SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
MSC (ENVIRONMENTAL SCIENCE AND TECHNOLOGY (EST))

RULES FOR DEGREE OF THE MASTER OF SCIENCE (M.Sc.) IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY (EST)

RPG.EST.1:A candidate who has obtained the degree of Bachelor of Science ,Agriculture, Forestry, Engineering, Home –Science, Fire-Safety, Geography, Pharmacy of this University or any other university recognized as equivalent there to may, after successful completion of the course work prescribed for the M. Sc. degree examination, for a period of two years subsequent to his passing the B. Sc. degree examination, will be admitted to the examination for the degree of M. Sc. The degree of the Master of Science will be taken by papers, practical and project work only.

RPG.EST.2: The examination for the various theory courses and laboratory work will be conducted under semester system. For this purpose each academic year will be divided into two semesters.

RPG.EST.3: The ratio between the external and internal assessment will be 70:30

RPG.EST.4: Candidate will be required to attend at least 75% of the total theory, lectures, practical and project work organized under each of the course by them during the semester.

RPG.EST.5: (i) The head of the department in consultation with other teachers of the department will prepare in the beginning of the semester a detailed scheme of the periodic test(s), seminars, quizzes etc., and the program for the test examinations and the same will be announced to the candidates. (ii) The record of the test examinations as well as seminars and quizzes will be maintained by the department. (iii) Every candidate shall maintain a regular record of this practical and project work which shall be duly certified by teacher(s) from time to time.

RPG.EST.6: Candidate will be required to obtain at least 33% marks in the internal evaluation separately in each head of passing. A candidate who fails to obtain 33% marks in not more than two heads of passing may be allowed to appear at the university examination by the Head of the department concerned on the recommendation of the committee appointed to assess the candidate's overall performance. (Note: Head of passing will mean a course in theory or practical, or project work).

RPG.EST.7: A teacher offering a particular course will be one of the examiners at the university examination and the examiner may be either a teacher from same university or from outside the university.

RPG.EST.8: The final results for the awards of the degree will be declared on the basis of the grand total of all the semesters examinations prescribed for the degree examination.

RPG.EST.9: No candidate will be allowed to reappear in course in which he / she has already passed.

RPG.EST.10: Standard of passing: The standard of passing of M. Sc. (Environmental Sciences and Technology) degree examination will be as under:-

i. To pass any semester examination for the M. Sc. degree a candidate must obtain at least 40% marks in the university examination and 40% marks in the aggregate of university and internal examination in each course of Theory, Practical and project work.

ii. Those of the successful candidates who obtain 50% or more marks in the aggregate of all the semesters taken together will be placed in the Second class and those who obtain 60% or more marks in the aggregate will be placed in the first class.
The successful candidates who obtain 70% or more marks in the aggregate of all the semesters taken together will be declared to have passed the examination in the first class with distinction.

RPG.EST.11: i) A candidate who fails in more than two courses (any two out of total heads of passing in the particular semester) in a particular semester will not be admitted for further study at a subsequent semester and will be required to repeat the courses in which he/she has failed by joining the department as a regular student in the semester in which these courses are again offered.

A candidate failing in not more than two courses at any semester examination will be promoted to the subsequent semester according to the following scheme.

ii) A candidate failing in the first semester will be permitted to prosecute his / or study up to the third semester but will not be permitted to go to the fourth semester until he / she has cleared all the coursed of the first semester even though he / she may have passed in the second and / or third semester.

A candidate failing in the second semester will be permitted to prosecute his /her studies up to the fourth semester.

