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VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની એમ.એસસી. એન્વાયરમેન્ટલ સાયન્સ વિષય ચલાવતી સંલગ્ન અનુસ્નાતક કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૧૯–૨૦ થી અમલમાં આવનાર M.Sc. Environmental Science (Sem-III & IV) નાં અભ્યાસક્રમ અને Examination Scheme અંગે એન્વાયરમેન્ટલ વિષયની નિયુકત એડહોક બોર્ડની તા.૦૮/૦૫/૨૦૧૯ ની સભાના ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ નીચેની ભલામણ વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૦૭/૬/૨૦૧૯ ની સભાના ઠરાવ ક્રમાંકઃ૩૦ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્ઉપરાંત તેનો અમલ કરવો.

એન્વાયમેન્ટલ સાયન્સ વિષયની નિયૂકત (એડહોક)સમિતિની તા.૦૮/૦૫/૨૦૧૯ની સભાનાં ભલામણ ક્રમાંકઃ ૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૧૯–૨૦ થી અમલમાં આવનાર M.Sc. (Environmental Science) Sem-III & IV નો અભ્યાસક્રમ અને Examination Scheme આ સાથે સામેલ પરિશિષ્ટ મુજબ સુધારા સાથે સ્વીકારવામાં આવે છે અને તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૭/૦૬/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંકઃ ૩૦

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૧૯–૨૦ થી અમલમાં આવનાર M.Sc. (Environmental Science) Sem-III & IV નો અભ્યાસક્રમ અને Examination Scheme સ્વીકારી તે મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૧૦૩૫૯/૧૯
તા. ૨૦–૦૬–૨૦૧૯

ઈ.ચા. કુલસચિવ

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની એમ.એસસી.એન્વાયરમેન્ટલ સાયન્સ વિષય ચલાવતી સંલગ્ન અનુસ્નાતક કોલેજોના આચાર્યશ્રીઓ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

SURAT

M. Sc. ENVIRONMENTAL SCIENCE

SYLLABUS (CBCS)

With Effect from 2019-20

1. M. Sc. Environmental Science course will run on semester basis.
2. Each semester will be of fourteen (14) weeks. (Actual Teaching)
3. The whole course will be of two years (Four Semesters).
4. Proposed Teaching and Examination Scheme for
   M. Sc. Environmental Science course (semester III, IV) will be as per Annexure-I.
5. Proposed Syllabus of M. Sc. Environmental Science course (semester III, IV) will be as per Annexure-II.
6. Examination system and passing standards will be as per VNSGU CBCS Norms.

ANNEXURE – I

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.Sc. Environmental Science

Teaching and Examination Scheme

Third Semester

Course No.	Course Title	Theory (hrs/wk)	Practical (hrs/wk)	Exam Hours :3 External Marks	Internal Marks	Total Marks	Credit
Ens. 301	Solid and Hazardous Waste Management	4	-	70	30	100	4
Ens. 302	Air and Noise Pollution	4	-	70	30	100	4
Ens. 303	Industrial Waste Water Treatment	4	-	70	30	100	4
Ens. 304	Geo Microbiology	4	-	70	30	100	4
Ens. 305	Laboratory Practicals	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

Fourth Semester

Course No.	Course Title	Theory (hrs/wk)	Exam Hours :3 External Marks	Internal Marks	Total Marks	Credit
Ens. 401	Instrumentation in Environmental Analysis - II	4	70	30	100	4
Ens. 402	Environmental Toxicology and Nanotechnology	4	70	30	100	4
Ens. 403	Environmental Disasters & Risk Management	4	70	30	100	4
Ens. 404	Environmental Management, Legislation and Policy	4	70	30	100	4
Ens. 405**	Dissertation OR	8*	140	60	200	8
Ens.405-A	Review of Research Article	4*	70	30	100	4
Ens.405-B	Seminar	4*	70	30	100	4
Total		**24**	**420**	**180**	**600**	**24**
Total Credits of Semester I + II + III + IV						**96**

** Student can opt for Either Dissertation OR Review of Research Article and Seminar.

* **It includes all guidelines related to: 1 Hour/Student/Week may be given.**

- Topic selection for Dissertation / Review of Research Article / Seminar.
- Its theoretical concept and experimental work in laboratory in case of Dissertation.
- Thesis writing in format and Power point presentation preparation.
- Continuous Evaluation of all the above mentioned tasks.
- Final Checking of Thesis and Power point presentation.

