

BIRLA VISHVAKARMA MAHAVIDYALAYA
(ENGINEERING COLLEGE)
(AN AUTONOMOUS INSTITUTION)
VALLABH VIDYANAGAR – 388120, GUJARAT
AFFILIATED TO GUJARAT TECHNOLOGICAL UNIVERSITY



ACADEMIC REGULATIONS
AND
COURSES OF STUDY
FOR
POST GRADUATE DEGREE PROGRAMME LEADING TO
MASTER OF TECHNOLOGY (M.TECH.)
IN
ENVIRONMENTAL ENGINEERING

For the students admitted during Academic Year 2015-18

OCTOBER – 2018

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Institute Vision

“Produce globally employable innovative engineers with core values.”

Institute Mission

- Re-engineer curricula to meet global employment requirement
- Promote innovative practices at all levels.
- Imbibe core values
- Reform policies, systems and processes at all levels.
- Develop faculty and staff members to meet the challenges

Core Values

Quality, Creativity, Team Work, Lifelong Learning, Pro-activeness,
Cost Consciousness, Sharing, Transparency

Academic Regulations

FOR POST GRADUATE PROGRAMMES

AR(PG) 1 ADMISSION

AR(PG) 1.1 A candidate for admission to the two year degree programme for Master of Technology must have eligibility as per the Gujarat Government/ACPC/GTU/CVM rules.

AR(PG) 1.2 Admission granted to an applicant is to be considered provisional until all the fees are paid and all the prescribed documents are in order. BVM Engineering College **DISCLAIMS ALL RESPONSIBILITIES** if any of the documents required as per ACPC/ Gujarat Technological University requirements are not submitted or found unacceptable by it. The college will not accept responsibility for students who do not submit the expected examination/ registration forms in time.

AR(PG) 2 PROGRAMMES OF STUDY

AR(PG) 2.1 A student shall follow the prescribed courses as given in the programme of study to which he/she is admitted. These courses for various programmes are listed in Annexure – I.

The syllabi for these courses are given in Annexure – II.

AR(PG) 3 COURSES LEVELS

AR(PG) 3.1 At the commencement of each semester a student shall register for the set of courses he/she intends to pursue during the semester. For the registration process, refer AR (PG) 8.

AR(PG) 3.2 All courses offered are divided into two levels: Level 1 and 2. The levels correspond to successive years of study of a typical M. Tech. student. In other words, a regular student will complete his Level-1 courses during his first year and Level-2 courses during his second year.

AR(PG) 3.3 The list of courses offered in semester will be announced by the college at the beginning of the semester.

AR(PG) 4 PROGRAMME ELECTIVE COURSES

AR(PG) 4.1 Each programme of studies contains a certain number of programme elective courses. Programme elective courses will be offered under each discipline at corresponding level from which a student may choose course(s).

AR(PG) 5 OPEN ELECTIVE COURSES

AR(PG) 5.1 Open elective courses are courses offer by a discipline for students other than the corresponding discipline.

AR(PG) 6 COURSE CREDITS

AR(PG) 6.1 Each course offered has **L-T-P** structure. Whereas, **L** means number of theory lecture hours per week, **T** means number of tutorial hours per week and **P** means number of practical/laboratory hours per week.

AR(PG) 6.2 Total course credits for a course are obtained by adding the hours of theory lectures, tutorials and practical together. E.g. 4-0-2 means a course has 6 credits, 3-2-0 means a course has 5 credits, 2-2-2 means a course has 6 credits.

AR(PG) 7 FACULTY COUNSELOR

AR(PG) 7.1 Each student is assigned to a Faculty Counselor who will advise and counsel him regarding the selection of courses to be registered in a given semester as well as monitor his/ her holistic growth. The final selection of courses made by the student must be approved by his Faculty Counselor.

AR(PG) 8 REGISTRATION

AR(PG) 8.1 To earn course credits in a semester a student must register for the courses at the commencement of the semester.

AR(PG) 8.2 At the commencement of each semester a period of two working days is designated as the registration period. A student must complete his registration formalities within this period as per the procedure laid down.

AR(PG) 8.3 A further period of 12 working days is designated as late registration period. During this period a student shall require to pay late registration fee, as decided by the Institute from time to time, to complete his registration. Late registration will only be permitted on genuine reasons (like medical and other unavoidable circumstances) to be approved by the concerned Head of Department and Principal

AR(PG) 8.4 Student shall not be permitted to attend classes without registration.

AR(PG) 8.5 The registration must be completed by the student in person.

AR(PG) 8.6 A student who has completed all the requirements for his degree will not be allowed to register in any further courses.

AR(PG) 8.7 All registrations in every semester must be duly approved by the concerned Head and Principal of the college.

AR(PG) 9 REQUIREMENTS FOR REGISTRARTION

AR(PG) 9.1 A student can register for a course provided that the following conditions are satisfied:

- i) The course is included for the student's assigned programme of studies, or the student has been permitted to take the course as an open elective.
- ii) The course is being offered in the semester.

AR(PG) 9.2 The courses selected by the student must be approved by his Faculty Counselor.

AR(PG) 10 MINIMUM ENROLLMENT

AR(PG) 10.1 Under normal circumstances an elective course will be conducted in a semester only if a stipulated minimum number of students have registered for the course as decided by the Board of Studies.

AR(PG) 10.2 An elective course in which the number of student registered is less than the stipulated minimum may be withdrawn from the elective course offering of that semester. The student registered in such a course will be permitted to amend their registration.

AR(PG) 11 ASSESSMENT OF STUDENT PERFORMANCE IN COURSE

AR(PG) 11.1 The performance of a student in a course is judged through (i) continuous assessment of theory, tutorial and practical work and (ii) end-semester theory, tutorial and practical examinations.

AR(PG) 11.2 The end- semester theory examination in a course has a weightage of 70 percent of theory marks. The remaining 30 percent of theory marks will be awarded through continuous assessment carried out during the semester.

AR(PG) 11.3 The end-semester tutorial/practical examination in a course has a weightage of 60 percent of total tutorial/practical marks and continuous assessment of the same carries the remaining 40 percent of total tutorial/practical marks. Tutorial/practical work (both end-semester and continuous) shall be evaluated on the basis of several of the following instruments of assessment: observation of experimental skills, reports, oral examination, quizzes, end-semester practical examination, attendance, etc.

Continuous assessment (tutorial/practical) scheme is given below:

Term work	20 percent (Equal weightage for every practical. At least 10 practical/ tutorial need to be performed or mini project)
Quiz /Assignment/ Viva/active learning component	20 percent
Total	40 percent

AR(PG) 11.4 The overall performance of student in the course is assessed on the principle of a “single head of passing”, i.e., there will be a single grade for a course based upon the aggregate of marks obtained by the student in theory and practical components in continuous assessment as well as end semester examination. However, a student should score minimum 30% marks in end semester examination to make himself/ herself gradable.