Syllabus (Effective from Academic Year June, 2016),
Institute of Science & Technology for Advanced Studies & Research (ISTAR)
Sardar Patel University, Vallabh Vidyanagar – 388 120, Gujarat

M. Sc. (Environmental Science and Technology) Choice Based Credit System (CBCS)

SEMESTER – I	CREDITS	Total Marks	Exter. Marks	Inter. Marks
CORE COURSES				
PS01CEST21 Environmental Biology and Restoration Ecology	4	100	70	30
PS01CEST22 Air Pollution and Climate Change	4	100	70	30
PS01CEST23 Water Pollution and Control Technology	4	100	70	30
ELECTIVE COURSE				
PS01EEST21 Environmental Chemistry and Geology	4	100	70	30
PS01EEST22 Sustainable Development	4	100	70	30
PS01CEST24 PRACTICALS BASED ON PS01CEST21 AND PS01CEST22	6	100	70	30
PS01CEST25 PRACTICALS BASED ON PS01CEST23 AND PS01EEST21	6	100	70	30
PS01CEST26 VIVA VOCE	1	50	50	
SEMESTER – II				
CORE COURSES				
PS02CEST21 Remote Sensing and Geographic Information System	4	100	70	30
PS02CEST22 Meteorological and Environnemental Instruments	4	100	70	30
PS02CEST23 Occupational and Environmental Toxicology	4	100	70	30
ELECTIVE COURSE				
PS02EEST21 Industrial Hygiene and Occupational Health	4	100	70	30
PS02EEST22 Environmental Economics	4	100	70	30

PS02CEST24 PRACTICALS BASED ON PS02CEST21 AND PS02CEST22	6	100	70	30
PS02CEST25 PRACTICALS BASED ON PS02CEST23 AND PS02EEST21	6	100	70	30
PS02CEST26 VIVA VOCE	1	50	50	

SEMESTER – III

CORE COURSES

PS03CEST21 Environnemental Bio-technology	4	100	70	30
PS03CEST22 Environmental Impact Assessment and Legislation	4	100	70	30
PS03CEST23 Industrial Safety and Control technology	4	100	70	30

ELECTIVE COURSE

PS03EEST21 Industrial Pollution and Control Technology	4	100	70	30
PS03EEST22 Environmental Geography	4	100	70	30
PS03CEST24 PRACTICALS BASED ON PS03CEST21 AND PS03CEST22	6	100	70	30
PS03CEST25 PRACTICALS BASED ON PS03CEST23 AND PS03EEST21	6	100	70	30
PS03CEST26 VIVA VOCE	1	50	50	

SEMESTER – IV

CORE COURSES

PS04CEST 21 Waste Management and Control Technology	4	100	70	30
PS04CEST22 Environmental Resources and Biodiversity Conservation	4	100	70	30
PS04CEST23 PRACTICALS BASED PS04CEST21 AND	6	100	70	30

PS04CEST22			
PS04CEST24 VIVA-VOCE	1	50	50
PS04CEST25 Project Work / Dissertation*	12	300	300

* Project work/ Dissertaion is offered compulsorily in fourth semester in Industry or Reseach centers .
Classroom Teaching of Industrial orientation/ exposure in each course atleast one period per week will be given as this master program is industrial oriented and multidisciplinary .

Scope: The scope of the course is very wide. The students passing with the M. Sc. degree in Environmental Sciences are expected to have opportunity at:

a. Industries in ETP, CETP
b. Industries as Hygienists, Safety officers
c. Pollution control boards
d. Chemical, Pharmaceutical, Fermentation Industries
e. Environmental consultants
f. Public health laboratories
g. Academic institutions, Colleges and University departments
h. Pollution control boards (Central and State Government)
i. Various disciplines of Science and Engineering
j. As research scientists at various research laboratories and
k. The students may develop their own laboratory to undertake water, soil, solid and hazardous wastes and air pollutants analyses
l. Space research centers

Duration: Two years Master Degree Course in Science with Four Semesters (CBCS).