VNSGU External Examination Marking Scheme

M.Sc. ENVIRONMENTAL SCIENCE

Theory Question Paper **Total Marks: 70**

There will be total 4 Questions. All questions are compulsory.(Internal Option)

Q.1, Q.2, Q.3 will be of 18 Marks, each from Unit 1,2,3.

Write any 3 questions (6 marks) out of 4.

Q.4 will be of 16 Marks, from Unit 4.

Write any 4 short notes (4 marks) out of 5.

Ens 405: Dissertation **Total Marks:140**

Power Point Presentation: 40 Marks

Dissertation Thesis: 80 Marks

Viva-Voce/Question-Answers (Oral): 20 Marks

OR

Ens 405-A: Review of Research Article **Total Marks:70**

Power Point Presentation: 20 Marks

Report: 40 Marks

Viva-Voce/Question-Answers(Oral):10 Marks

AND

Ens 405-B: Seminar **Total Marks:70**

Power Point Presentation: 20 Marks

Report: 40 Marks

Viva-Voce/Question-Answers(Oral):10 Marks

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Grand Total of Ens 405-A+Ens 405-B : **Total Marks: 140**

ANNEXURE – II

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

Ens 301: Solid & Hazardous Waste Management

Total Hours: 48

1	**Solid Waste**	**12 Hours**
1.1	Introduction of solid waste management rules and regulation	
1.2	Sources and types based classification	
1.3	Physical, chemical and biological properties	
1.4	Composition and generation rate	
1.5	Collection, on-site handling, transfer station and transportation	
1.6	Physical, chemical(thermal), biological processing technologies	
1.7	Recycling and reuse: material and energy recovery	
1.8	Disposal methods: open dumping, sanitary landfill, land farming	
2	**Hazardous Waste**	**12 Hours**
2.1	Introduction to hazardous waste and harmful effects	
2.2	Sources and classification	
2.3	Identification:characteristics and types of listed hazardous waste	
2.4	Generation, collection - storage , transfer and transport	
2.5	Treatment Methods: physical, chemical, photolytic, thermal, biological, land treatment and composting	
2.6	Preparation of waste for disposal	
2.7	Ultimate disposal of waste: disposal above ground, surface impoundment , deep well disposal of liquids, secured landfill	
2.8	In-situ treatment	
3	**Radioactive & E Waste Management**	**12 Hours**
3.1	Introduction to radioactive and E-waste	
3.2	Sources - natural and anthropogenic	
3.3	Harmful effects of radioactive pollution/E-waste	
3.4	Maximum permissible dose values - ICRP standards	
3.5	Preventive and control measures	
3.6	Collection, storage and disposal	

4	**Plastic & Bio medical Waste**	**12 Hours**
4.1	Introduction to plastic and biomedical waste and hazards/harmful effects	
4.2	Sources of generation	
4.3	Types/Categories	
4.4	Segregation, storage & transportation	
4.5	Treatment techniques	
4.6	Disposal methods	

References:

1. Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel A Vigil, 1st Edition, 1993, 2nd Reprint, 2014, McGraw-Hill Education (India) P. Ltd.
2. Textbook of Solid Waste Management, Iqbal H. Khan, Naved Ahsan, 1st Edition, 2003, 7th Reprint, 2017, CBS Publishers and Distributors P. Ltd.
3. Management of Municipal Solid Waste, T.V. Ramchandra, 1st Edition, 2006, 5th Reprint, 2014, Teri Press.
4. Environmental Sciences, S.C. Santra, 3rd Edition, April 2013, 3rd Reprint, 2016, New Central Book Agency P. Ltd.
5. Environmental Chemistry, B.K.Sharma, 1st Edition, 1994, 16th Edition, 2016, Krishna Prakashan P. Ltd.
6. Standard Handbook of Hazardous Waste Treatment and Disposal, H.M.Freeman, 2nd Edition, 1997, McGraw Hill.
7. Hazardous waste management, Charles A. Wentz, 2nd Edition, 1995, McGraw Hill.
8. Handbook of Solid waste management, Frank Kreith, 2nd Edition, 1994, McGraw-Hill.
9. Hazardous Waste Management, Michael D La Grega, Phillip L Buckingham, Jeffrey C. Evans, 1st Edition, 1994, McGraw-Hill.
10. Environmental Engineering, Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, 1st Edition, 1984, Mc Graw Hill.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