Examiner(s) can grace up to 10% of total marks of end semester theory examination in marks of end semester theory examination to make a student gradable by making the resolution of the same in grade sheet. However, grace marks shall not be counted in the aggregate of marks obtained by the student for the grading.

AR(PG) 12 EXAMINATIONS

AR(PG) 12.1 The end-semester examination for all courses offered in each semester of an academic year will be conducted by the Institute.

AR(PG) 12.2 No student shall be allowed to the end semester examination unless he/she has attended minimum 75% of Theory Lectures/ Tutorials/ Practical classes of the course and will be awarded letter grade LA (Ref. AR (PG) 13) in all the subjects he/she has registered in the corresponding semester.

AR(PG) 12.3 The college will conduct two continuous assessment of theory (mid semester examination) in a semester for each subject. The average marks of two mid semester examinations shall be considered as the final marks for continuous assessment of theory.

A student who remains absent in any of the two mid semester examination for whatsoever reason(s) shall be awarded with zero marks in the respective mid semester examination.

However, a student remains absent due to any of the following unforeseen reasons, shall be permitted to appear along with remedial mid-semester examination. The marks of mid semester remedial examination of such students shall be considered as marks of mid semester examination in which he/she remained absent.

- a) A student is critically ill or injured. (Student or his/her relative shall get prior approval)
- b) Death of direct blood relation relative. (Student or his/her relative shall inform to Head/Principal immediately after the incident and permission will not be granted for more than 24 hours)
- c) A student representing Gujarat state in national level events and/or India in international events organized by official boards.

AR(PG) 12.4 No student shall be allowed to appear in the end semester examination of a course unless he/ she scored at least 30% marks in mid semester examination and will be considered in “NOT PERMITTED TO APPEAR (NPTA)” status for the respective course. The NPTA status carries zero grade point in performance index calculation.

Remedial mid semester examination shall be conducted by the department for NPTA students before the beginning of the end semester examination. If a student gets 30% or more marks, he/she shall be “PERMITTED TO APPEAR” in the end semester examination. However, he/she will be awarded only 30% marks in continuous theory assessment. For genuine reasons, if a student remains absent in the mid semester examination and subsequently

appear in the remedial examination, the marks scored by the student will be considered as continuous theory assessment marks.

If a student still remains with NPTA status, he/she shall appear in mid semester remedial examination of the next semester.

AR(PG) 12.5 The End Semester tutorial/practical examination shall be rescheduled for a student who is not able to appear in the regular schedule due to following reason.

- a) A student is critically ill or injured. (Student or his/her relative shall get prior approval)
- b) Death of direct blood relation relative. (Student or his/her relative shall inform to Head/Principal immediately after the incident and permission will not be granted for more than 24 hours)
- c) A student representing Gujarat state in national level events and/or India in international events organized by official boards.

However, such rescheduling should be confined within the Academic Calendar of the respective semester.

AR(PG) 12.6 The college will conduct only one continuous assessment of theory (mid semester examination) for all subjects of the semester in the following cases.

- a) First Semester of M. Tech.
- b) Corresponding semester of the year of transfer for transferred students or international students, if the admission of such students is five week later than commencement of academic calendar.

AR(PG) 13 LETTER GRADES

AR(PG) 13.1 The overall performance of a student in a course is represented by a letter grade from AA to FF and LA with the following meaning and equivalent grade points:

LETTER GRADE	EQUIVALENT GRADE POINTS	REMARK
AA	10	Outstanding
AB	9	Excellent
BB	8	Very Good
BC	7	Good
CC	6	Average
CD	5	Pass
FF	0	Fail
LA	0	Low Attendance (Fail)

AR(PG) 13.2 A course is completed successfully, i.e., credit is earned for a course, when a letter grade CD or better (in grade points) is obtained in the course.

AR(PG) 13.3 The scheme of awarding letter grades and the letter grades awarded in each course are subjected to scrutiny and approval by Academic Council.

AR(PG) 15 FAILURE IN A COURSE

- AR(PG) 15.1 A student earns **zero** credit for a course when he gets letter grade **FF** or **LA** in the course.
- AR(PG) 15.2 If letter grade **FF** or **LA** is obtained in an elective course, the student may change the elective.
- AR(PG) 15.3 The letter grade **FF** or **LA** obtained in a course will be shown in the final transcript issued to the student (refer AR (PG) 22) whether or not he subsequently obtains another letter grade in a repeat attempt.
- AR(PG) 15.4 A student with letter grade **LA** should repeat the course i.e. he/she should attend theory and practical classes as and when the course is offered.
- AR(PG) 15.5 A student with letter grade **FF** should appear in end semester theory as well as practical/ viva exam and should obtain a letter grade **CD** or better (in grade points).
- AR(PG) 15.6 A student with more than **four FF grade and/or NPTA status** in a level will not be allowed to move to the next level.

AR(PG) 16 SEMESTER PERFORMANCE INDEX (SPI)

- AR(PG) 16.1 The performance of a student in a semester is expressed in terms of the semester Performance Index (SPI).
- AR(PG) 16.2 The semester Performance Index is the weighted average of course grade points obtained by the student in the course taken in the semester. The weights assigned to course grade points are the credits carried by the respective courses.

That is,

$$SPI = \frac{\sum_{i=1}^n g_i c_i}{\sum_{i=1}^n c_i}$$

where, g_i is the equivalent grade point of i^{th} course,

c_i is the credit of the course

n is total number of courses registered by the student in a semester

AR(PG) 17 CUMULATIVE PERFORMANCE INDEX (CPI)

- AR(PG) 17.1 The cumulative performance of student is expressed in terms of the Cumulative Performance Index (CPI). This index is defined as the weighted average of course grade points obtained by the student for all courses taken

since entry to the programme, where the weights are defined in same way as in AR (PG) 16.

AR(PG) 17.2 If a student repeats a course, only the grade points obtained in the latest attempt are counted towards the Cumulative Performance Index (CPI).

AR(PG) 18 DISCONTINUINACE FROM THE PROGRAMME

AR(PG) 18.1 A Semester Performance Index (SPI) of less than 3.00 in two consecutive semesters shall disqualify a student from continuing his studies. Such a student will be referred to the Academic Council. After considering the extenuating circumstances, if any, the Academic Council shall decide whether the student should be allowed to continue his/ her studies. The Academic Council decision shall be final and binding.

AR(PG) 19 ADMISSION BY TRANSFER

AR(PG) 19.1 For a student admitted by transfer to the M. Tech. programme after completing part of his degree requirements elsewhere or under the previous regulations, the Board of Studies (BOS) shall decide the subjects which he/she is deemed to have completed and shall be exempted from those subjects. In the grade sheet, the exempted subjects shall be specified as “EXEMPTED”.