Eligibility: Bachelor of Science, Agriculture, Forestry, Home Science**,** Engineering, Fire & Safety, Geography, Pharmacy

Number of Seats: 60 (Sixty)

COURSE STRUCTURE

SEMESTER - I

CORE COURSES

PS01CEST21	Environmental Biology and Restoration Ecology
PS01CEST22	Air Pollution and Climate change
PS01CEST23	Water Pollution and Control Technology

ELECTIVE COURSE

PS01EEST21	Environmental Chemistry and Geology
PS01EEST22:	Introduction to Sustainable Development
PS01CEST24	Practicals based on PS01CEST21and PS01CEST22
PS01CEST25	Practicals based on PS01CEST23and PS01EEST21
PS01CEST26	Viva Voce

SEMESTER - II

CORE COURSES

PS02CEST21	Remote Sensing and Geographic Information System
PS02CEST22	Meteorological and Environnemental Instruments
PS02CEST23	Occupational and Environmental Toxicology

ELECTIVE COURSE

PS02EEST21	Industrial Hygiene and Occupational Health
PS02EEST22:	Environmental Economics
PS02CEST24	Practicals based on PS02CEST21and PS02CEST22
PS02CEST25	Practicals based on PS02CEST23 and PS02EEST21
PS02CEST26	Viva Voce

SEMESTER - III

CORE COURSES

PS03CEST21	Environmental Biotechnology
PS03CEST22	Environmental Impact Assessment and Legislation
PS03CEST23	Industrial Safety and Control Technology

ELECTIVE COURSE

PS03EEST21	Industrial Pollution and Control Technology
PS03EEST22	Environmental Geography
PS03CEST24	Practicals based on PS03CEST21 and PS03CEST22
PS03CEST25	Practicals based on PS03CEST23 and PS03EEST21
PS03CEST26	Viva Voce

SEMESTER - IV

CORE COURSES

PS04CEST21	Waste Management and Control Technology
PS04ECST22	Environmental Resources and Conservation
PS04CEST23	Practicals Based on PS04CEST21 and PS04CEST22
PS04CEST24	Viva-Voce
PS04CEST25*	Project Work /Dissertation

* Project work/ Dissertaion is offered compulsorily in fourth semester in Industry or Reseach centers .

Classroom Teaching of Industrial orientation/ exposure in each course atleast one period per week will be given as this master program is industrial oriented and multidisciplinary .

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SEMESTER - I

PS01CEST21: ENVIRONMENTAL BIOLOGY AND RESTORATION ECOLOGY

Environmental complexes- Ecology, Ecosystem, Environment and their concepts. limiting and inhibiting affects of light and temperature. Biotic factors- Relationship between organisms- Mutualism, commensalisms, parasitism, competition, antibiosis, predation. Concept of ecology- Food chain - grazing food chain and detritus food chain, food web. Ecological pyramids - Number, biomass and energy, energy flow models and budget. Concepts of productivity and determination of productivity in different ecosystems.

Autecology- biological clocks along with influence factors, Liebig's law of minimum and Shelford's law of Tolerance. Population ecology - Describing population characters, Dynamics and regulation. Community Ecology- Composition, structure, origin and characters used in community structure. Analytical and synthetic characters. Methods of study of community. Ecological succession: primary and secondary processes of successions, climax community.

Aquatic ecosystems- Wetlands, Ramsar sites and conservation of wetland. Physical ,chemical and biological characters of lentic, lotic ecosystems. Eutrophication : Sources and consequences. Restoration of biological diversity: reintroduction of biota, Degradation and restoration of Forests ecosystems, grassland ecosystems, aquatic ecosystems (wetlands), Restoration of wastelands and degraded soils: Bio-geo-chemical cycles- Carbon, nitrogen, phosphorous, sulfur- involvement of organisms

Marine Environment: Zonation pattern, physical – tides, light, temperature, density, salinity, chemical –Phosphate, sulphate, nitrate, D.O, and biological characters-plankton,nektons and benthos,types of biomes. Sources of pollution, oil-pollution, Hydrocarbons- polycyclic and petrolium hydrocarbons, Coastal pollution: Coral reefs, Estuaries and Mangrooves.

Suggested Books

1. Dash, M.C. 2011. Fundamentals of Ecology.
2. David, A. 1995. Stream Ecology. Kluwer Academic Publications.
3. Horney, A.R. 1978. Marine Chemistry. Wiley.
4. Nelson, S.L., Gerry, T.B. Morten,. F.P. 2004. Estuarine Nutrient Cycling: Influence of Primary Producers. Kluwer Academic Publications.
5. Odum, E.P. Fundamentals of Ecology. Nataraj Publishers, Dehradun
6. Priya Rajan Trivedy er al. 1994. International Encyclopedia of Ecology and Environment. Indian Institute of Ecology and Environment, New Delhi. Vol.I to 16.
7. Robert, J.L. 2001. Eutrophication Process in Coastal Ecosystems. CRC Press.

