will be able to get job after completing this course in (Please specify name/type of industry, company etc.)	• Entry level jobs in IPR management • Environmental Analyst/ Project Fellow • Industrial waste treatment plant Engineer/ Supervisor • Manager in waste treatment, electroplating, recycling industries • Industrial Waste Analyst/ Technician

Syllabus: Manager in waste treatment, electroplating & recycling industries.

Unit	Topics	General/ Skill component	Theory/ Practical/ OTJ/ Internship/ Training	No. of theory hours (Total-15 Hours= 1 credit)	No of Hours (Total-60 Hours=2 credits)
I	• Classification and characteristics of waste containing metals	Skill developed in waste unit head	PRACTICALS/THEORY: Segregation and characterisation of industrial waste	02	04
II	• Environmental policies and laws on waste management	Skill on policy making on environment IPR expertise	PRACTICALS: Air Pollution practical exercise	03	08
III	• Conferences/conventions • related to environment	Paper writing/Review writing/ skill	THEORY: Paper/Review Article writing on value recovery from different industrial waste	02	08
IV	• Hazardous waste management.	Managerial skill on waste management	PRACTICALS: sampling, handling and analysis of hazardous waste by presentation/ videos / virtual lab etc .	03	16
V	• Material balance, with or without chemical reaction. • Flow diagram for material balance, simple material balance with or without recycle or bypass for chemical engineering	Skill developed Plant-in-charge/head in water treatment/wastewater treatment plant	THEORY: Material balance, with or without chemical reaction	02	08

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	operations such as distillation, absorption, crystallization, evaporation, extraction etc.				
VI	• Value recovery from electroplating industry waste, battery and pickling sludge waste etc	Waste recovery expert/Plant in charge in electroplating industries etc	THEORY/PRACTICAL: Estimation of heavy metals in industrial waste using AAS/ Flame photometric method of analysis/ Spectrophotometry/ Gravimetric analysis	03	16

Suggested readings:

1) Industrial Chemistry by B.K Sharma, Krishna Publication, GOEL publishing house
2) Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut
3) Environmental Chemistry by A.K. De, New Age International Publishers
4) Material Balance and Process Calculations, A book for engineers and chemists, Kingsley Augustine
5) Micheael D. La Grega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management", Hazardous waste Management, McGraw-Hill International edition, New York, 2001.
6) Unit Process for organic synthesis by P.H. Groggins, fifth edition, Tata McGraw Hill edition

Suggested Digital Platforms/web links for reading:
https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters
https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352
https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
https://pubs.acs.org/doi/abs/10.1021/ie900135u

Suggested OJT/Internship/ Training/ Skill partner:

Suggested Continuous Evaluation Methods: unit test and semester exams

Course Pre-requisites:

- No pre-requisite required, open to all.
- To study this course, a student must have the subject **CHEMISTRY** in class 12th/certificate/diploma.
- If progressive, to study this course a student must have passed previous courses of this series.

Suggested equivalent online courses:

Any remarks/ suggestions:

Notes:

- Number of units in Theory/ Practical may vary as per need
- Total credits/semester-3 (it can be of more credits, but students will get only 3 credits/semester or 6 credits/semester
- Credits for Theory =01 (Teaching Hours=15)
- Credits for Internship/OJT/Training/Practical=02 (Training hours =60)

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Format for syllabus of Skill development course (IV Semester)

Title of course- **RECOVERY AND REUSE OF METALS FROM INDUSTRIAL WASTE**	
Nodal Department of HEI to run course	
Broad Area/Sector	Waste Management
Sub Sector-	Recovery of metals from industrial waste
Nature of course – Independent / Progressive	Progressive
Name of suggestive Sector Skill Council	Chemical and Petro Chemical Sector Skill Council
Aliened NSQF level	7
Expected fees of the course -Free/Paid	
Stipend to student expected from industry	-
Number of Seats-	
Couse Code-	Credits- 03 (1 Theory, 2 Practical)
Max Marks…100… Minimum Marks…	
Name of proposed skill Partner (Please specify, Name of industry, company etc. for Practical/ training/ internship/ OTJ)	
Job prospect- Expected Fields of Occupation where student will be able to get job after completing this course in (Please specify name/type of industry, company etc.)	• Manager- waste management in textile, tanneries, leather foundries etc • Environmental Analyst • Industrial waste Analyst/ Technician • Industrial Waste Treatment Plant Supervisor/Engineer • Engineer in waste treatment plant • Entry level Management Role in Waste Treatment Plants & Recycling Industry

Syllabus

Unit	Topics	General/ Skill component	Theory/ Practical/ OTJ/ Internship/ Training	No. of theory hours (Total-15 Hours= 1 credit)	No of Hours (Total-60 Hours=2 credits)
I	• Effects of waste containing metals on the environment	Managerial skill in waste management	PRACTICALS: • Determination of particulate air pollutants (PM 2.5 and PM 10)		
II	• Liquid waste generation its treatment and management	Skill in handling waste	PRACTICALS: • Liquid Sample preparation and sampling techniques		
III	• Environmental pollution, its kind and control	Skills on Environmentalist in organization like pollution control board	PRACTICALS: • Determination of gaseous air pollutants		
IV	• Solid waste management plan	Managerial skill on waste management	PRACTICALS: • Characterisation of municipal solid waste and • Analysis of solid waste/sludge for moisture content.		
V	• Material balance involving chemical reactions: concepts of	Managerial skill / plant in charge skill	THEORY:		

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	limiting reactant, conversion, yield, selectivity, and liquid phase reaction, gas phase reaction with or without recycle or bypass.		• Material balance, with or without chemical reaction		
VI	• Advanced microscopy and spectroscopy: Electron microscopy (SEM and TEM), Flame photometry, UV-Vis photometry, and Atomic absorption spectrophotometry.	Skill on handling State of the Art lab instruments (Instrumentation scientist skill)	PRACTICALS: Estimation of heavy metals using any one of the following techniques- • Flame photometric method/ • Gravimetric method/AAS • Material balance, with or without chemical reaction		

Suggested readings:
- Industrial Chemistry by B.K Sharma, Krishna publications.
- Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut
- Vogel's Text book of Quantitative Chemical Analysis, sixth edition, Pearson Education
- Environmental Chemistry by A.K. De, New age International Publishers
- Municipal solid wastes, Problems and Solution, edited by Robert E Landreth and Paul A Rebers
- Unit Process for organic synthesis by P.H. Groggins, fifth edition, Tata McGraw Hill edition

Suggested Digital Platforms/web links for reading:
https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters
https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352
https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
https://pubs.acs.org/doi/abs/10.1021/ie900135u

Suggested OJT/Internship/ Training/ Skill partner:

Suggested Continuous Evaluation Methods: Unit Tests and Semester Exams

Course Pre-requisites:
- No pre-requisite required, open to all.
- To study this course, a student must have the subject **CHEMISTRY** in class 12th/certificate/diploma.
- If progressive, to study this course a student must have passed previous courses of this series.

Suggested equivalent online courses:

Any remarks/ suggestions:

Notes:
- Number of units in Theory/ Practical may vary as per need
- Total credits/semester-3 (it can be of more credits, but students will get only 3 credits/semester or 6 credits/semester
- Credits for Theory =01 (Teaching Hours=15)
- Credits for Internship/OJT/Training/Practical=02 (Training hours =60)

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