Vision of the Institution

Imparting technical education that encourages independent thinking, develops strong domain of knowledge, hones contemporary skills and positive attitudes towards holistic growth of young minds.

Mission of the Institution

- Student-centered Teaching-learning processes and a stimulating R&D environment.
- Providing Quality Education and ethics to students.
- State-of-art Infrastructure for professional aspirants.

Vision of Centre for Water Resources

To generate advanced technical man power in order to develop techniques and methodologies by undertaking advanced research in the field of water and environment and to achieve university symbiosis by undertaking participatory approaches.

Mission of Centre for Water Resources

- Student centered Teaching learning processes and a stimulating R&D environment.
- To build advanced laboratories for conducting research and to design sustainable systems for water and environment.
- To establish state of art infrastructure for professional training and to establish networking among the user agencies.

Program Outcomes (POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Students should be able to cope with changing technological environment to meet the challenges emanating out of Climate change and Environment

Note: Program may add up to three additional POs.

Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) are as follows:

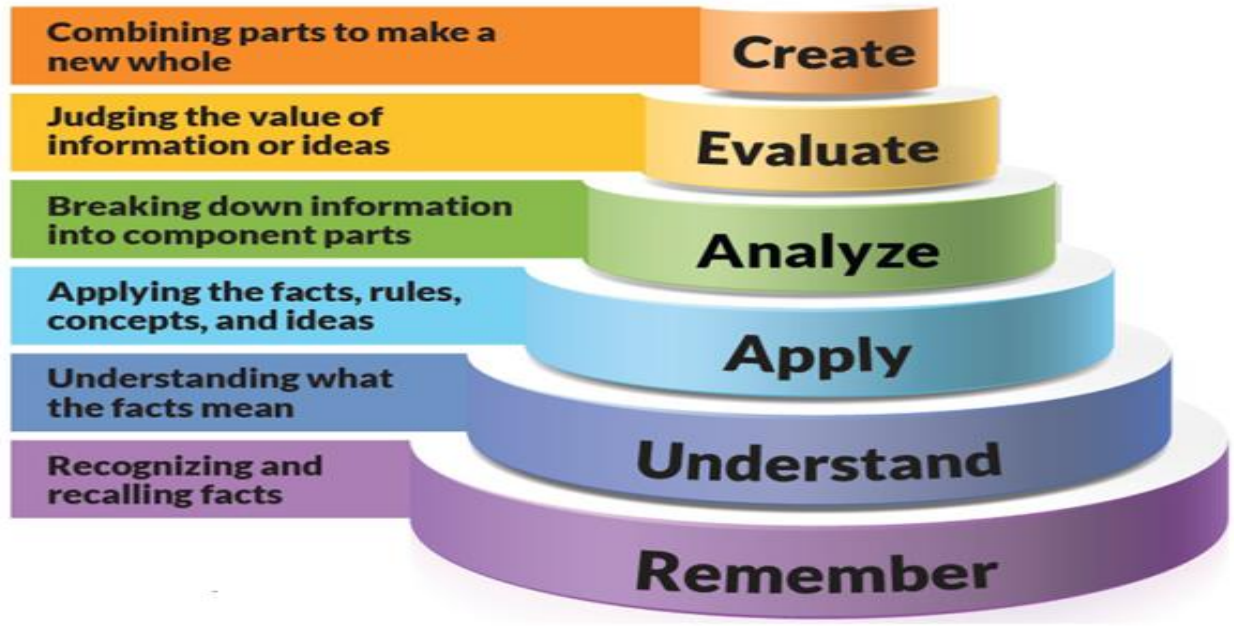
PEO1: To prepare the students as one of the problems solving engineers/technologists in water, land and environmental fields.

PEO2: To generate technical man power at advanced level to maintain and manage the existing infrastructure of water, land and environment of the nation.

PEO3: To impart technical training to the students that empowers them to withstand changing technological environment in order to cope with the natural climate change and environment.

PEO4: To develop the students' personality in such a manner that they become responsible citizens in the society.

BLOOM'S TAXONOMY



KNOWLEDGE LEVELS

Self-Assessment of a student is based on the answers given to the Blooms level of questions

The Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Facts	list	paraphrase	classify	outline	rank	categorize
Concepts	recall	explains	show	contrast	criticize	modify
Processes	outline	estimate	produce	diagram	defend	design
Procedures	reproduce	give an example	relate	identify	critique	plan
Principles	state	converts	solve	differentiates	conclude	revise
Meta-cognitive	proper use	interpret	discover	infer	predict	actualize

University Academic Regulations of M.Tech Programmes

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by Act No.30 of 2008)
Kukatpally, Hyderabad–500085, Telangana State (India)

Academic Regulations of M.Tech (Regular/Full Time) Programmes, 2017- (R17) (CBCS)

(Effective for the students admitted into I year from the Academic Year 2017-18 and onwards)

1.0 **Post-Graduate Degree Programmes in Engineering & Technology (PGP in E & T)** Jawaharlal Nehru Technological University Hyderabad (JNTUH) offers **Two** Years (**Four** Semesters) full-time Master of Technology (M. Tech.) Degree programmes, under Choice Based Credit System (CBCS) at its constituent (non- autonomous) and affiliated colleges in different branches of Engineering and Technology with different specializations.

2.0 **Eligibility for Admissions**

2.1 Admission to the PGPs shall be made subject to eligibility, qualification and specializations prescribed by the University from time to time, for each specialization under each M.Tech programme.

2.2 Admission to the post graduate programme shall be made on the basis of either the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by Telangana State Government (PGECET) for M.Tech. programmes / an entrance test conducted by JNTUH/ on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.3 The medium of instructions for all PG Programmes will be **ENGLISH** only.

3.0 **M.Tech. Programme (PGP in E & T) Structure**

3.1.1 The M.Tech Programmes in E & T of JNTUH are of Semester pattern, with **Four** Semesters consisting of **Two** academic years, each academic year having **Two** Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per Semester.

3.1.2 The student shall not take more than four academic years to fulfill all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

3.2 **UGC/AICTE** specified definitions/descriptions are adopted appropriately for various terms and abbreviations used in these PG academic regulations, as listed below:

3.2.1 **Semester Scheme**

Each Semester shall have 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of Regulations. The terms

'SUBJECT' and 'COURSE' imply the same meaning here and refer to 'Theory Subject', or 'Lab Course', or 'Design/Drawing Subject', or 'Seminar', or 'Comprehensive Viva', or 'Project', or 'Technical Paper Writing' as the case may be.

3.2.2 Credit Courses

All subjects/courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/course in an L: T: P: C (Lecture Periods: Tutorial Periods: Practical Periods: Credits) structure based on the following general pattern:

- One credit for one hour/week/semester for theory/lecture (L) courses
- One credit for two hours/ week/semester for laboratory/ practical (P) courses or tutorials (T)

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations, and identified mandatory courses, if any, will not carry credits.

3.2.3 Subject Course Classification

All subjects/courses offered for the Post-Graduate Programme in E & T (M.Tech Degree Programme) are broadly classified as follows. The University has followed in general the guidelines issued by AICTE/UGC.