AR(PG) 19.2 The remaining requirements must be completed by the student in a proportionately smaller number of semesters which shall be prescribed for him at the time of his admission to the programme.

AR(PG) 19.3 The CPI of such a student will be calculated on the basis of only the courses taken at this Institute.

AR(PG) 20 REQUIREMNTS FOR THE AWARD OF M. Tech. DEGREE

AR(PG) 20.1 To be eligible for the award of the degree of Master of Technology a student must earn a total of at least **115** credits as prescribed under his programme of studies with

- i) A minimum CPI of 5.00 and
- ii) No course with letter grade FF or LA at any level.

AR(PG) 20.2 The total credits requirements for the degree of M. Tech must be completed in not more than 8 semesters from the date of admission.

AR(PG) 20.3 For a student admitted by transfer the maximum permissible duration shall be 50 percent more than the period prescribed for completion of his programme at the time of his admission.

AR(PG) 20.4 If the Academic Council is satisfied that there are extenuating circumstances, the student may be allowed a maximum of 2 additional semesters to complete his degree requirements.

AR(PG) 21 AWARD OF CLASS

AR(PG) 21.1 The class awarded to a student with his M. Tech. degree is decided by his final CPI as per the following table :

FIRST CLASS WITH DISTICTION	- CPI not less than 7.25
FIRST CLASS	- CPI less than 7.25 but not less than 6.50
SECOND CLASS	- CPI less than 6.50 but not less than 5.75
PASS CLASS	- CPI less than 5.75 but not less than 5.00

CPI less than 5.00 is not eligible for award of degree

A candidate who passes in all subjects and all heads of passing in the examination shall be given a gracing of the required CPI for getting second class/ first class/ first class with distinction, subject to a maximum of CPI 0.10, in concurrence with rules and guidelines of AICTE/ GTU.

AR(PG) 22 TRANSCRIPT

AR(PG) 22.1 The Transcript issued to the student at the time of leaving the University will contain a consolidated record of the entire course taken by him, grades obtained, SPI, CPI, etc.

AR(PG) 23 EXAMINERS

AR(PG) 23.1 The respective board of studies shall appoint at least two examiners for end semester theory as well as practical/viva examination. For each end semester theory examination, there shall be two paper setters. One paper setter out the two shall be from outside the institute (external examiner). The end semester theory and practical examination of each subject shall be conducted by an internal and an external examiner. The internal examiner shall be appointed as convener who shall co-ordinate the examination procedure for end semester examinations of the respective subject.

AR(PG) 24 RE-ASSESSMENT

AR(PG) 24.1 A student shall apply for re-assessment of his/ her answer books of end semester examination (theory) only within seven working days after the declaration of the results.

AR(PG) 24.2 The board of studies shall appoint **two examiners (one is Convener of original exam and other is new examiner)** for the reassessment of the end semester examination (theory) for both sections. **Both examiners shall jointly reassess both the sections.**

AR(PG) 24.3 The marks obtained by the candidate shall be considered for grading after re-assessment, only if, the change in mark is more than or equal to 10% of total mark of End Semester **(Theory)** Examination.

AR(PG) 25 GRADING

- AR(PG) 25.1 The office of the Controller of Examination shall prepare the histogram of each subject for the purpose of grading after the completion of assessment of the subject. The histogram for dissertations shall not be prepared and each dissertation shall be graded individually as per the guidelines given from time to time.
- AR(PG) 25.2 The convener of the respective subject shall grade the students based on the histogram provided by the Controller of Examination.

AR(PG) 26 GRADE REVIEW

- AR(PG) 26.1 The Academic Council shall appoint Grade Review Committee for each semester. The Grade Review Committee shall constitute following members.
- (a) Principal
 - (b) All Board of Studies Chairman
 - (c) University Nominee
 - (d) Dean, Academics
 - (e) Associate Dean, Academics
 - (f) Controller of Examination
 - (g) Member Secretary, Academic Council
 - (h) Office-in-charge of Credit System
- AR(PG) 26.2 The Grade Review Committee shall meet immediately after results of all courses are completed and review the grades awarded by the convener of respective subject. The revision of the grade suggested by the Grade Review committee shall be considered as final grade and binding.

AR(PG) 27 DISSERTATION EVALUATION

- AR(PG) 27.1 The student shall present his/her progress during the dissertation phase for at least two times in a semester as a part of continuous evaluation. The presentation shall be evaluated by the Dissertation Progress Committee (DPC). The DPC comprises at least two faculty members from the department of same area/field and the guide. The convener of the DPC shall be other than guide of the student.
- AR(PG) 27.2 At the end of each semester, the dissertation shall be evaluated by the guide (internal examiner) and external examiner.
- AR(PG) 27.3 Marks Distribution for a Dissertation in a semester shall be as follows.

Continuous Evaluation (CE)	End Semester Examination (ESE)
40 Marks	60 Marks
Evaluated in two presentations by DPC as per AR (PG) 27.1, each	Evaluated in the presentation made by the student at the end of semester by internal examiner/s and external

evaluator has equal weightage in assessment.	examiner/s. Internal examiner/s shall award 50% of ESE marks and external examiner/s shall award 50% of ESE mark.
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- AR(PG) 27.4 As partial fulfilment of the dissertation, the student shall present/publish at least one paper in conference/journal.
- AR(PG) 27.5 The student shall submit the plagiarism report for his/her thesis. The thesis with less than 20% plagiarism shall be accepted for the End Semester Presentation. The plagiarism instruction shall be issued from time to time.
- AR(PG) 27.6 No exemption/relaxation in the course work of 3rd and 4th semester shall be permitted during the dissertation period of the PG student.

**Annexure – I: Programme of studies leading to the degree of the Master of Technology
(Environmental Engineering)**

Semester I

SR. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	HM501	Essential of Management and Entrepreneurship Development	3	2	0	5
2.	EN501	Theory of Water and Waste Water Engineering	4	0	2	6
3.	EN502	Environmental Chemistry and Microbiology	4	0	2	6
4.	MA501	Probability and Statistics	3	2	0	5
5.		Program Elective I	3	2	0	5
Total			17	6	4	27

Program Elective I, Semester I

5A.	EN551	Ground Water Hydrology and Contamination	3	2	0	5
5B.	EN552	Noise and Thermal Pollution	3	2	0	5

Semester II

SR. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CE541	Research Methodology in Civil Engineering	1	0	2	3
2.	EN503	Air Pollution Control	4	0	2	6
3.	EN504	Hazardous and Solid Waste Management	3	2	0	5
4.	EN505	Industrial Water and Waste Water Treatment	4	0	2	6
5.		Program Elective II	3	2	0	5
6.		Program Elective III	4	2	0	6
Total			19	8	4	31

Program Elective II, Semester II

5A.	EN555	Industrial Hygiene and Safety	3	2	0	5
5B.	EN556	Advances in Environmental Laboratories	3	2	0	5