8. Santra, S.C. 2001. Environmental Science. New Central Book Agency.
9. Sharma, P.D. 2012. Ecology and Environmental Biology.
10. Verma & Agarwal. 2010. Environmental Biology

PS01CEST22: AIR POLLUTION AND CLIMATE CHANGE

Definition, history, sources of air pollution - natural and anthropogenic, primary and secondary, Aeroallergens - sources, biology and health effects, general effects of atmospheric pollutants (PM, HC, CH_4, CO_2, H_2S, CO, NOx, SOx) on humans, animals, plants and materials; Ambient air quality emission standards, automobile pollution (photochemical oxidants, photochemical smog), characteristics - auto exhaust, and its control (catalytic converters), air pollution episodes (Bhopal, Chernobyl, Los Angeles, London smog, Indonesian forest fire), recent case studies on air pollution

Environmental factors and air pollution - heat, insulation, wind, precipitation, plume behavior, sampling and measurement of air pollution - ambient air and stack monitoring, indoor air pollution, indoor air quality, prevention and control of air pollutants - particulate matter & gaseous pollutants – absorption, adsorption, settling chambers, fabric filters, scrubbers, cyclone & electrostatic precipitators, Clean Development Mechanisms (CDM): carbon sequestration, carbon footprint, carbon trading, carbon market

Climate Change: Definition of Climate and weather, Evolution of atmosphere, composition and structure, Particles, ions and radicals in atmosphere, Chemical reactions of different chemical species in the atmosphere, Oxygen and ozone chemistry and ozone hole formation. green house gases- global warming, temperature inversion, global effects of GHGs,Classification of Climates, causes and consequences of Climate changes,Impacts of climate change on ecosystems, Global dispersion of toxic substance: Dispersion and circulating mechanisms of pollutants, ozone depletion, dust dome effect, acid rain, photochemical smog, heat island, Kyoto Protocol, Role of IPCC, Climate change methodologies

Disaster management- Concept of disasters, causes, prevention and correction hazards related to Earthquakes, Tsunami, Volcanic eruption, Cyclones, Floods, Drought, Landslides, Forest fires, Avalanches and Pest infestation, El nino and La Nina,

Suggested Books

1. A.K.DE. 1987. Environmental Chemistry. Wiley Eastern Limited
2. Blaikie, P., Cannon, T., Davies, I. and Wisner, B. (1994) At Risk: Natural Hazards, People's Vulnerability, and Disasters. London: Routledge. Bohle, H., Downing, T. and
3. Burroughs, W.J. 2001. Climate Change. Cambridge University Press.
4. Hobbes, P.V. 2002. Atmospheric Chemistry. Cambridge University Press.
5. Houghton, J. 2001. Global Warming. Cambridge University Press.
6. Maslin, M. Global Warming: A Very Short Introduction. (Oxford: Oxford University Press, 2008) [ISBN 9780199548248].
7. Rao, M. 2002. Air Pollution. Prentice & Hall.
8. Sainfeld, J.H. 1975. Air Pollution. Physical and Chemical Fundamentals, McGraw Hill, N.Y.
9. Sharma, B.K. 2002. Air Pollution. Academic Press.
10. Wayne, R.P. 2003. Chemistry of Atmosphere. Oxford University Press.

PS01CEST23: WATER POLLUTION AND CONTROL TECHNOLOGY

Supply of water: Sources of water and their characteristics: water from precipitation (Strom water), surface water, ground water. Water Quantity: Water and Its Properties, Necessity of Water, Water Demand, Factor Affecting Water Demand, Population Forecast by Different Methods. Sampling, sample preservation, physical characteristics, chemical characteristics and biological characteristics, drinking water standards.