Ens 302: Air and Noise Pollution

Total Hours : 48

1. Ambient Air & Noise Pollution **12 Hours**

1.1 Introduction to air and noise pollution
1.2 Classification of sources of air pollutants: Stationary and mobile, natural and artificial
1.3 Types: primary and secondary air pollutants
1.4 Effects of natural air pollutants, Effects of air pollution on humans, vegetation and materials
1.5 **Noise Pollution:** Characteristics of sound, measurement of noise, equipment used for noise measurement
1.6 Sources of noise pollution physiological and psychological effects of noise pollution
1.7 Control measures of noise pollutions, noise pollution control in industries, important parameters in noise control, standards prescribed for noise in Indian context.

2 Air pollution Meteorology and Thermodynamics **12 Hours**

2.1 Meteorological parameters
2.1.1 Heat, radiation and temperature lapse rate
2.1.2 Wind speed, wind direction and wind rose
2.1.3 Mixing height
2.1.4 Moisture and humidity
2.1.5 Rainfall and precipitation
2.1.6 High and low pressures
2.2 Plume behavior
2.3 Effect of topography on pollutant dispersion
2.4 Themodynamics of formation of CO, SO_x, NO_x
2.5 Thermodynamics of combustion: air fuel ratio
2.6 Combustion of coal, oil and natural gas

3 Air Pollution Monitoring and Management **12 Hours**

3.1 Environmental guidelines for industries
3.2 Ambient air quality standards
3.3 Stack emission monitoring
3.3.1 Stack emission standards
3.3.2 Location of sampling ports and traverse points
3.3.3 Sampling train
3.3.4 Isokinetic sampling

3.3.5 Determination of stack characteristics
3.3.6 Stack monitoring procedure
3.4 Ambient air quality monitoring: SPM and gaseous sampling
3.5 Ambient air quality survey
3.6 Air quality management in India

4 Air Pollution Control Technology 12 Hours

4.1 Control of particulate pollutants
4.1.1 Control at source
4.1.2 Control equipments: settling chambers, cyclones, fabric filters, electrostatic precipitators, scrubbers (spray towers, venturi scrubbers, cyclone and packed scrubbers)
4.2 Control of gaseous pollutants: adsorption, absorption, combustion, condensation
4.3 SO_x control
4.4 NO_x ontrol
4.5 Automobile pollution: vehicular emissions, automotive fuels, motor fuel combustion, control of motor vehicle emissions
4.6 Pollution control in chemical process industry

References:

1. Air Pollution, M. N. Rao and H. V. N. Rao, 26th Edition, 2007,Tata McGraw Hills.
2. An introduction to air pollution , R. K. Trivedy, P. K. Goel, 1st Edition, 2003, ABD Publishers.
3. Textbook of Air Pollution And Its Control ,S. C. Bhatia, 1st Edition, 2007, Atlantic Publishers .
4. Air Pollution Control Engineering, Noel De Nevers, 2nd Edition, 2000, McGraw Hill.
5. Environmental pollution and control in chemical industries, S. C. Bhatia, 2nd Edition, 2014, Khanna Publishers.
6. Methods of Air Sampling and Analysis, James P. Lodge, JR., 3rd Edition, 2016, CRC Press.
7. Air Pollution Engineering Manual, Wayne T. David, 2nd Edition, 2000, John Wiley and Sons.
8. Air Pollution and Control, K.V.S.G. Murlikrishnan, 2nd Edition, 2017, University Science Press

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

Ens 303: Industrial Wastewater Treatment

Total Hours: 48

1	**Sources, Characteristic & Treatment of Wastewater from different Industries**	**12 Hours**
1.1	Textiles and Dye Manufacturing	
1.2	Metal Plating	
1.3	Fertilizer	
1.4	Drugs and Pharmaceuticals	
1.5	Sugar and Dairy	
1.6	Petrochemicals	
2	**Common Effluent Treatment Plant**	**12 Hours**
2.1	Introduction of ETP and CETP	
2.2	Need for effluent treatment and principle of ETP	
2.3	Common problems, design and management of CETP	
2.4	Sources and characteristics of industrial waste water	
2.5	Indian standards for disposal of industrial effluents	
3	**Treatment of Industrial Effluent**	**12 Hours**
3.1	Primary treatment: screening, neutralization, equalization, sedimentation and coagulation	
3.2	Secondary treatment: aerobic biological - activated sludge process, oxidation pond, aerated lagoon, trickling filter. anaerobic digestion.	
3.3	Tertiary treatment: removal of dissolved inorganic matter, organics (biodegradable & other organics), oil & grease, acid and alkali, toxic material, carbon, nitrogen, phosphorus and microorganisms.	
4	**Waste Reduction and Disposal Methods**	**12 Hours**
4.1	Flow measurement	
4.2	Volume reduction	
4.3	Strength reduction	
4.4	Treatment and disposal of sludge solids	
4.5	Methods of waste water disposal: Natural, artificial and combined	
4.6	Wastewater disposal on land & land treatment	