Program Elective III, Semester II

6A.	EN557	Environmental Sanitation	4	2	0	6
6B.	EN558	Environmental Impact Assessment	4	2	0	6

Semester III

SR. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EN601	Seminar - I	0	4	0	4
2.	EN611	Dissertation - I	0	0	20	20
3.		Open Elective	3	2	0	5
Total			3	6	20	29
Open Elective, Semester III						
3A.	EN681	Climate Change	3	2	0	5
3B.	EN682	Conveyance of Water and Waste Water	3	2	0	5

Semester IV

SR. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EN602	Seminar - II	0	4	0	4
2.	EN612	Dissertation – II	0	0	20	20
3.		Program Elective IV	4	0	2	6
Total			4	4	22	30
Program Elective IV, Semester IV						
3A.	EN651	Design Of Water and Waste Water Treatment Systems	4	0	2	6
3B.	EN652	Environmental Auditing and Legislation	4	0	2	6

Annexure –II: Syllabi for the courses offered in programme of studies leading to the degree of Master of Technology (Environmental Engineering)

CE541: RESEARCH METHODOLOGY
(CREDITS = 3 (L=1, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
1	0	2	3	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Introduction to research methodology.	01
2	Importance of research in decision Making.	01
3	Defining research problem and formulation of research problem.	02
4	Research designs: Exploratory, Descriptive, And Experimental.	02
5	Data collection and measurement:-Methods and techniques of data collection: Primary data through communication, Designing Questionnaire, Qualitative Research, sampling and sampling designs Attitude measurement and scales.	03
6	Data presentation and analysis: Data processing, Univariate and Bivariate analysis, Correlational analysis ANOVA, Analysis of Associations, Multivariate analysis and data, Model building and decision making.	05
7	Report Writing and presentation: Content of reports, formatting of content, and presentation of reports.	01
Total		15

List of References:

1. C.R. Kothari. *"Research Methodology - Methods and Techniques"*, 2nd Edition, New Delhi, New Age International (P) Limited, 2003.
2. Eileen M. Trauth. *"Qualitative Research in IS: Issues & Trends"*, USA/London: IDEA Group Publishing, 2001. (ISBN: 1-930708-06-08).

EN501: THEORY OF WATER AND WASTEWATER ENGINEERING
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE	CE	ESE	CE	
4	0	2	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Water Quality: Physical, chemical and biological parameters of water, Water Quality Requirement for various uses, Drinking water standards – Wastewater disposal standards.	03
2	Water Treatment Processes: Introduction to Unit operations related to treatment of Ground water & surface water. Water treatment plant layout and flow diagram.	02
3	Ground Water Treatment processes: Aeration, Gas transfer. Surface Water Treatment processes: Plain sedimentation and sedimentation aided with coagulants. Colloids, Stability of Colloids and destabilization of Colloids. Coagulation and flocculation: Process and Mechanism, Various coagulants, Coagulants aids. Sedimentation: types, Ideal sedimentation Basin. Design of Flocculator and Sedimentation Basin, Clariflocculator.	08
4	Filtration: Theory of granular media filtration; Types of filters- slow sand filter and rapid sand filter; Working of RSF, Mechanism of filtration: Operational problems- Mud ball formation, negative head etc and their remedies; Dual and multimedia filtration, pressure filters, Design of RSF.	06
5	Disinfection: Factors affecting disinfection, Methods of disinfection, Disinfection by Chlorine; Residual Chlorine and Chlorine Dose, Ozonation.	05
6	Waste Water Treatment: Domestic Waste Water treatment plant layout and flow diagram. Theory, Working and Design: Parshall flume, Screen, Grit chamber, PST, Activated sludge unit, Trickling filter, Sludge digester and Sludge drying beds, Sludge dewatering unit.	10
7	Miscellaneous methods: Micro-filtration, Nano-filtration, Ultrafiltration.	06
Total		40

List of References:

1. Metcalf and Eddy, “*Wastewater Engineering, Treatment and Reuse*”, Tata McGraw- Hill Publication, New Delhi, 2003.
2. Fair, Geyer and Okun, “*Water & Waste Water Engineering*”, Vol.-I & Vol.-II
3. Mackenzie, “*Introduction to Environmental Engineering*”.
4. Weber W.J., John Wiley and sons, “*Physicochemical processes for water quality control*”, Network, 1983.
5. Peavey H.S., Rowe D.R. and Tchobanoglous, G., “*Environmental Engineering*”, McGraw Hills, New York, 1985.
6. “*Water Quality and Treatment*” (A handbook of community water supplies 5th edition): Published by American Water Works Association.
7. Clerk and Viessman, Hammer, “*Water supply engineering*”.
8. Ministry of urban Dev., “*Manual of Water supply*”, New Delhi.
9. Ministry of urban Dev., “*Manual of Waste Water Treatment*”, New Delhi.

EN502: ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	0	2	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	<p>Basic concept of Physical Chemistry: Dissociation constant, Solubility and solubility product constant, Reversible Reaction, Equilibrium constant, Colloidal chemistry, Nuclear chemistry, Preparation of standard solutions.</p> <p>Water & Waste Water Analysis: Biological Oxygen Demand, Dissolved Oxygen, Chemical Oxygen Demand, pH, Turbidity, Color, Hardness, Acidity, Alkalinity, Solids, Volatile Acids, Oil & Grease, Chloride- Residual chlorine & Chlorine Demand, Fluoride, Sulphate, Nitrogen, Phosphorus and Phosphate, Iron, Manganese, Trace Contaminants.</p>	08
2	<p>Basic concept of Organic Chemistry: Introduction of IUPAC nomenclature, Introduction of Fats, Oils, Waxes, Detergents, Soaps, Synthetic Detergent, Pesticides- Chlorinated, Organic Phosphorous, Carbonate, s-Triazines and Biological properties of pesticides.</p>	06

Unit No.	Topics	Teaching Hrs.
3	Instrumental methods of Chemical Analysis: Introduction and basic principle of followings; Gravimetry, Volumetry, Colorimetry, Chromatography, Fluorimetry, Flame Photometry, Polarography, Potentiometry, Mass Spectrometry, Nuclear Magnetic Resonance Spectroscopy.	06
4	Introduction to Microbiology: Scope and area of environmental microbiology, Major group of microorganisms. Morphology & fine structure of Bacteria. Microscopic examination of microorganisms-Simple and Compound Microscope, Stains & Staining-Simple staining & Gram's staining.	06
5	Cultivation of Bacteria: Nutritional requirements of Bacteria, Common ingredients of culture media, Bacteriological media. Physical conditions requires for growth of Bacterial: Temperature, PH & oxygen. Growth and growth cycle of Bacteria, Pure culture & Methods of isolation, Introduction to control of microorganisms by physical and chemical agents	06
6	Environmental Microbiology: Soil microbiology - Microbial flora of soil and interaction among soil microorganisms. Microbiology of domestic water and waste water- Bacteriological evidence of pollution, Bacteriological examination of water-MPN & Presumptive test, Waste water - chemical characteristics. B.O.D. Waste water treatment process-septic tank. Municipal treatment processes-Primary, Secondary, Final treatment	08
Total Hrs.		40