Groundwater: Introduction, types of aquifers, means to draw groundwater, Ground water conservation, seepage from surface water, artificial recharge, saline water intrusion - Causes and remedies of saline intrusion.

Water treatment: Conventional water treatment process, Screening, chemical handling and feeding, coagulation and flocculation, sedimentation, Filtration, Theory of filtration, filtration slow sand, rapid sand and pressure, filters. Disinfection; Criteria for good disinfectant, mechanisms of disinfection, factors affecting efficiency of disinfection, chlorination – chlorine chemistry, chlorination practices in India. Aeration, limitation of aeration, types of aerators.

Advanced water treatments – membrane technology; Microfiltration, Ultrafiltration, Nanofiltration Reverse Osmosis, Other treatment technologies: Ion Exchange, Water Softening, Adsorption, Electrodialysis.

Suggested Books

1. Besselviere, E and Schwartz. 1975. Treatment of Industrial Wastes, McGraw Hill.
2. Birdie, G.S. 2002. Water Supply and Sanitary Engineering. Dhanpatraj and Sons Press.
3. Fair, G.M. Geyer, T.C. and Okun, D.A. 1984. Water and waste water Engineering. Vol. I and II, John Wiley and Sons.
4. Garg, S.K. Water and Sewage Treatment. 2002. Blackwell Publishing.
5. Mahajan 1985. Pollution control in process industries. Tata McGraw Hill
6. Metcalf and Eddy Inc. 1979. Waste water Engineering treatment, Disposal, Reuse. Tata McGraw Hill Publ. Co. Ltd.
7. Mitchekk, Ralphed. 1978. Water Pollution Microbiology, Wiley and Sons.
8. Nemwrow. N.L. 1971. Liquid waste of Industry – theories, practices and treatment, Addison Wesley.
9. Peavy, Rowe Tchobanoglous. Environmental Engineering. McGraw Hill International ed.
10. Weber, W.J. 1969. Physico-chemical processes for water quality control, Wiley Inter Science.

PS01EEST21: ENVIRONMENTAL CHEMISTRY AND GEOLOGY

Fundamental of Chemistry: Elements, Chemical bonding, chemical reactions and equations, Organic functional groups, classes of organic compounds, Free radical reactions, catalytic processes, acid base reactions, solutions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydro carbons, radio-nuclides.

Green Environmental Chemistry & Issues: Principles- tools of green chemistry- alternative feed stocks starting materials, alternative reagents, alternative solvents, alternative products

and alternative catalysis, Introduction- ecological and carbon foot prints- polluters pay principle- consumerism- sustainable mining- urban forestry green buildings- green building practices- approaches to green computing

Environmental Segments: Lithosphere, atmosphere, hydrosphere and biosphere. Lithosphere- Rocks and Minerals. Principles of weathering of rocks, processes, effects of physical, chemical and biological factors, Physical Geology: Geological work of wind, Running water, Underground water, Glaciers. Drainage systems and patterns. Structural Geology: Dip and Strike, Folds, Faults, Joints, Unconformity, Overlap. Mountains .

Soil Chemistry & Soil Composition: Organic & Inorganic, physical, chemical and biological properties, cation exchange capacity, soil pH, environmental properties of soils, leaching and erosion and conservation,reactions with acids and bases, geochemical reactions that neutralize acidity- biological process that neutralize acidity – salt affected soils- trace metals in soils.

Suggested Books

1. A.K.DE. 1987. Environmental Chemistry. Wiley Eastern Limited
2. Baird, C. 2001. Environmental Chemistry. Hopkins Press.
3. Kumar,V. 2000. Introduction to Green Chemistry. Narosa Publications.
4. Manahan, S.E. Environmental Chemistry. Cambridge University Press.
5. Rashmi Sanghi and M. M. Srivastava Green Chemistry: (Narosa Publishing house)
6. Roy, A.B. 2002. Fundamentals of Geology. Narosa Publications.
7. Sanghi & Srivastava. 2000. Green Chemistry. Narosa Publiations.
8. Sharma B.K. and Kaur, H. Environmental Chemistry. Goel Publishing House, Meerut.
9. Singh, P. 2002. General Geology. Oxford Publications.
10. Turk, A, Turk, J. Wittes J.T. and Wottes, R.E. 1978. Environmental Science, W.B. Saunder Company, Philadelphia.
11. Watt, K.E.F. 1973. Principles of Environmental Sciences, McGraw Hill Book Company.