S.No.	Broad Course Classification	Course Group/ Category	Course Description	Credits
1	Core Courses (CoC)	PC- Professional Core	Includes subjects related to the parent discipline/department/ branch of Engineering	28
		Project Work	M.Tech Project or PG Project or Major Project	32
		Seminar, Technical Paper Writing	Seminar/Colloquium based on core contents related to parent discipline/department/branch of Engineering	04+02 06
		Comprehensive Viva-Voce	Viva-voce covering all the PG subjects studied during the course work and related aspects	04
2	Elective Courses (EIE)	PE - Professional Electives	Includes elective subjects related to the parent discipline/department/branch of Engineering	12
		OE - Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/department/ branch of Engineering	06
Total number of Credits				88

4.0 Course Registration

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each specialization, who will advise on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

4.2 The Academic Section of the College invites 'Registration Forms' from students within 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

4.3 A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 If the Student submits ambiguous choices or multiple options or erroneous entries during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.

4.5 Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices also will not be considered. However, if the Subject/ Course that has already been listed for Registration by the University in a Semester could not be offered due to unforeseen or unexpected reasons, then the Student will be allowed to have alternate choice either for a new Subject, if it is offered, or for another existing Subject (subject to availability of seats). Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

5.0 Attendance Requirements

The programmes are offered on the basis of a unit system with each subject being considered a unit.

5.1 Attendance in all classes (Lectures/Laboratories/Seminar/Project Work) is compulsory. The minimum required attendance in each theory including the attendance of mid-term examination / Laboratory etc. is 75%. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject. A student shall not be permitted to appear for the Semester End Examinations (SEE), if his attendance is less than 75%.

5.2 A student's seminar report and seminar presentation will be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in seminar presentation classes during that semester.

5.3 **Condoning of shortage of attendance** (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and Medical grounds) in each subject of a semester shall be granted by the College Academic Committee.

5.4 Shortage of Attendance below 65% in any subject shall in **no case be condoned.**

5.5 A Student, whose shortage of attendance **is not condoned** in any subject(s) in any semester, is considered detained in that subject(s) and is not eligible to write End Semester Examination(s) of such subject(s) in that semester, and he has to seek re-registration for those subject(s) in subsequent semesters, and attend the same as and when offered.

5.6 A student fulfills the attendance requirement in the present semester, shall not be eligible for readmission into the same class.

5.7 A prescribed fee per subject shall be payable for condoning shortage of attendance.

5.8 A student shall put in a minimum required attendance in at least three theory subjects in I Year I semester for promotion to I Year II Semester.

6.0 Academic Requirements

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no. 5. The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks per subject / course (theory / practical), on the basis of Internal Evaluation and End Semester Examination.

6.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course, if he secures not less than 40% of marks (30 out of 75 marks) in the End Semester Examination, and a minimum of 50% of marks in the sum total of CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades and this implies securing 'B' Grade or above in a subject.

6.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to a subject/ course, if he secures not less than 50% of the total marks. The student is deemed to have failed, if he (i) does not attend the comprehensive viva-voce as per the schedule given, or (ii) does not present the seminar as required, or (iii) does not present the Technical Paper Writing as required. In such a case, he may reappear for comprehensive viva-voce in supplementary examinations and for seminar/ technical paper writing, in the subsequent semesters, as and when scheduled.

6.3 A student shall register for all subjects for total of 88 credits as specified and listed in the course structure for the chosen specialization, put in required the attendance and fulfill the academic requirements for securing 88 credits obtaining a minimum of 'B' Grade or above in each subject, and all 88 credits securing **SGPA ≥6.0** (in each semester) and final CGPA (i.e., **CGPA at the end of PGP) ≥ 6.0**, to complete the PGP successfully.

Note: (1) The Semester Grade Point Average (SGPA) will be computed and printed on the marks memo only if the candidate passes in all the subjects offered and gets minimum B grade in all the subjects.

(2) CGPA is calculated only when the candidate passes in all the subjects offered in all the semesters

6.4 Marks and Letter Grades obtained in all those subjects covering the above specified 88 credits alone shall be considered for the calculation of final CGPA, which will be indicated

in the Grade Card /Marks Memo of second year second semester.

6.5 If a student registers for extra subject(s) (in the parent department or other departments/ branches of Engineering) other than those listed subjects totaling to 88 credits as specified in the course structure, the performance in extra subject(s) (although evaluated and graded using the same procedure as that of the required 88 credits) will not be taken into account while calculating the SGPA and CGPA. For such extra subject(s) registered, percentage of marks and Letter Grade alone will be indicated in the Grade Card/Marks Memo, as a performance measure, subject to completion of the attendance and academic requirements as stated in items 5 and 6.1 - 6.4.

6.6 When a student is detained due to shortage of attendance in any subject(s) in any semester, no Grade allotment will be made for such subject(s). However, he is eligible for re-registration of such subject(s) in the subsequent semester(s), as and when next offered, with the academic regulations of the batch into which he is re-registered, by paying the prescribed fees per subject. In all these re-registration cases, the student shall have to secure a fresh set of internal marks and Semester End Examination marks for performance evaluation in such subject(s), and SGPA/CGPA calculations.

6.7 A student eligible to appear for the Semester End Examination in any subject, but absent from it or failed (failing to secure 'B' Grade or above), may reappear for that subject at the supplementary examination as and when conducted. In such cases, his Internal Marks assessed earlier for that subject will be carried over, and added to the marks secured in the supplementary examination, for the purpose of evaluating his performance in that subject.

6. 8 A Student who fails to earn 88 credits as per the specified course structure, and as indicated above, within **four** academic years from the date of commencement of his first year first semester, shall forfeit his seat in M.Tech. programme and his admission **shall stand cancelled.**

7.0 Evaluation - Distribution and Weightage of Marks

The performance of a student in each semester shall be evaluated subject- wise (irrespective of credits assigned) for a maximum of 100 marks. The M.Tech. project work (major project) will also be evaluated for 100 marks.

7.1 For the theory subjects 75 marks shall be awarded for the performance in the Semester End Examination and 25 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid-Term Examinations conducted, one in the middle of the Semester and the other, immediately after the completion of Semester instruction. Each Mid-Term Examination shall be conducted for a total duration of 120 minutes with Part 'A' as compulsory consisting of 5 questions carrying 2 marks each (10 marks), and Part 'B' with 3 questions to be answered out of 5 questions, each question carrying 5 marks (15 marks). The details of the Question Paper pattern for Semester End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 75 marks. It consists of two parts. i).Part A for 25 marks, ii). Part B for 50 marks.
- Part A is compulsory and consists of 5 questions, one from each unit and carrying 5 marks each.

- Part B consists of 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered.

7.2 For practical subjects, 75 marks shall be awarded for performance in the Semester End Examinations and 25 marks shall be awarded for day-to-day performance as Internal Marks.

7.3 For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Principal of the College and this is to be informed to the Director of Evaluation within two weeks, before for commencement of the lab end examinations. The external examiner should be selected from outside the College concerned but within the cluster. No external examiner should be appointed from any other College in the same cluster/any other cluster which is run by the same Management.