List of References:

1. Sawyer C.N, McCarty P.L and Parkin G.F, "*Chemistry for Environmental Engineering and Science*", 5th ed., Tata McGraw-Hill, 2003.
2. "*Standard Methods of Testing of Water and Wastewater*" Use by APHA, AWWA, AND WPCF (USA) – Latest Edition.
3. "*Physico Chemical Examination of Water Sewage and Industrial Effluents*", Pragati Prakashan, Meerut, India.
4. Manahan S.E., "*Environmental Chemistry*", Eighth Edition, CRC press, 2005.
5. Ronbald A. Hites., "*Elements of Environmental Chemistry*", Wiley, 2007.
6. Stanley E. Mahajan, "*Fundamental of Environmental Chemistry*", Lewis Publishers.
7. Plezar, Chan, Krieg, "*Microbiology*", McGraw Hill.
8. E. Gaudy and Gaudy, "*Environmental Microbiology*", McGraw Hill.
9. Maier, R.M., Pepper I.L. and Gerba C.P., "*Environmental Microbiology*", Academic Press, New York, 1999.
10. B. K. Sharma, "*Instrumental method of chemical analysis*", 17th Edition, Goel Publishing House, Meerut.
11. IS-3025.

EN503: AIR POLLUTION CONTROL
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	0	2	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Air Pollution: Sources, Types, Effects of air pollution on human, vegetation, material and properties. Units of measurement of Air Pollutant, Ambient Air quality and emission standards.	06
2	Meteorology: Introduction, factors, wind circulation, lapse rate, stability conditions, wind velocity profile, maximum mixing depth, wind rose diagram, turbulence, general characteristics of stack plumes. Heat island, Dust dome effect, Acid rain, Global warming.	08
3	Dispersion of Air Pollutants: Types of Dispersion models. Gaussian model: Introduction, Dispersion Equation for Point Source at GL. Effective Stack height.	06
4	Sampling Methods: Atmospheric sampling and analysis for grit, dust, smoke, Sulphur dioxide, Carbon Monoxide, Hydrocarbons, Oxides of Nitrogen. Stack sampling methods.	02
5	Particulate Pollution Control: Settling chambers, Cyclone separators, Scrubbers, Filters and Electrostatic precipitators. Gaseous pollution control: Absorption, Adsorption and Combustion processes.	10
6	Automobile pollution: Types & Source of Automobile pollution, vehicle emission standard and fuel quality, inspection and certificate programme. IC engine- petrol base and diesel base, A/F ratio, Control: by process change, by engine design change, by fuel change. Catalytic converters.	08
Total Hrs.		40

List of References:

1. Nevers N.D., “*Air Pollution Control Engineering*”, McGraw Hill Publication.
2. Rao M. N., “*Air Pollution*”, Tata McGraw Hill Publication.
3. Wark K and Warner C, “*Air Pollution*”.

4. Boubel Richard W., “*Fundamentals of Air Pollution*”, Academic Press, New York.
5. H. C. Perkins, “*Air Pollution*”.
6. Peavy and Rowe, “*Environmental Engineering*”, McGraw Hill Publication.
7. Davis, “*Environmental Engineering*”, McGraw Hill Publication.
8. Lee and Liptak, “*Environmental Engineering*” Hand Book, Chilton Book Co., Philadelphia.
9. Crawford Marti, “*Air Pollution Control Theory*”, Tata McGraw Hill Publishing Company Ltd, New Delhi.

EN504: HAZARDOUS AND SOLID WASTE MANAGEMENT
(CREDITS = 5 (L=3, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
3	2	0	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hrs.
1	Introducing Municipal solid waste Management: Classification of solid wastes, Source based classification; Type based classification, Solid waste Management (SWM), SWM system, ESSWM and EST, Factors affecting SWM system, SWM-Indian Scenario.	03
2	Waste Generation Aspects: Waste generation and composition, Factors causing variation, Waste characterizes-physical, and Chemical, Health and Environment effects-Public health effect, Environmental effects, Waste generation.	03
3	Waste collection storage and transport: Collection components, storage-containers/collection vehicles, Container/storage bins, Collection vehicles, Collection operation, transfer station,	03
4	Source reduction, Product Recovery and Recycling: Source reduction: Basics, Purpose, Significance of recycling, Recycling programme elements: Source separation; Drop- off/buy back; curbside programme; Storage and collection of recyclable; Collection vehicle for recycling; Processing equipments for recycling; Material recovery facilities(MRF’s); Full stream processing, Commonly recycled materials and processes- Paper and card board; Glass; Metal; Plastic; Batteries and Tires	08
5	Biological Conversion Products: Compost and Biogas: Composting: Benefits; Processes; Stages; Technologies; Bio Gasification: Anaerobic Processing; Types of Digester; Biogas plants in India.	03

Unit No.	Topics	Teaching Hrs.
6	Incineration and Energy Recovery: Incineration: An Introduction, Combustion of Waste Material; Incineration Objectives, Incineration Technologies-Mass Burning System; Refused Derived Fuel(RDF) System, Modular Incineration; Fluidized Bed Incineration, Energy Recovery, Air Emission and its Control: Gaseous pollutants; Gas Cleaning Equipment..	04
7	Waste disposal: Disposal option, sanitary landfill: principle, landfill process, Landfill gas emission, Composition and properties, Hazards; Migration; Control, Leachate Formation: Composition and Properties; Leachate Migration; Control; Treatment, Landfill Operation Issues: Design and Construction; Operation; Monitoring.	04
8	Hazardous Waste: Management and Treatment: Hazardous waste: identification and classification-Identification; Classification, Hazardous Waste Management- Generation; Storage and Collection; Transfer and Transport; Processing; Disposal, Hazardous Waste Treatment-Physical and Chemical Treatment; Thermal Treatment; Biological Treatment, Pollution Prevention and Waste Minimization.	12
Total Hrs.		40

List of References:

1. Central Public Health and Environmental Engineering Organization (CPHEEO), “*Manual on Municipal Solid waste management*” Government of India, New Delhi, latest edition.
2. Theisen H. and Vigil Samuel A, Tchobanoglous George, “*Integrated Solid Waste Management*”, McGraw- Hill, New York, 1993.
3. Vesilind P.A., Worrell W and Reinhart, “*Solid waste Engineering*”, Thomson Learning Inc., Singapore, 2002.
4. Flintoff , “*Management of Solid Wastes in Developing Countries*”, WHO.
5. Wentz Charles A. “*Hazardous Waste Management*”, Second Edition, McGraw Hill International Edition, New York, 1995.
6. Rosencranz, Divan and Noble, “*Environmental Law and Policy in India*”.