PS01EEST22: SUSTAINABLE DEVELOPMENT

Introduction to sustainable development: Concept of sustainable development, Rio earth Summit (1992), Brundtl and commission report, scheme of sustainability: economic, social, environmental; indicators of sustainable development and its selection criteria, Agenda 21 World Summit on Sustainable Development, Local agenda 21 (Earth Summit 2002), planning (for Sustainable Development).

Global challenges of sustainable development: poverty, pollution, population, finance for sustainable development, health, nutrition, sanitation, energy crisis, disasters, desertification, biopiracy etc. Currencies for evaluations of sustainable development- Biophysical measurements; Environmental degradations and conservation issues; Global change and sustainability issues: Climate change, biological invasion, bio-diversity concerns

Millennium development goals and its recent status (global, Indian), approaches to sustainable development: natural resource management, capacity building, Ecosystem concept in space and time; Ecosystem level processes and landscape level processes; the concept of sustainable development temporal and spatial dimensions.

Human resource development, pollution management, green policy development, good governance and recycling, reuse and recovery. Ecosystem and social processes in: (a) Rehabilitation of degraded rural landscape, (b) Rehabilitation of unbalanced soils, (c) Rehabilitation of specialized habitats, e.g. water bodies, mangroves; (d) Mined area rehabilitation participatory research and education environmental decision making with people initiates.

1. AID Environment (1997) Strategic Environmental Analysis: A New Planning Framework for Sustainable Development, AIDEnvironment, Amsterdam
2. Banuri, T and Holmberg, J (1992) Governance for Sustainable Development: a Southern Perspective, IIED, London
3. Carew-Reid, J (ed) (1997) Strategies for Sustainability: Asia, IUCN in association with Earthscan, London
4. Degnbol, T (1996) The Terroir Approach to Natural Resource Management: Panacea or Phantom? – the Malian Experience, working paper no 2/1996, International Development Studies, Roskilde University, Denmark
5. Earthscan. 2002. Sustainable Development Strategies: A Resource Book. Organisation for Economic Co-operation and Development, Paris and United Nations Development Programme, New York.
6. Grieg-Gran, M (2001) 'Investment in Sustainable Development: The Public–Private Interface', in The Future is Now, vol 2, IIED, London

PS01CEST24: Practical based on PS01CEST21and PS01CEST22

Interactions between organisms, productivity of phytoplankton by chlorophyll method (biomass) and Light and dark bottle method, determination of light penetration and DO of surface water, Macrophyte productivity, phytoplankton measurement by micrometry.

Marine water quality analysis: Salinity, TDS, TSS, Phosphates, silicates, Nitrates, Sulphates, Hydrocarbon, Planktons.
Prepare case-study on latest disasters – Global. Field visits to Forest, coastal environments and wetlands and prepare a report and submit at the time of university Exam.

PS01CEST25: Practical based on PS01CEST23 and PS01EEST21

Preparation and Standardization of solutions and reagents- Normal, Molar, percentage, solutions, working solution, Determination of pH, conductivity, Acidity, Total alkalinity, solids-TS, TDS, TSS, Hardness, Dissolved Oxygen, calcium, sulfate, phosphate, Nitrate, Chloride, Residual Chlorine, Fluoride, boron , Iron of tape water (ground)and surface waters, Determination of total and fecal coli-form in water and Most Probable Number. Visit to various industry-ETP,CETP,STP prepare a report and submit at the time of university Exam.

Soil Properties: Determination of Water holding capacity, particle density, bulk density, moisture content, porosity, N, P, K, Ca, Mg, SO_4, Cl^-, organic carbon, matter content of soil. Study of Geological maps, topo maps, drainage patterns, preparation of land use maps. contour cross-sections.

PS01CEST26: Viva Voce