7.4 There shall be two seminar presentations during I year I semester and II semester respectively. For seminar, a student shall collect the literature on the advanced topic in relevant fields and critically review the literature and submit it to the department in a form of report and shall make an oral presentation before the Department Academic Committee consisting of Head of the Department, seminar coordinator and two other senior faculty members of the department. For each Seminar there will be only internal evaluation for 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to obtain the minimum mark, he has to reappear for the seminar during the supplementary examinations. The word 'Seminar' implies presentation of Technical Report, presentation/ discussion on the state of Art of Technology.

7.5 Technical Paper Writing shall cover concepts of abstract, introduction, material and methods, conclusion, references, acknowledgement etc of advanced topics in a branch of Engineering through the medium of attending seminars/ referring to peer reviewed journals, which will enhance the skill of writing technical reports. The students shall not be required to give oral presentation of technical paper. The report shall be presented as a printed document for evaluation. Evaluation shall be made solely by the teacher, but may be moderated by committees appointed by the Head of the Department as per Institute rules.

7.6 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Head of the Department shall be associated with the conduct of the Comprehensive Viva-Voce through a Committee. The Committee shall consist of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Principal of the college concerned and this is to be informed to the Director of Evaluation within two weeks. There are no internal marks for the Comprehensive Viva-Voce and it is evaluated for a maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the viva-voce during the supplementary examinations.

7.7 Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

7.8 A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.

7.9 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement in all the subjects, both theory and practicals.

7.10 After satisfying 7.9, a candidate has to present in Project Work Review-I, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the Project Work Review Committee (PRC) for approval within four weeks from the commencement of Second year First Semester. Only after obtaining the approval of the PRC can the student initiate the Project work.

7.11 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

7.12 A candidate shall submit his project progress report in two stages at least with a gap of **three** months between them.

7.13 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of approval of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.

7.14 The Project Work Review II in II Year I Sem. carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review II. If he fails to obtain the minimum required marks, he has to reappear for Project Work Review-II as and when conducted.

7.15 The Project Work Review III in II Year II Sem. carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not the Project is eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review III. If he fails to obtain the required minimum marks, he has to reappear for Project Work Review-III as and when conducted. For Project Evaluation (Viva Voce) in II Year II Sem. there are external marks of 100 and it is evaluated by the external examiner. The candidate has to secure a minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

7.16 Project Work Reviews II and III shall be conducted in phase I (Regular) and Phase II (Supplementary). Phase II will be conducted only for unsuccessful students in Phase I. The unsuccessful students in Project Work Review II (Phase II) shall reappear for it at the time of Project Work Review III (Phase I). These students shall reappear for Project Work Review III in the next academic year at the time of Project Work Review II only after completion of Project Work Review II, and then Project Work Review III follows. The unsuccessful students in Project Work Review III (Phase II) shall reappear for Project Work Review III in the next academic year only at the time of Project Work Review II (Phase I).

7.17 After approval from the PRC, a soft copy of the thesis should be submitted for ANTI-PLAGIARISM check and the plagiarism report should be submitted to the University and be included in the final thesis. The Thesis will be accepted for submission, if the similarity index is less than **30%**. If the similarity index has more than the required percentage, the student is advised to modify accordingly and re-submit the soft copy of the thesis after one month. The maximum number of re-submissions of thesis after plagiarism check is limited to TWO. The candidate has to register for the Project work and work for two semesters. After three attempts, the admission is liable to be cancelled. The college authorities are advised to make plagiarism check of every soft copy of theses before submissions.

7.18 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute, after submission of a research paper related to the project work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.

7.19 The thesis shall be adjudicated by an external examiner selected by the University. For this, the Principal of the College/School/Institute shall submit a panel of **three** examiners from among the list of experts in the relevant specialization as submitted by the Chairperson of Board of Studies, with the help of the supervisor concerned and Head of the Department.

7.20 If the report of the external examiner is unsatisfactory, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unsatisfactory again, the thesis shall be summarily rejected. Subsequent actions for such dissertations may be considered, only on the specific recommendations of the external examiner and /or Project work Review Committee. No further correspondence in this matter will be entertained, if there is no specific recommendation for resubmission.

7.21 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination. The Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The candidate has to secure a minimum of 50% of marks in Project Evaluation (Viva-Voce) examination.

7.22 If he fails to fulfill the requirements as specified in 7.21, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, if he fails to fulfill the requirements, he will not be eligible for the award of the degree, unless he is asked to revise and resubmit his project work by the board within a specified time period (within **four** years from the date of commencement of his first year first semester).

7.23 If the candidate's oral presentation is not satisfactory, the board may defer it and the candidate has to re-appear for the oral presentation before the same board for the award of degree.

7.24 The Project Viva-Voce External examination marks must be submitted to the University on the day of the examination.

8.0 Re-Admission/Re-Registration

8.1 Re-Admission for Discontinued Student

A student, who has discontinued the M.Tech. degree programme due to any reason whatsoever, may be considered for '**readmission**' into the same degree programme (with the

same specialization) with the academic regulations of the batch into which he gets readmitted, with prior permission from the authorities concerned, subject to item 6.6.

8.2 If a student is detained in a subject (s) due to shortage of attendance in any semester, he may be permitted to **re-register** for the same subject(s) in the same category (core or elective group) or equivalent subject, if the same subject is not available, as suggested by the Board of Studies of that department, as and when offered in the subsequent semester(s), with the academic regulations of the batch into which he seeks re-registration, with prior permission from the authorities concerned, subject to item 3.1.

8.3 A candidate shall be given one chance to re-register for a maximum of two subjects, if the internal marks secured by a candidate are less than 50% and failed in those subjects. A candidate must re-register for failed subjects within four weeks of commencement of the class work and secure the required minimum attendance. In the event of the student taking this chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stand cancelled.

9.0 Examinations and Assessment - The Grading System

9.1 Grades will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Technical Paper Writing or Project, etc., based on the % of marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 7 above, and a corresponding Letter Grade shall be given.

9.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured in a subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above (≥ 90% , ≤100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥80% , <90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (≥70% , <80%)	A (Very Good)	8
Below 70% but not less than 60% (≥60% , <70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50% , <60%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

9.3 A student obtaining F Grade in any Subject is deemed to have 'failed' and is required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted. In such cases, his Internal Marks (CIE Marks) in those subjects will remain as obtained earlier.

9.4 If a student has not appeared for the examinations, 'Ab' Grade will be allocated to him for any subject and shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted.