EN505: INDUSTRIAL WATER AND WASTEWATER TREATMENT
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	0	2	6	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hrs.
1	Industrial Water Treatment: Treatment of water for cooling, heating, steam generation and other process water.	04
2	Basics of Industrial waste treatment: Stream sampling, economics of waste treatment, Concept CETP, Zero Effluent discharge.	04
3	Industrial waste treatment theory: Volume reduction, Strength reduction, Neutralization, Equalization and proportioning, Treatment and disposal of sludge solid.	14
4	Applications: Disposal standards for Disposal to various sinks: Stream standards, Effluent standards.	04
5	Origin Characteristics and Treatment of Major Industrial Waste: Textile waste, Tannery waste, Cannery waste, Dairy waste, Brewery - Distillery and Pharmaceutical waste, Cane sugar waste, paper and pulp mill waste, Oil field & Refinery waste, Cement industry waste, Metal plating waste.	14
Total Hrs.		40

List of References:

1. Nemerow Nelson L, *“Industrial Water Pollution”* - Addison Wesley Pub. Co.
2. Besselièvre E.B. and Schwartz M., *“Treatment of Industrial Waste”*, International Student Edition, McGraw Hill, Kega Kusha Ltd. Publication (latest).
3. Quasim S.R., *“Wastewater Treatment Plants Planning Designing & Operation”* - H.R.W. (Holf Rine Heart & Winstone).
4. Eckenfelder W. W., Jr. Ford Davis L. and Englande Andrew, *“Industrial water Quality”*, McGraw Hill Publishing Co, 2009.
5. *“Water Quality and Treatment”* Hand Book of Public Water Supplies, AWWA McGraw Hill.
6. Gurnham, *“Industrial Waste Treatment”*.
7. Tchobanoglous George, *“Wastewater Engineering: Treatment and Reuse”*, Publisher Tata McGraw Hill.

EN551 : GROUNDWATER HYDROLOGY AND CONTAMINATION
(CREDITS = 5 (L=3, T=2, P=0))

Type of Course: - Engineering and Technology

Prerequisite: Basics & Fundamentals of Hydrological Cycle and Sources of Groundwater.

Rationale: To Develop Fundamentals of Groundwater Hydrology, Quality, Pollution and Conversion.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T/P	P		C	Theory Marks		Tutorial/Practical Marks			
			ESE (E)		PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2	-	5	70	30	20	10	10	10	150

L- Lectures; T-Tutorial/Teacher guided student Activity; P-Practical; C-Credit; ESE-End Semester Examination; PA-Progressive Assessment; OEP-Open Ended Problem; AL-Active Learning

Content: -

Unit No.	Topics	Teaching Hrs.	Module Weightages
1.	Introduction: Definition of Ground Water, Aquifers, Vertical Distribution of Subsurface Water, Hydrological Properties of Water Bearing Strata, Ground Water in Hydrological Cycle.	6	15
2.	Ground Water Hydraulics: Darcy's law, its range of validity, Dupuit for Chheimer assumptions, application of Darcy's law for simple flow systems, governing differential equations for confined and unconfined aquifers, steady and unsteady flow solutions for fully penetrating wells, partially penetrating wells, interference of wells, test pumping analysis with steady and unsteady flows, delayed yield, methods of images.	10	25
3.	Ground Water Quality: Indian and international standards.	2	5
4.	Ground Water Pollution: Sources, remedial and preventive measures.	6	15
5.	Ground water conservation: Ground water budget, seepage from surface water, artificial recharge.	6	15
6.	Models for groundwater flow, sampling and monitoring methods, transport mechanism, modeling advective-dispersive transport, adsorption and chemical reaction, biodegradation kinetics, numerical flow and transport modeling, waste site characterization/investigation, ground water remediation, legal issues in groundwater contamination.	10	25

List of References:

1. Dynamics of Fluids in Porous Media. J. Bear, Elsevier, New York.
2. Geohydrology by ROGER J.M. DE WIEST: John Wiley & Sons, New York, 1965.
3. Groundwater Assessment, Development and Management"" by K. Karanth, McGraw Hill Companies.
4. Groundwater by H.M Raghunath, 2nd edition, Wiley Eastern Ltd, New Delhi.
5. Groundwater Contamination: Transport and Remediation by P.B Bedient, H.S. Rifai and C.J. Newell, Prentice Hall, New Jersey.

6. Groundwater Hydraulics and Pollutant Transport by Randall J. Charbeneau, 2006 Waveland Press, ISBN 9781478608318.
7. Groundwater BY R. A. Freeze and J. A. Cherry, Prentice Hall, New York.
8. Groundwater Hydrology by D.K Todd, Wiley, New York.
9. Groundwater Hydrology by H. Bouwer, McGraw Hill, New York.
10. Groundwater Modelling Using Geographical Information Systems, by G.F. Pinder, Wiley New York.
11. Groundwater Remediation and Treatment Technologies, by Nicholas P. Cheremisinoff by Elsevier, ISBN 9780815517337.
12. Groundwater Resources Evaluation BY W.C. Walton McGraw Hill, New York.
13. Hydraulics of Groundwater, by J. Bear, McGraw Hill, New York.
14. Subsurface Hydrology, George F. Pinder, Michel A. Celia John Wiley & Sons, 2006 ISBN 9780470044193.
15. Theory of Groundwater Movement by Polubarinova-kochina, P. Y. Priceton University Press, New jersey.
16. Groundwater by K. Raghunath

Course Outcome:

On completion of the course, the students are expected to be able to:

- Understand Groundwater Flow and Contaminant Transport Issues and The Technologies Employed to Deal with Them
- Assess the Groundwater Hydrology, Quality, Pollution and Conservation.
- Understand the Groundwater Quality Parameters and Its Modeling.

List of Exercise: Term Work Will Comprise of Assignments on The Questions Related to Definition of Terms Used in Groundwater Hydrology, Groundwater Contamination, Numerical, Flow and Contaminant Modeling, Methods of Treatment of Contaminated Groundwater.

Design based problems (DP)/Open ended problems: problems based on groundwater hydraulics and contaminant transport.