References:

1. Industrial Wastewater Treatment, M. N. Rao, A. K. Dutta, 2nd Ed, 2007, Reprint, 2014, Oxford & IBH Publishing Co.Pvt.Ltd.
2. Water Supply and Sanitary Engineering, G.S. Birdie & J. S. Birdie, 9th Edition 2011, Reprint, 2015, Dhanpat Rai Publishing Company.
3. Chemistry of Environmental Engineering and Science, C. N. Sawyer and P. L. Mc Carty, 5th Edition, 2003, 21st Reprint, 2015, McGraw Hill Education (India) Pvt. Ltd.
4. Hand book of drinking water quality by John DeZuane, 2nd Edition, 1997, Reprint, 2013, Wiley India Pvt. Ltd.
5. Environmental Problems Protection and Control, Vol-1 & 2, Arun Kumar, 1st Edition, 1999, Anmol Publications Pvt. Ltd.
6. Environmental Pollution and Control in Chemical Process Industries, S.C. Bhatia, 2nd Edition, 3rd Reprint, 2014, Khanna Publishers.
7. Industrial Wastewater Treatment, A.D. Patwardhan, 1st Edition, 2nd Reprint, 2009, PHI Learning Private Limited.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

Ens 304: Geo Microbiology

Total Hours : 48

1	**Introduction, History, Earth as Microbial Habitat**	**10 Hours**
1.1	Introduction to Geolomicrobiology, geological importance, features and biosphere	
1.2	Beginnings and evolution of life through the Precambrian	
1.3	The evidence	
2	**Geomicrobial Process: A Physical and Biochemical overview**	**14 Hours**
2.1	Types of geomicrobial agents	
2.2	Geomicrobially important physiological groups of procaryotes and its role	
2.3	Types of microbial activities influencing geological processes	
2.4	Microbes as catalysts of geochemical processes	
2.5	Microbial mineralization and geomicrobial transformations	
3	**Methods in Geomicrobiology**	**12 Hours**
3.1	Detection and isolation of geomicrobially active organisms	
3.2	*In situ* study of past and ongoing geomicrobial activity	
3.3	Quantitative study of growth on surfaces	
3.4	Enzymatic and nonenzymatic geomicrobial activity and transformation	
4	**Geomicrobiology of Fossil Fuels**	**12 Hours**
4.1	Natural abundance of fossil fuels	
4.2	Methane	
4.3	Peat	
4.4	Coal	
4.5	Petroleum	

References:

1. Geomicrobiology, Henry Lutz Ehrlich and Dianne K. Newman., 5th Edition, 2009, CRC press.
2. Geomicrobiology, S.K. Jain; A.A. Khan, M.K.Rai, 1st Edition, 2010, CRC press.
3. Introduction to Geomicrobiology, Kurt O. Konhauser , 1st Edition, 2006 , Wiley-Blackwell.
4. Geomicrobiology: Molecular and Environmental Perspective, Larry L. Barton, Martin Mandl, Alexander Loy, 1st Edition, 2010, Springer.
5. Analytical Geomicrobiology: A Handbook of Instrumental Techniques, Janice P. L. Kenney, , Harish Veeramani, Daniel S. Alessi, 1st Edition, 2019, Cambridge University Press.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
THIRD SEMESTER

EnS 305: Laboratory Practicals

Ens 301: Sampling and Analysis of Solid Waste

1. Determination of % of Moisture, Volatile Matter, Ash and Fixed Carbon by Proximate analysis and Calculation of Calorific value of solid waste.
2. Chemical analysis of Organic Carbon and Organic Nitrogen of solid waste.
3. Chemical analysis of Total Phosphate and Pottasium of solid waste.