9.5 A Letter Grade does not imply any specific marks percentage; it is only the range of percentage of marks.

9.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

9.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits .... For a Course

9.8 The student passes the Subject/ Course only when he **gets GP ≥6 (B Grade or above).**

9.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

$$\textbf{SGPA} = \{ \textstyle\sum_{i=1}^{N} C_i G_i \} / \{ \sum_{i=1}^{N} C_i \} \text{ .... For each Semester,}$$

where 'i' is the Subject indicator index (taking into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the i^{th} Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

9.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

$$\textbf{CGPA} = \{ \textstyle\sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ ... for all S Semesters registered}$$
(ie., upto and inclusive of S Semesters, S ≥2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' for from the 1^{st} Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (taking into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j^{th} Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA

Course/Subject	Credits	Letter Grade	Grade points	Credit Points
Course 1	4	A	8	4*8 = 32
Course 2	4	O	10	4*10 = 40
Course 3	4	B	6	4*6 = 24
Course 4	3	B	6	3*6 = 18
Course 5	3	A+	9	3*9 = 27
Course 6	3	B	6	3*6 = 18
	21			159

SGPA = 159/21 = 7.57

Illustration of calculation of CGPA

Semester	Credits	SGPA	Credits * SGPA
Semester I	24	7	24*7 = 168
Semester II	24	6	24*6 = 144
Semester III	24	6.5	24*6.5 = 156
Semester IV	24	6	24*6 = 144
	96		612

CGPA = 612/96 = 6.37

9.11 For Calculations listed in Item 9.7 – 9.10, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations.

10.0 Award of Degree and Class

10.1 If a student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **88** Credits (with CGPA ≥6.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with the specialization that he was admitted into.

10.2 Award of Class

After a student has earned the requirements prescribed for the completion of the programme and is eligible for the award of M.Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75≤ CGPA < 7.75
Second Class	6.00≤ CGPA < 6.75

A student with final CGPA (at the end of the **PGP**) < **6.00** shall not be eligible for the Award

of Degree.

11.0 Withholding of Results

If the student has not paid the dues, if any, to the University or if any case of indiscipline is pending against him, the result and degree of the student will be withheld and he will not be allowed into the next semester.

12.0. Transitory Regulations

12.1 Candidate detained due to shortage of attendance in one or more subjects is eligible for re-registration of maximum of two earlier or equivalent subjects at a time as and when conducted.

12.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R17 Academic Regulations.

13.0 General

13.1 **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

13.2 **Credit Point:** It is the product of grade point and number of credits for a course.

13.3 Wherever the words "he", "him", "his", occur in the regulations, they shall include "she", "her".

13.4 The academic regulation should be read as a whole for the purpose of any interpretation.

13.5 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the University is final.

13.6 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

MALPRACTICESRULES
DISCIPLINARYACTIONFOR / IMPROPERCONDUCTINEXAMINATIONS

S.No	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject to the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. Incase of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject to the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that

		semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in- charge, or any person on duty in or outside the examination hall or any	Incase of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any par there of inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.

10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses1to11shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show cause notice shall be issued to the college.
   - (ii) Impose a suitable fine on the college.
   - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year

CENTRE FOR WATER RESOURCES

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

R-17 COURSE STRUCTURE FOR M. Tech (WET)

Full- Time PG M.Tech (Water and Environmental Technology) Syllabus

FIRST SEMESTER

SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
CORE COURSE (CC)						
WET-01	Surface Water Hydrology	25	75	4	--	4
WET-02	Ground Water Hydrology	25	75	4	--	4
WET-03	Advanced Fluid Mechanics	25	75	4	--	4
FOUNDATION COURSE (FC)						
WET-04	Hydraulic Structures Applied Statistical Methods Water Supply and Treatment Technologies Environmental Chemistry and Microbiology	25	75	4	--	4
OPEN ELECTIVE (OE)						
WET-05	Geo-Physical Exploration and Watershed Management River Basin Management Air pollution and Control Technologies	25	75	4	--	4
LABORATORY						
WET-06	Environmental Laboratory	25	75	--	6	3
WET-07	Groundwater laboratory	25	75	--	6	3
WET-08	Seminar –I	100	--	--	6	2
Total Credits:				**24**	**8**	**28**

SECOND SEMESTER

SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
CORE COURSE (CC)						
WET-09	Geospatial Applications to Water Resources	25	75	4	--	4
WET-10	Irrigation Management	25	75	4	--	4
WET-11	Advanced Wastewater Treatment Technologies	25	75	4	--	4
FOUNDATION COURSE (FC)						
WET-12	Fluvial Hydraulics Solid and Hazardous Waste Management Urban Hydrology Water Resources System Analysis	25	75	4	--	4
OPEN ELECTIVE (OE)						
WET-13	Sustainable Water Resources Development Environmental Impact Assessment Hydropower Development	25	75	4	--	4
LABORATORY						
WET-14	Water Resources Simulation and Modeling Lab	25	75	--	6	3
WET-15	Image Processing Laboratory	25	75	--	6	3
WET-16	Seminar – II	100	--	--	6	2
Total credits:				**24**	**8**	**28**

SECOND YEAR

THIRD SEMESTER

SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
WET-17	Comprehensive Viva-Voice	--	100	--	--	4
WET-18	Project work Review – I	100	--	--	24	12
	Total				**24**	**16**

FOURTH SEMESTER

SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
WET-19	Project work review-II	100	--	--	8	4
WET-20	Project Evaluation (Viva-Voce)	--	100	--	16	12
	Total			--	**24**	**16**

P.G. Programme: Centre for Water Resources

M.Tech.: (WATER AND ENVIRONMENTAL TECHNOLOGY)	B.Tech in Civil Engineering/Agriculture Engineering / Environmental Engineering Or M.Sc in Geo-Physics/ Geology/ Hydrology/ Remote Sensing/ Water & Environmental Sciences.
M.Sc.: (WATER AND ENVIRONMENTAL SCIENCES)	Graduate of Science/Forestry/Agriculture.

FIRST SEMESTER

CORE COURSE (CC) WET- 01

SURFACE WATER HYDROLOGY

OBJECTIVES:

1. The students acquire knowledge about hydrologic cycle, precipitation its measurement and analysis along with its abstractions
2. Students understand infiltration, constitution of stream flow and hydrographs
3. The students understand floods, analysis, routing along with its mitigation and management
4. It creates awareness regarding surface water pollution, causes, prevention and remedial measures
5. The students are made to understand different disasters and its management. In addition, they study about climate change, drought and water harvesting

UNIT-I: Components of Hydrologic Cycle: Hydrologic Cycle, Precipitation, Cloud Seeding, Rain Gauge Net Work, Estimation of Missing Rainfall Data, Mean Precipitation Over an Area by Arithmetic Mean, Thiessen Polygon and Isohyetal Methods, Checks of Rainfall Data, Double Mass Curve, Evaporation, Transpiration, Methods of Estimation of Evapotranspiration.

UNIT-II: Initial Abstractions & Hydrograph Analysis: Infiltration, Factors affecting Infiltration, Measurement of Infiltration, Infiltration Curve and Infiltration Indices. Runoff: Stream flow Hydrograph, Hydrograph Separation, Unit Hydrograph.

UNIT-III: Hydrology of Floods: Definition: Hydrology of Floods: Causes of Floods, Flood Discharge Formulae and Envelope Curves, Flood Frequency Analysis, Flood Control- Flood Control Dams, Detention Basins, Levees, Diversion Channels, Flood Channel Improvement Schemes. Flood Routing: Routing Through a Reservoir by I.S.D. Method, Channel Routing by Muskingum Method.