List of Open Sources Software/Learning Website:

- <http://nptel.ac.in/>

EN555: INDUSTRIAL HYGIENE AND SAFETY
(CREDITS = 5 (L=3, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
3	2	0	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hrs.
1	<p>Introduction To Safety Standards: Safety, Safety and Productivity, Role of Government, ILO, Factory act, Boiler Act, Concept of safety, safety Terminology, Accident problem, Reasons for prevention, factors impeding safety, Accident prevention.</p>	06
2	<p>Safety engineering and Planning for safety: Concept of management, element of management, functions, management principles, safety management & its responsibilities, safety organization, Purpose for planning: planning procedure; Range of plans, Safety policies, Elements of safety policy, Implementation.</p>	05
3	<p>Accident and Incident Investigation: Reporting and Analysis, Accident and Incident Investigation, Identifying the key factors and the immediate and basic causes. Corrective Action, Agencies investigating accident. Accident reporting: Report forms, writing reports, essential elements. Accident and Incident Analysis Standard classification of factors associated with accident, Record keeping.</p> <p>Risk identification and Risk Assessment, hazard analysis (HAZAN) study, HAZOP Study.</p>	06
4	<p>Personal Protective Equipment: Need for personal protection equipment: selection; applicable standards; supply; use; care & maintenance respiratory and non-Respiratory personal protective equipment: Classification and selection</p>	03
5	<p>Occupational Health And Ergonomics: Objectives, Classification of occupational health hazards, dangerous properties of chemical and their health effects, routes of entry of toxic material into human body, permissible exposure limits, Threshold limit value, lethal dose and lethal concentration.</p> <p>Ergonomics, Human-body, Health, Posture, Workplace or office ergonomics, Ergonomics for women at work: physical work and environment, Anthropometry, Work related stress: Causes of stress.</p>	10
6	<p>Safety In Chemical Industry: U.N Classification of Hazardous materials, Criteria for siting and layout of Chemical and Petrochemical Plants. Instrumentation for safe plant operations, Hazards in Unit Processes and Unit Operations, Control, precautions and prevention, specific safety measures for certain chemical industry like fertilizer, insecticide, pesticides-choler-alkali, explosives, polymer plants, pharmaceuticals, petro-chemical. Transportation of hazardous materials.</p>	06
7	<p>Fire Engineering: Chemistry of fire, Factors contributing towards fire, Classification of fires, Common causes of industrial fires, Determination of fire load, Design of building exists, etc. for fire safety, Fire resistance of building materials</p>	04

BIRLA VISHVAKARMA MAHAVIDYALA (Engineering College)
(An Autonomous Institution affiliated to Gujarat Technological University)

Unit No.	Topics	Teaching Hrs.
	Prevention of fire, Portable extinguishers, Hydrant system, sprinkler system, introduction to Carbon dioxide systems, Foam extinguisher system, Dry Chemical Extinguishing systems Halon replacement of firefighting products, Fire detection and alarms system.	
Total		40

List of References:

1. American Management Association Hand Book for Safety Managers.
2. International organization UNO Encyclopedia for Occupational Health published.
3. Mistry K.U. “*Industrial safety*”.
4. Fingret Ann and Smith Akin, “*Occupational Health*”, A Practical Guide for Managers.
5. Kudesia Y P and Kudesia.Ritu, “*Environmental Health & Technology*”.
6. Triff N M, “*Environment & Health*”.

EN557: ENVIRONMENTAL SANITATION
(CREDITS = 6 (L=4, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	2	0	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Control of Communicable and certain Noninfectious diseases: Types, agents, Control of Water, Food and Insect borne diseases and zoonoses.	08
2	Residential and Institutional Environment: Appraisal Quality of Living, Hygiene Indices , Health Principles of Housing and its Environment	06
3	Indoor Quality Standards: Causes and Sources of Indoor Air Pollution Biological Contaminants, Thermal and moisture Requirement; Ventilation.	06
4	Radiation Protection: Radiation Fundamentals - Types of radiation Ionizing and Non- Ionizing radiation, their uses and biological effects. Radioactive waste disposal Radioactive substances soil, water and air and their fate. Treatment and disposal Liquid and solid Radioactive wastes.	20
Total		40

List of References:

1. Joseph A. Salvato, “*Environmental Engineering and Sanitation*” P.E. Dee - Wiley International latest edition (old 1992 edition).
2. Chanlett “*Environmental Protection*”, McGraw Hill Publishing Co.
3. Lee and Tchobanoglous, “*Environmental Engineering*” Hand Book Mc Graw Hill.

EN651: DESIGN OF WATER AND WASTE WATER TREATMENT SYSTEMS
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	0	2	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Combination of Unit Processes: Study of fundamental factors affecting choice of treatment units and combination of unit processes into integrated plant.	03
2	Design of water supply system: Design of Flow measuring device, Source yield, Collecting system design, Transportation system design, Treatment units for surface and ground water sources by physiochemical processes.	10
3	Special design units : Special design units for specific water treatment for Ion exchange, Reverse Osmosis, Electro dialysis	10
4	Design of Waste water system: Collecting system, Transportation system, Treatment units by conventional methods of physiochemical and biological processes and detailed drawings of units designed thereof. This may include Screen, grit chamber, flow equalization, clariflocculator, Rapid sand filter, plain sedimentation tank, activated sludge process, Rotating biological contactor, Up flow sludge blanket reactor and digesters	17
Total		40

List of References:

1. WPCF (USA), “*Waste Water Treatment Plant Design*” Manual of Practice.
2. Schroeder, “*Water & Waste Water Treatment*”, McGraw Hill.
3. S. J. Arceivala, “*Waste Water Treatment & Disposal*” Marcel Dekker.

4. Ministry of Urban Development, “*Manual of Water Supply*”, latest Ed. Manual of Waste Water Treatment.
5. Treatment Disposal Reuse, waste Water Engg., Metcalf Eddy Incorporation “*Waste Water Engineering Disposal & Reuse*”, McGraw Hill.
6. Qasim, “*Wastewater treatment Plant*”.
7. Qasim, “*Waterworks Engineering*”.
8. Benfield and Randall, Biological Process “*Design for wastewater Treatment*”.
9. Steel and McGhee, “*Water supply and sewerage*”.

EN652: ENVIRONMENTAL AUDITING AND LEGISLATION
(CREDITS = 6 (L=4, T=0, P=2))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	0	2	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Introduction: Overview of constitution of India; Fundamentals duties and rights; State Centre and concurrent lists of subjects.	02
2	Historical legislative background of environmental concerns in different Acts, including IPC, Administrative mechanisms for environmental protection at state and central level.	03
3	Water Act, 1974: Familiarization with important sections and clauses of the Act; Comments on certain provisions, lacunae; Amendments to the Water Act 74; Water rules.	05
4	Water Cess Act, 1977: Familiarization with important sections and clauses of the Act; Amendments to Cess Act 1977.	05
5	Air Act, 1981: Familiarization with important sections and clauses of the Act; Amendments to Air Act 1981; Air rules.	05
6	Environmental Protection Act, 1986: Familiarization with important sections and clauses of the Act; Amendments if any; Environmental rules; Hazardous waste rules; Hazardous microorganism rules.	05
7	Different Notifications: Under EPA 1986. i) Hazardous Waste (Management and Handling), Rule, 1989	09