Ens 301: Sampling and Analysis of Landfill Leachate

1. Chemical analysis of pH and Electrical Conductivity of Leachate sample.
2. Chemical analysis of BOD, COD, NH_4^+ - N, Solids in Leachate sample.
3. Chemical analysis of Heavy metals in Leachate sample.
4. Chemical analysis of Cl^-, F^- in Leachate sample.

Ens 302: Air Pollution Monitoring:

1. Sampling and chemical analysis of the concentration of SOx in ambient air.
2. Sampling and chemical analysis of the concentration of NOx in ambient air.
3. Sampling and gravimetric analysis of the PM_{10} and $PM_{2.5}$ in ambient air.
4. To study the Stack Monitoring Kit.
5. Sampling and microbiological analysis of air from different location.

Ens 303:Industrial Wastewater Analysis:

Sampling and Analysis of Physico-chemical characteristics of effluent from various industries:

1. Analysis of pH and Electrical Conductivity, BOD of industrial wastewater.
2. Chemical analysis of, COD, NH_4^+ - N, Solids in industrial wastewater.
3. Chemical analysis of Heavy metal in industrial wastewater.

Ens 304:Geo Microbiology:

1. Isolation of *Geobacter* spp from sedimentary environment.
2. Isolation of anaerobic bacteria from mud sample.
3. Isolation of *Arthrobacter* spp. from soil.
4. Isolation of methanogens from cattle dung.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
FOURTH SEMESTER

Ens 401 : Instrumentation in Environmental Analysis-II

Total Hours: 48

1	**Gas Chromatography**	**12 Hours**
1.1	Introduction of chromatography and principle of separation	
1.2	Classification -GSC and GLC & its applications	
1.3	Components of instruments: carrier gas, sample injection system, stationary and mobile phase	
1.4	Columns - packed column and capillary column - WCOT, SCOT, PLOT	
1.5	Detectors - FID , TCD, ECD , ASD	
1.6	Principle and applications of GC-HS, GC-MS	
2	**High Performance Liquid Chromatography**	**12 Hours**
2.1	Introduction, principle and types of HPLC	
2.2	Components of instruments: pumps high pressure, pneumatic, syringe, reciprocating, hydraulic	
2.3	Sample injection system	
2.4	Column	
2.5	Detector: ultra violet light absorption , refractive index, evaporative light scattering	
2.6	Selective applications in separation and estimations	
2.7	Principle and applications of LC-MS	
3	**Ion Exchange Chromatography**	**12 Hours**
3.1	Ion exchangers - characteristics and properties	
3.2	Types of ion exchangers	
3.3	Synthesis and working of cation and anion exchange resins	
3.4	Ion exchange equilibrium and factors affecting it	
3.5	Instrumental set up of IEC- columns and detector	
3.6	Principle and procedure of IEC	
3.7	Applications	
4	**Chemical Sensors**	**12 Hours**
4.1	Definition and classification of sensors	
4.2	Signal and noise, efficiency of sensors	
4.3	Principle and applications of	
4.3.1	Electrochemical sensors	
4.3.1.1	Coulometry & Potentiometry	
4.3.1.2	Conductimetry & Amperometry	
4.3.1.3	Polarography & Voltammetry	
4.3.2	Solid state electrode sensors	
4.3.3	Optical sensors	
4.3.4	Thermal sensors	
4.3.5	Mass sensitive sensors	

References:

1. BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd.
2. Handbook of Analytical Instrument, R.S. Khandpur,2nd Edition, Reprint 2009, Tata McGraw Hill Publishers.
3. Instrumental Methods of Chemical Analysis (Analytical Chemistry) , H. Kaur, 8th Edition, 2012, Pragati Prakashan.
4. Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers.
5. Analytical Instrumentation Handbook, Ewing's , Edited by Jack Cazes, 3rd Edition, 2005, Marcel Dekker Publisher.
6. Instrumental Methods of Analysis, H.H.Willard, L.L.Meritt, J.A. Dean and F.A. Settle, 7th Edition, 1986, CBS Publishers.
7. Instrumental Methods of Analysis, B.K. Sharma, 24th Edition, 2005, Goel Publishing House.
8. Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 11th Edition, Reprint 2012, Cengage Learning.
9. Analytical Instrumentation, Bela G. Liptak, 1st Edition,1994, 1st Indian Reprint, 2012, Chilton Book Company.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
FOURTH SEMESTER