UNIT-IV: Surface Water pollution: Introduction, Causes of Water Pollution, their Effects, Remedial Measures, Pattern of Pollution, Self Purification Processes in Streams. Raw and Treated Water Quality Monitoring and Surveillance Including Various Standards.

UNIT-V: Disaster Management: Types of Natural Disasters and Manmade Disasters, Effects of Drought, Combating Drought, Reducing Runoff Losses, Reducing Evaporation and Deep Percolation, Efficient use of Stored Soil Water, Early Warning Systems, Evacuation Plans and Post Disaster Management and Administration, Climate change and its impact on Water Resources, Overview of rainwater harvesting.

COURSE OUTCOMES

The student is expected to

CO1: To learn about precipitation and its measurement, analysis and interpretation.
CO2: Know about abstractions to rainfall, infiltration, evaporation and transpiration along with their estimation and derivation of unit hydrograph from hydrograph.
CO3: Gain Knowledge about floods, its estimation, combat floods and flood routing.
CO4: Familiarize with surface water pollution, causes, effects and remedial measures.
CO5: Acquire knowledge about disasters and its management, conservation of water and climate change and its impact on water resources.

TEXT BOOKS:

1. Water Resources Engineering by Larry W.Mays, John Wiley & 2010.
2. A Text Book on Hydrology by P.Jayarami Reddy, Laxmi publishers, 2011.
3. A text book on Hydrology by H.M.Raghunadh.

REFERENCE BOOKS:

1. Water and Environment by U.Aswathanarayana, A.A. Balkema Publishers, 2001
2. Hydrology and Water Resources Engg by K.C.Parti, Narosa Publishers, 2001.
3. Water Resources-Environment Planning& development by A.K.Biswas, Tata McGraw Hill, 1997.
4. Hydrology Quantity & Quality by Wanisliste & Elenlin, John Wiley, 1997.
5. Applied Hydrology by Ven Te Chow, Maidenment & Mays, Mc Graw Hill, 1988.

CORE COURSE (CC) WET 02:

GROUND WATER HYDROLOGY

OBJECTIVES:

1. To understand the fundamentals concepts of groundwater concepts for its storage movement governing laws with field and laboratory estimation of hydraulic properties.
2. To learn flow of water porous medium its governing equations and estimation of aquifer parameters with various types of pumping tests in tube wells and open wells.
3. To learn ground water exploration techniques by using geophysical methods such as electrical resistivity methods and seismic refraction method.
4. To learn various ground water management techniques such as artificial recharge, conjunctive use basin management and control of sea water intrusion.
5. To understand the ground water pollution, remediation and modeling of the aquifer with respect flow model and transport model.

UNIT-I: Fundamental Concepts: Types of Aquifers, Vertical Distribution of Soil Water below the Ground, Porosity, Specific Yield, Hydraulic Conductivity and Storage Coefficient, their Practical Significance, Darcy's Law and its Validity, Ground Water Flow Contours and their Applications, Tracer Techniques in Ground Water Flow Studies.

UNIT-II: Ground Water Hydraulics: Derivation of Basic Differential Equation and its Solutions, Steady and Unsteady Radial Flow of Ground Water towards a Well in Confined and Unconfined Aquifers, Analysis of Pumping Test Data, Theis type Curve Method, Jacob's Method for Time and Distance Draw Down Tests, Open Well Hydraulics, Recuperation Test.

UNIT-III: Groundwater Exploration: Electrical Methods, Expression for Apparent Resistivity in Four Electrode Arrangements viz. – Werner, Schlumberger Arrays, Field Surveys, Interpretation Techniques in Sounding and Profiling for Ground Water Investigation, Seismic Refraction Method – Principle and Propagation of Refracted Energy in Two and Three Media Earth, Field Procedure and Interpretation Techniques.

UNIT-IV: Ground Water Management: Water Balance Studies, Perennial Yield, Concept of artificial recharge, Various types of artificial recharge techniques, Conjunctive use of surface and groundwater, Management of coastal aquifers – Ghyben Herzberg relation, upconing of Saline Water, Methods of control of salt-water intrusion.

UNIT-V: Ground Water Pollution and Modelling: Ground Water Quality, Ground Water Pollution, Elements and Source of Pollution, their Effects and Remedial Measures. Aquifer Modeling: Electrical Analog Models, RC Network Techniques, Principles of Digital Modeling of Aquifers, Flow Modeling Using Finite Difference Methods and Finite Element Methods, Advection Process, Diffusion and Dispersion Process, Solute Transport Modeling. Case Studies.

COURSE OUTCOMES

The student is expected to

CO1: To understanding the fundamentals concepts of groundwater for its storage movement governing laws with field and laboratory estimation of hydraulic properties.

CO2: Derivation of flow of Water through porous media its governing equations and estimation of aquifer parameters with various types of pumping tests in tube wells and open wells.

CO3: Application of ground water exploration techniques by using geophysical methods such as electrical resistivity methods and seismic refraction method to explore groundwater.

CO4: Practicing various groundwater management techniques such as artificial recharge, conjunctive use basin management and control of sea water intrusion.

CO5: To understand the groundwater pollution, remediation and modeling of the aquifer with respect to flow model and transport model.

TEXT BOOKS:

1. Ground Water Hydrology by D.K. Todd, John Wiley & Sons, 1976.
2. Ground water Hydrology by H.M.Raghunath, Wiley Eastern Limited.
3. Numerical Ground Water Hydrology by Rasthogi.

REFERENCE BOOKS:

1. Concepts and Models in Groundwater Hydrology by Domenice.
2. Regional Ground Water Modelling by M. Thangarajan, Capital Publishing Co., 2004.
3. Ground Water Resources Evaluation by W.C.Walton, Mc Graw Hill, 1976.
4. Geohydrology by Davis and Dewiest.

CORE COURSE (CC) WET- 03

ADVANCED FLUID MECHANICS

OBJECTIVES:

1. To understand basic knowledge about fluid properties
2. To learn and apply fluid statics for solving fluid problems
3. To acquire the fluid kinematics knowledge for solving fluid kinematics problems in fluid mechanics
4. To understand and solve problems an dynamics of ideal fluids
5. To understand and solve problems an dynamics of real fluids
6. To understand concepts of boundary layer theory and apply in boundary layer flows.

UNIT-I: Fluid Properties And Fluid Statics: Density, Specific weight, Specific gravity, viscosity, Vapour pressure, compressibility, Pressure at a point, Pascal's law, pressure variation with temperature, density and attitude. Hydrostatic law, Piezometer, Simple and differential manometers, pressure gauges, total pressure and center of pressure plane, vertical and inclined surfaces.

UNIT-II: Fluid Kinematics: Mathematical Descriptions of Fluid Motion, Classification of Flows, Stream line, path line, streak line, stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, one, two and three dimensional flows Continuity equation in 3D flow, stream function, velocity potential function.

UNIT-III: Dynamics of Ideal Fluids: Three Dimensional Continuity and Energy Equations For Steady Incompressible Flow, Applications to Simple One Dimensional Problems, Impulse- Momentum Equations for Steady Incompressible Flow, Problems of Pipe Bend, Flow through Venturimeters and Orificemeter, Pitot tube.