Unit No.	Topics	Teaching Hrs.
	ii) Biomedical Waste (Management and Handling) Rule, 1998 iii) Plastic Manufacture, Sale and Usage Rules 1999 iv) Noise Pollution (Regulation and Control) Rules, 2000 v) The Batteries (Management and Handling) Rule, 2001 vi) The Public Liability Insurance act 1991. vii) Coastal Regulation Zone Notification, 2011.	
8	The Forest Conservation Acts, National Policy of Environmental protection and forest.	02
9	Case Studies: Study of important features of about 5 – 10 recent Environmental court cases.	02
10	General: Supreme Court’s directives to media and educational institutions; Role of public awareness and NCD’s campaign of safe and sustainable development. Need for special environmental courts.	02
Total		40

List of References:

1. Constitution of India.
2. The Water (Prevention and Control of Pollution) Act, 1974.
3. The Air (Prevention and Control of Pollution) Act, 1981.
4. The Motor Vehicle Act, (Amended), 1989.
5. The Water Cess Act, 1977.
6. The Environmental Protection Act, 1986.
7. Amendments and notifications published under above Acts.
8. Armin Rozencaranz, Shyam Divan and Marhta L. “*Environmental Law and policy in India*”, Noble, Tripathi publication.
9. Lal, “*Commentary on Environmental Legislation*”.
10. V Krishnamurti, “*Environmental Legislation*”.

EN681: CLIMATE CHANGE
(CREDITS = 6 (L=4, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
4	2	0	6	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Basics of climate change: Science of climate change, Natural climatic variability Global warming, Natural and enhanced greenhouse effect, Greenhouse gases & Carbon emissions, Climate modeling.	08
2	Green House Gases: Carbon dioxide & climate change, Methane & climate change, Nitrous oxide & climate change, CFCs & climate change.	08
3	Policies and legislation: International and national legislative frameworks- UNFCCC, IPCC and Kyoto protocol: Scientific and implementation bodies of Kyoto, Kyoto mechanisms-CDM, Joint implementation and Emission Trading, Decisions of Conference of Parties (COP) and Meeting of Parties (MOP), Carbon markets- CERs, Environmental Economics- Issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming.	08
4	Impacts and adaptation: Causes and severity of impacts, Vulnerability of various sectors like water resources, agriculture, forest, energy sector, coastal zones, human health, Adaptation strategies & options.	08
5	Climate change mitigation: GHG emission trends, Climate change mitigation policies, Mitigation technologies for transport, infrastructure, industry, waste, energy sector Renewable and alternative energy, Green building.	08
Total		40

List of References:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
2. Eileen Clausen, Vicki Arryo and Cochran, “*Climate Change: Science, strategies & solutions*”.
3. William Kininmouth, “*Climate change: a multidisciplinary approach*”.
4. Frank Chambers and Michael Ogle, “*Climate change: Critical Concepts in the environment*”.

EN682: CONVEYANCE OF WATER AND WASTE WATER
(CREDITS = 5 (L=3, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
3	2	0	5	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Hydraulics and Measurement of flow: Fluid properties; fluid flow - continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity-Flow measurement, Venturimeter, Orifice meter, Nozzle meter, Rota meter, Notches.	08
2	Transmission of Water: Need for Transport of water and wastewater-Planning of Water System - Selection of pipe materials, pipe thickness calculations. Water transmission main design- gravity and rising main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, Water hammer phenomenon and analysis.	10
3	Water distribution System: Layout of distribution networks, methods of water distribution, storage capacity of ESR, and underground service reservoir, minimization of water losses, leak detection, Introduction to the use of computer software in water transmission, water distribution design.	07
4	Storm Water Drainage: Necessity, combined and separate system; Estimation of storm water Run off, Formulation of rainfall intensity duration and frequency relationships, Rational methods, Design of storm water drains.	05
5	Wastewater collection and conveyance: Planning factors, Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations, sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls- mixing conditions; conveyance of corrosive wastewaters.	10
Total		40

List of References:

1. G.S. Birdie and J.S. Birdie, “*Water Supply and Sanitary Engineering*”, Dhanpat Rai Publishing Co. - New Delhi.
2. A.K. Jain, “*Fluid Mechanics*” published by Khanna publication, New Delhi.
3. Metcalf and Eddy, “*Wastewater Engineering: Treatment, disposal Reuse*” (Revised by G. Tchobanoglous) Tata-McGraw Hill, New Delhi.
4. Viesman, Hammer, “*Water Supply and Pollution Control*” Dun Donnelley Publisher, New York
5. Bajwa, “*Practical Handbook on Public Health Engineering*” G.S. Deep Publishers, Shimla, 2003.
6. CPHEEO, “*Manual on water supply and Treatment*” Ministry of Urban Development, Government of India, New Delhi, Latest Edition.
7. CPHEEO, “*Manual on Sewerage and Sewage Treatment*” Ministry of Urban Development, Government of India, New Delhi, Latest Edition.
8. Steel and McGhee, “*Water supply and sewerage*”.

**HM501: ESSENTIALS OF MANAGEMENT & ENTREPRENEURSHIP
DEVELOPMENT**
(CREDITS = 5 (L=3, T=2, P=0))

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE	CE	ESE	CE	
3	2	0	5	70	30	30	20	150

Course Content:

Unit No.	Topics	Teaching Hrs.
1	Nature of management: Meaning and definition of management, Role of engineers as managers and significance of economics and management for engineers, Functions of management, Management levels- Types & functions.	05
2	Corporate social responsibility and management ethics: Meaning and definition of CSR, Dimensions of CSR, Social stakeholders of business & CSR, Advantages of CSR, Business ethics, meaning & types, Mechanism of ethical management, Institutionalizing ethics.	05
3	Financial management & project appraisal: Costing, Investment Appraisal-Break even analysis, Calculation of Depression, Calculation of NPV, IRR, Cost benefit analysis.	08
4	Entrepreneurship development: Entrepreneur: Definition, Characteristics, Types and functions, Distinction between an entrepreneur and manager, Role of entrepreneurship in economic development, Rural entrepreneurship, Opportunities for an entrepreneurial carrier.	08
5	Project identification & selection: Meaning of project, Project formulation: Planning commission's guidelines for formulation of project, Specimen of a project report.	05
6	Elements of Environmental Economics.	05
7	Business correspondence & Corporate reporting.	04
Total Hrs.		40

List of References:

1. Gail Freeman Bell and James Balkwil, "*Management in Engineering Principles and Practices*", Prentice Hall of India, New Delhi.
2. Hirsch Robert D. and Petas Michael P., "*Entrepreneurship*", Tata McGraw Hill Edition.
3. James A. F. Stoner, R. Edward Freeman and Denial R. Gilbert Jr, "*Management*", Pearson Prentice Hall.