Ens 402: Environmental Toxicology and Nanotechnology

Total Hours: 48

1	**Toxicology of Heavy Metals**	**12 Hours**
1.1	Toxic chemicals in the environment: classification	
1.2	Impact of toxic chemicals on enzymes	
1.3	Biochemical effects and toxicology of	
1.3.1	Cadmium	
1.3.2	Lead	
1.3.3	Arsenic	
1.3.4	Mercury	
2	**Toxicology of Hazardous Chemicals**	**12 Hours**
2.1	Biochemical effects and toxicology of	
2.1.1	Ozone & Peroxy Acetyl Nitrate	
2.1.2	Cyanide	
2.1.3	Methyl Iso Cyanate (MIC)	
2.1.4	Pesticides	
2.2	Preventive measures to protect environment	
2.3	Better industrial process	
2.4	Industrial ecosystem	
3	**Fundamentals of Nanotechnology**	**12 Hours**
3.1	Introduction to nanotechnology	
3.2	Concept and principle of bionanotechnology	
3.3	Biological engines	
3.4	Nanometers of biological systems	
4	**Nanotechnology for Environmental Development**	**12 Hours**
4.1	Remediation: nanosized metal oxides for remediation	
4.2	Photocatalysis	
4.3	Monitoring devices of pollutant	
4.4	Cytotoxicity of nanoparticles	

References:

1. Environmental Chemistry: Stanley. E. Manahan, 10th Edition, 2017, CRC Press.
2. Environmental Chemistry: A. K. De, 7thedition, 2018, New Age International Publisher
3. Environmental Chemistry: Sameer K. Banerjee, 2nd Edition, 2005, Prentice Hall of India Pvt. limited.
4. Chemistry of Environmental Engineering and Science, C. N. Sawyer and P. L. Mc Carty, 5th Edition, 2003, 21st Reprint, 2015, McGraw Hill Education (India) Pvt. Ltd.
5. Environmental Chemistry, B. K. Sharma, 16th Edition, 2016, Goel Publishing House
6. Environmental Chemistry - H. Kaur, 8th Edition, 2014, Pragati Prakashan.
7. Bionanotechnology: Concepts and Application, Madhuri Sharon; Maheshwar Sharon, 1st Edition, 2013, Ane Books Pvt., Ltd.
8. Nanotechnology: A future technology with visions, Author: Appin Labs-team, 1st Edition, 2007, BPB publication.
9. Nanotechnology, R.K.Yadav, 1st Edition, 2007, Manglam Publisher.

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M.Sc. Environmental Science
FOURTH SEMESTER

Ens. 403: Environmental Disasters and Risk Management

Total Hours:48

1	**Hazards in the Environment**	**14 Hours**
1.1	Hazards, risk and disasters	
1.2	Current views: the complexity paradigm	
1.3	Phases of disaster	
1.4	Explaining, measuring and managing disaster	
2	**Natural Disasters**	**14 Hours**
2.1	Types of natural disasters	
2.2	Natural disasters and medicine	
2.3	Natural disaster: awareness and education	
2.4	Natural disaster reduction: global concern	
3	**Risk Assessment and Management**	**10 Hours**
3.1	Nature of risk and assessment	
3.2	Risk perception and its' communication and practice	
3.3	Risk management	
3.4	Role of information technology in risk assessment and management	
4	**Reducing the Impact of Disaster**	**10 Hours**
4.1	Protection: hazard resistance	
4.2	Mitigation: disaster aid and insurance	
4.3	Adaptation: preparedness, predictions, forecasts and warnings	
4.4	Adaptation: land use planning	

References:

1. Environmental Hazards: Assessing risk and reducing disaster, Keith Smith, 6th Edition, 2013, Routledge, Taylor and Francis group.
2. Towards Basics of Natural Disaster Reduction, D.K.Sinha, 1st Edition, 2006, Researchco.
3. Disaster Management, V.K.Sharma, 2nd Edition, 2013, Medtec-An imprint of Scientific International Pvt. Ltd.
4. Environmental Health, Assessing Risk and Reduction Disaster, Smith, K. 3rd Edition, 2001, Routledge.
5. Disaster Management, Mukesh Kapoor, 1st Edition, 2010, Saurabh Publishing House.
6. Disaster Management and Preparedness, Judah Carter, 1st Edition, 2017, Syrawood Publishing House.
7. Handbook of Disaster Risk Reduction & Management**,** Christian N Madu and Chu-Hua Kuei, 1st Edition, 2017, World Scientific.
8. World Famous Disasters, Narendra Malhotra, 1st Edition, 2004, Jain Book Depot.
9. Natural Disasters, R.K. Sharma and Gagandeep Sharma, 1st Edition, 2005, Jain Book Depot.