UNIT-IV: Dynamics of Real Fluids: Navier Stokes Equations, Flow between Parallel Plates, Hagen Poiseuille flow, Karman-Prandtl Equations for Velocity Distribution.

UNIT-V: Boundary Layer Flows: Boundary layer definitions and characteristics, displacement thickness, momentum thickness and energy thickness, expressions for Boundary Layer Thicknesses, Prandtl's Boundary Layer Equations, Laminar and Turbulent Boundary Layer Equations, Boundary Layer Separation and its control.

COURSE OUTCOMES

The student is expected

CO1: Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.

CO2: Develop understanding on the dynamics of Ideal fluids, applications to one dimension problems and evaluate the problems on pipe bend, venturimeter and orifice meter.

CO3: Imbibe the equations of real fluids like Navier Stokes equation, Stokes flow and Hagen Poiseuille flow.

CO4: Acquire knowledge on boundary layer flow for various expressions and equation on laminar and turbulent boundary, Integral momentum and boundary layer separation.

CO5: Grasp the basic idea of turbulence in fluid flow.

TEXT BOOKS:

1. Fluid Mechanics by F.M. White, Mc Graw Hill, 2005.
2. Fluid Mechanics by Streeter, Mc Graw Hill.
3. Fluid Mechanics by D.Ramadurgaiah.

REFERENCE BOOKS:

1. Fluid Mechanics by Massey, ELBS Publishers.

FOUNDATION COURSE (FC) WET-04

FC: 1 HYDRAULIC STRUCTURES

OBJECTIVES:

1. It gives an introduction of types of dams, analysis and design
2. It enables the students to learn types of spillways, their suitability and energy dissipation
3. The students learn earth and rock fill dams , stability analysis and design
4. The students also study suitability and critical conditions in respect of earth and rock fill dams

Unit-I: Classification of dams, Selection of type of dam, site investigations, Gravity dams, Forces acting, causes of failures and design criteria,- Single and multiple step design, Method of zoning stability analysis – Overview section, evolving of ogee profile, discharge characteristics.

Unit-II: Different types of spill ways their application and operations, Drainage galleries, Different types of I.S energy dissipaters and their suitability.

Unit-III: Earth & Rockfill dams-1: Types and general principles of design, Methods of control of seepage through embankment and through foundation, Stability of earth dam slopes under different conditions- Slip circle analysis.

Unit-IV: Earth & Rockfill dams-2: Horizontal shear, sudden drawdown condition, factors of safety. Rockfill dams- Types & Suitabilities.

Unit-V: Arch and Buttress dams: Classification of arch dams, Cylinder theories, Principles of elastic theory and Elementary principles of trial load analysis, Buttress dams-types and relative merits of dams, Buttress spacing, unite Column design.

COURSE OUTCOMES

The student is expected

CO1: To learn about gravity dams, its analysis and design, theoretical and practical profile of gravity dam.
CO2: Understand spillways, types, operation, relative merits and demerits, energy dissipation, types of stilling basins and design specifications.
CO3: Know about earth dams, its suitability, types, design and analysis, types of failures and remedial measures.
CO4: Gain knowledge about rock fill dams, types, its suitability and safety measures.
CO5: Be familiar with classification of arch and buttress dams, stability analysis, relative merits and demerits and design.

TEXT BOOKS

1. Irrigation and water Power Engineering by B.C Pummia and Lal.
2. Irrigation & Hydraulics Structures by S.K.Garg.
3. Engineering of Dams by Creager, Justin and Hinds.

FOUNDATION COURSE (FC) WET-04

FC: 2 APPLIED STATISTICAL METHODS

OBJECTIVES:

1. To understand the concepts of differentiation and integration.
2. The various statistical analyses are discussed in this unit.
3. The concepts of finite difference method are discussed for one dimensional and two dimensional problems.
4. Developments of element matrices and posting into global locations for the finite element method are dealt in this unit.
5. The concepts of neural network and fussy logic are understood in this unit.

UNIT-I: Differentiation and Integration: Derivative of a function, Trigonometric, reverse trigonometric, hyperbolic, inverse hyperbolic functions- derivatives. Methods of differentiation, second order derivatives, equations of tangent and normal to a curve, lengths of tangent, normal, subtangent and subnormal. Angles between two curves and conditions for orthogonality of curves, increasing and decreasing functions, maxima and minima, successive differentiation and Leibnitz theorem. Integration of a function, integration for trigonometric functions, different methods of integration, integration by parts, definite integrals, problems on definite integrals, areas.

UNIT-II: Statistical Methods: Statistical Inference and Regression Analysis – Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses, Multiple Linear Regression, Correlation and Regression Analysis.

UNIT-III: Finite Difference Method: Construction of Finite Difference Approximations – Taylor Series, Forward, Backward and Central Difference Approximations, Finite Difference Approximations of Boundary Value and Initial Value Problems, One Dimensional and Two Dimensional Problems, Explicit, Implicit, and Crank – Nicolson Schemes, Convergence and Stability, Alternating Direction Implicit (ADI) Method for Two Space Dimensions, Simple examples.

UNIT-IV: Finite Element Method: General Principles, Types of Elements, Interpolation Functions, Development of Basis Functions for One-Dimensional and Two Dimensional Elements, Linear Interpolation, Local Co-Ordinate System, Variational Formulation, Galerkin Formulation, Development of Element Matrices. Posting into Global Locations, Treatment of Initial and Boundary Conditions, Solution of Linear Algebraic Equations, Simple Examples.

UNIT-V: Neural Network and Fuzzy Logic: Introduction: Basic Concepts of Neural Networks and Fuzzy Logic, Differences Between Conventional Computing and Neuro-Fuzzy Computing, Characteristics of Neuro-Fuzzy Computing. Fuzzy Set Theory: Basic Definitions and Terminology and Membership Functions – Formulation and Parameters, Neural Networks, Fuzzy Logic and Genetic Algorithm:

COURSE OUTCOMES

The students should be able

CO1: To solve applied problems using differentiation and integration.
CO2: Understand, apply and examine the confidence intervals, tests of hypotheses and regression analysis.
CO3: Gain knowledge on finite difference approximations and to solve practical problems concerned to groundwater.
CO4: Develop the ability to generate the governing finite element equations for systems governed by partial differential equations.
CO5: Comprehend the fuzzy logic control and design the fuzzy logic using genetic algorithm.

TEXT BOOKS:

1. Advanced Engineering Mathematics by Kreyszic.
2. Finite Element by Buchnan, TataMcgraw Hill, 2006

REFERENCE BOOKS:

1. Partial Differential Equations by Jani & Irengar-New age Publications.
2. Multi Objective Genetic algorithms by Kalyanmoy Deb, PHI Publishers.
3. Genetic Algorithms in search, Optimisation & Machine learning by D.E.Goldberg Addison- Wesley Publishers.
4. Neural Networks by Satish Kumar,Tata Mcgraw Hill,2004.