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M.Sc. Environmental Science
FOURTH SEMESTER

Ens. 404: Environmental Management, Legislation and Policy

Total Hours: 48

1	**Environmental Management**	**12 Hours**
1.	ISO: 14000 Environmental Management Systems	
1.1	ISO 14001:Environmental Management Systems (EMS) and requirements	
1.2	Step by step preparation for EMS certification	
1.3	ISO 14004 guidance documents, ISO 14010 audit standards, ISO 14020 labeling standards	
2.	**Environmental Impact Assessment (EIA) &Environmental Audit (EA)**	**12 Hours**
2.1	Introduction-purpose and goal, methodology of EIA	
2.2	Environmental risk assessment - EIA of hazardous waste	
2.3	Role of EIA in sustainable development- limitations of EIA	
	Environmental Audit (EA)	
2.4	Introduction: Audit practices in developed countries and India	
2.5	Range of Audit objectives - Audit methodology	
2.6	EA report - preparation according to format	
2.7	Benefits of Environmental Audit	
3.	**Environmental Legislation-I: Objectives and Provisions of Acts**	**12 Hours**
3.1	Introduction and international concern for environment	
3.2	Environment protection laws in India- the regulatory structure	
3.3	Constitution of central and state pollution control board	
3.4	Power and functions/duties, penalties for violations of the provisions of the acts of pollution control board for:	
3.4.1	The Indian Forest Act, 1927	
3.4.2	Indian Wildlife (Protection) Act, 1972	
3.4.3	The Water (Prevention and Control of Pollution) Act, 1974	
3.4.4	The Air (Prevention and Control of Pollution) Act 1981	
3.4.5	The Environment (Protection) Act, 1986	
3.4.6	The Motor Vehicle Act, 1988	
3.4.7	The Biodiversity Act, 2002	
4.	**Environmental Legislation-II: Objectives and Provisions of Rules**	**12 Hours**
4.1	Municipal Solid Waste (Management and Handling Rules), 2000, 2016, Plastics Manufacture, Sale and Usage Rules, 2011 Recycled Plastics Manufacture and Usage Rules, 1999	
4.2	The Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008	
4.3	Bio-Medical Waste (Management & Handling) Rules,1998	
4.4	E-waste Management and Handling Rules 2011	
4.5	Noise Pollution (Regulation and Control) Rules, 2000	
4.6	Wetland Rules 2009	
4.7	Coastal Regulation Zones (CRZ) Rules, 2011.	

References:

1. Environmental Law Case Book, Leelakrishnan P., 2nd Edition, 2006, 4th Reprint, 2015, LexisNexis.
2. Shantakumar's Introduction to Environmental Law, Shantakumar S., 2nd Edition, 2005, LexisNexis.
3. Handbook of Environmental Law in India, Sahasranaman P. B., 2nd Edition, 2012, Oxford University Press (India).
4. Environmental Engineering & Management, S.K. Dhameja, 1st Edition, 2005, Kataria Publication.
5. Environmental Studies, S.K. Dhameja, 1st Edition, Reprint, 2017, Kataria Publication.
6. Environmental Protection, Law and Policy, **Jane Holder, Maria Lee,** 2nd Edition, 2012, Cambridge University Press.
7. Environmental Law and Policy, Stephen R. Chapman, 1st Edition, 1997, Prentice Hall.
8. Environmental Law-An Introduction, Nawneet Vibhav, 2nd Edition, 2017, LexisNexis.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. Environmental Science
FOURTH SEMESTER

Ens 405-Dissertation
OR
Ens 405-A Review of Research Article
Ens 405-B Seminar

Total Hours: 96

Dissertation/Review of Research Article/Seminar can be carried out on any subject related to Environmental science and technology under guidance and supervision of respective teacher.

It includes all guidelines related to:

- Topic selection for Dissertation/Review of Research Article/Seminar.
- Literature work for the subject.
- Its theoretical concept and experimental work in laboratory in case of Dissertation.
- Thesis writing in format and Power point presentation preparation.
- Continuous evaluation of all the above mentioned tasks.
- Final checking of Thesis and Power point presentation.
- Submission of Thesis and Power point presentation.