FOUNDATION COURSE (FC) WET-04

FC: 3 WATER SUPPLY AND TREATMENT TECHNOLOGIES

OBJECTIVES:

1. The students learn basics of fluid mechanics and its principles and pumping of fluids
2. The students understand transmission and distribution of treated water. Also, they study water and waste water audit.
3. It enables the students to acquire knowledge about different stages of water treatment
4. It deals with different advanced water treatment processes to treat water in specific cases
5. The students learn about water conservation, environmental protection and grey water management

UNIT-I: Fundamentals: Fluid Properties, Fluid Flow, Continuity Principle, Energy Principle and Momentum Principle, Frictional Head Loss in Free and Pressure Flow, Major and Minor Head Losses, Formula for Estimation of Head Loss, Planning Factors for Fluid Transport Systems, Pumping of Fluids, Selection of Pumps With Reference to Duty.

UNIT-II: Water Transmission and Distribution: Water Transmission Main Design Including CAD Design, Pipe Material, Economics, Water Distribution, Pipe Networks, Methods for Analysis and Optimization, Laying and Maintenance, In Situ Lining, Appurtenances, their Design, Corrosion Prevention, Preventive Maintenance and Leak Detection, Non-Revenue Water, Water and Wastewater Audit.

UNIT-III: Water Treatment Processes: Pumping, Grit Removal, Flow Measurement, Screening, Primary and Secondary Sedimentation, Tube Settlers, Rapid Sand Filtration, Its Operation, Slow Sand Filtration, Its Operation, Pressure Filtration, Water Softening, Disinfection, Design of Water Treatment Plant including CAD Design.

UNIT-IV: Advanced Water Treatment: Specific Treatment for Sea Water, Removal of Chloride, Fluoride, Iron, Manganese, Odour Pesticides, Arsenic and other Heavy Metals, Activated Carbon Treatment for Carbonate Balancing for Corrosion Control.

UNIT-V: Ecological Sanitation: Sanitation of human excreta, dry sanitation, separation of urine and faeces, dehydration and decomposition, house hold management, communal management, recycling the nutrient, grey water management in ecological sanitation.

COURSE OUTCOMES

The student is expected

CO1: To learn about water transmission pipe networks, non-revenue water and wastewater treatment as a part of water conservation.

CO2: Understand different water treatment units and its stages and design of water treatment plant using CAD.

CO3: Be acquainted with advanced water treatment methods for the removal of various pollutants including metals.

CO4: Understand corrosion of pipes, causes, effects and control.

CO5: Have thorough idea about ecological sanitation and know about grey water management and recycling of nutrients.

TEXT BOOKS:

1. Analysis of flow in water distribution Networks by P.R. Bhave, Technomic Publishing Co., USA, 1991.
2. Water Supply Engineering by S.K.Garg, Khanna Publishers, 2008.
3. Ecological Sanitation by Uno Winblad Published by Stockholm Environment Institution.

REFERENCE BOOKS:

1. Environmental Engineering by Peavy and Row, Mc Graw Hill, 1998.
2. Environmental Engineering by G. Kiely, Mc Graw Hill, 2007.
3. Manual on Water Supply and Treatment, 3rd Edition- Revised & Updated, May, 1999 Published by CPHEEO, Ministry of Urban Development, GOI, New Delhi.
4. Geiger, W.F., Marsalek, J. Zudima and Rawls, G. J. (1987 "Manual on Drainage in Urban Areas", 2 Volumes, UNESCO, Paris).
5. Storm water Management by Wanelista and Edelin, Wiley publications, 1993.

FOUNDATION COURSE (FC) WET-04

FC: 4 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

OBJECTIVES:

1. In the unit the concepts concerned to ecosystem and balance in nature are dealt in detail.
2. The energy flow in the ecosystem and its influence in the ecosphere are discussed.
3. The relationship between the biochemistry of water and waste water with the organic chemistry are discussed in this unit.
4. An overview of the waste disposal and chemistry of different chemicals are dealt here.
5. To understand the concepts of microorganisms prevailing in different environments are discussed.

UNIT-I: Ecology: Introduction, Levels of Organization in Nature and Scope of Ecology, Structure of Ecosystem, Ecosystem Function, Population Ecology, Photosynthesis and Respiration, Gross and Net Primary Production, Balance in Nature.

UNIT-II: Energy in Ecosystem: Earth's Energy Budget, Ecosystem Energy Budget, Energy Flows through Ecosystem, Efficiencies of Energy Transfer in Ecosystem, Pyramids, Food Chains and Food Webs, Biogeochemical cycles in ecosphere, Natural Resources, Role of an individual in conservation of Natural Resources.

UNIT-III: Environmental Chemistry: Chemical Reactions in Water and Wastewater Treatment, Analysis, Significance and Interpretation of Different Characteristics of Water and Wastewater. Organic Chemistry and Biochemistry of Water and Wastewater, Buffers, Organic Reactions involved in Water and Wastewater, Bio-Chemical Reactions, Solubility Product, Order of Equations, Rate Control Step, Factors affecting Biochemical Reactions, Chemistry of Biodegradation, BOD, Kinetics of BOD, Factors affecting BOD.

UNIT-IV: Sanitary Chemistry: Domestic Waste Disposal With and Without Water Carriage System, Household and Community Waste Disposals, Chemistry of Pesticides, Insecticides and Herbicides, Detergents, Chemistry of Rodent Control Chemicals, Fumigation and Disinfectants.

UNIT-V: Microbiology: Scope of Microbiology, Characterization and Classification of Microorganisms, Microscopic Observations of Microorganisms, Fundamentals of Microbial Ecology, Soil Microbiology, Microbiology of Air, Aquatic Microbiology, Microbiology of Domestic Water and Sewage, Water borne diseases, Microbiology of Foods, Microbiology of Milk and Milk Products, Industrial Microbiology, Virology important concepts.

COURSE OUTCOMES

The student is expected to

CO1: Develop an understanding of structure and formation of an ecosystem.

CO2: Gain knowledge on energy flow and to understand biogeochemical cycles and their significance in the sustainability ecosystems.

CO3: Gain competency and understanding of the significance of chemical and biological reactions in environmental problems.

CO4: Identify domestic waste, household, community waste disposals and also to familiarize with chemistry of pesticides, insecticides, herbicides, detergents, and rodent control chemicals.

CO5: Acquire knowledge on soil, air, aquatic, domestic water and sewage, foods, milk and industrial microbiology.

TEXT BOOKS:

1. Chemistry for Environmental Engineers by Sawyer, C.N. and Mc Carthy, P.L, McGraw Hill, 1990.
2. Ecology by Kormanday.
3. Text book of Microbiology by R.C.Dubey and D.K.Maheahwari, S.Chand and Co. Publishers, New Delhi.

REFERENCE BOOKS:

1. Environmental Studies by Dr.Suresh K. Dhameja
2. Essential Environmental Studies by S.P.Mishra & S.N.Pandey
3. Ecology by Odum, Mc Graw Hill,1997
4. Standard methods for examination of Water and Wastewater by American Public Health Association Inc. New York, 1989.
5. Water Supply and Sanitary Engineering G.S.Bridie & J.S.Brides, Dhanpat Rai & Sons 1993.
6. Microbiology - Pelzar, Reid and Chan. Tata - Mc Graw Hill Publishing Company Limited, 1996
7. A text book of Microbiology by Chakravarthy, New central Book agency Publishers, Kolkata, 2012.

OPEN ELECTIVES (OE) WET-05

OE: 1 GEO- PHYSICAL EXPLORATION AND WATER SHED MANAGEMENT

OBJECTIVES:

1. To know the occurrence, movement and distribution of Ground water in various geological formations of the earth.
2. To learn the ground water by using various geophysical techniques.
3. To know the construction of various water wells.
4. Learning design development and completion of water wells.
5. To know the various water shed management techniques.

UNIT-I: Fundamentals: Internal Constitution of the Earth. Basic Concepts of Geologic Structures Governing Occurrence and Movement of Ground Water, Ground Water in Igneous, Metamorphic and Sedimentary Rocks, Hydrogeological Methods of Exploration

UNIT-II: Geophysical Methods: Review of electrical & seismic methods with advanced interpretation techniques. Magnetic and Electromagnetic Methods, Principle and Field Practices, Magnetic and VLF Techniques and its Interpretation.

UNIT-III: Water Well Technology-I: Wells and their Construction, Open Wells and Cavity Wells, Types and Construction of Tube Wells in Alluvial Soils and in Hard Rock Areas, Drilling Fluids-Functions and Properties, Methods of Drilling Tube Wells-Hydraulic Rotary Method and Reverse Rotary Method, DTH method,

UNIT-IV: Water Well Technology-II: Well Logging Techniques-Electrical – Long Normal Short Normal SP and Radioactive Loggings, Development Of Wells And Completion of Wells - Various Methods, Design of Strainer Tube Wells, Pumping Arrangements, Well Failures and Reclamation Techniques, Well Losses and its Estimation, Aquifer Remediation Technologies.

UNIT-V: Watershed Management: Objectives of Planning Watershed Projects, Guidelines for Project Preparation, Watershed Delineation, Codification, Resources Surveys, Hydrological, Soil, Vegetative and Land Use Surveys, Socio-Economic Surveys, Water and Soil Conservation Works, People's Participation and Constraints, Participatory Rural Appraisal in Watershed Programme, Community Mobilization & Participatory Management, Peoples Institutions, Capacity Building.

COURSE OUTCOMES

The student is expected to

CO1: Understanding the hydro geological concepts and occurrence of groundwater in various rock formations application of hydrological methods to groundwater exploration.

CO2: Application of various geophysical methods for groundwater exploration.

CO3: Learning the drilling methods and construction of water wells in various rock formations.

CO4: Learning the design development of water well using well logging and well hydraulic methods.

CO5: Understanding the planning, surveying and development of watershed management programmes.

TEXT BOOKS:

1. Hydrogeology by Davis and Dewiest
2. Soil and Water Conservation Engineering by Schwarb, Fengmin, John Wiley, 2002.

REFERENCE BOOKS:

1. Watershed Management for Indian conditions by E.M. Tademan, Omega Scientific Publishers, 2002.
2. Watershed Hydrology by Peter.S.Black, Prentice Hall, 1991.

OPEN ELECTIVES (OE) WET-05

OE: 2 RIVER BASIN MANAGEMENT

OBJECTIVES:

1. 1. To discuss different aspects of water resource development and management.
2. To understand the concepts of River reach routing and reservoir routing.
3. To discuss about irrigation distribution systems, water conservation and technological innovation.
4. To learn about allocation of water to drinking, irrigation, hydropower and flood control.
5. To understand the theory of soil erosion and reservoir sedimentation.

UNIT-I: Management of Multiple System Objectives: Water Supply, Flood Control, Navigation, Recreation, Fish and Wildlife Habitats, Hydropower Production.

UNIT-II: Parameters Involved: River Gauging-Measured and Forecasted Flows, River Reach- Routing the Flow and Calculation of Gains and Losses, River Confluences-Mass Balance at River Confluences, Reservoirs - Storage Reservoirs, Power Reservoirs, Reservoir Routing, Groundwater Storage, Canals, Aggregation of Water Users, etc.

UNIT-III: Management of Irrigation Structures: Reservoirs, Irrigation Canal and Distribution Systems, Regulatory Structures, Regulatory Measures, Economic Instruments, Behavioral Changes, Water Conservation, Technological Innovation.

UNIT-IV: Water Allocations: Drinking Water Supply, Irrigation, Hydropower and Flood Control, Reservoir Operations.

UNIT-V: Soil Erosion & Sedimentation: Theory of soil erosion, sediment transport, reservoir sedimentation, control measures, catchment treatment.

COURSE OUTCOMES

The student is expected to

CO1: To learn know about forecast of river flows, routing the flow and river confluences.
CO2: To understand river confluences and its balance, reservoir routing and aggregation of water users.
CO3: Be familiar with management of different irrigation structures, water conservation and concerned technological innovations.
CO4: Have thorough understanding of judicious water allocation for various purposes and reservoir operation.
CO5: Gain knowledge about soil erosion and sedimentation, control measures and catchment treatment.

TEXT BOOKS:

1. Water Resources Management and the Environment by U. Aswathanarayana, A.A. Balkema, The Netherlands, 2001.
2. Water Resources and Land-use Planning: A systems Approach by P. Laconte and Y.V. Haimes (eds.), Martinus Nijhoff Publishers, The Hague, 1982.

REFERENCE BOOKS:

1. Mechanics of Sediment Transport and Alluvial Stream Problems by Garde, R.J. and Rangaraju, K.G.,
2. Flow through Open Channels by Ranga Raju, K.G.

OPEN ELECTIVES (OE) WET-05

OE: 3 AIR POLLUTION AND CONTROL TECHNOLOGIES

OBJECTIVES:

1. In this unit concepts concerned to different types of air pollutants and their effects on the environment are studied.
2. Types of pollutant sampling and collection as well as analysis of the pollutants are dealt in this unit.
3. To understand the different types of control methods adopted for air pollutant are enumerated in this unit.
4. Control of sulphur-dioxide and nitrogen oxides are discussed here.
5. To understand the concepts of vehicular emissions and their mechanism of origin.

UNIT-I: Air Pollution & Global issues: Classification and Properties of Air Pollutants, acid rain, Global warming Importance of Anthropogenic Sources, Photochemical Smog, Effects of Air Pollution-Health, Vegetation and Materials Damage in India, Air Pollution Laws and Standards. Meteorological Aspects of Air Pollution Dispersions, Temperature Lapse Rates and Stability, Wind Velocity and Turbulence, Plume Behavior, Dispersion of Air Pollutants, Solutions to the Atmospheric Dispersion Equation, the Gaussian Plume Model

UNIT-II: Air Pollution Sampling and Measurement: Types of Pollutant Sampling and Measurement, Ambient Air Sampling, Collection Of Gaseous Air Pollutants, Collection of Particulate Pollutants, Stock Sampling, Analysis of Air Pollutants, Sulfur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Oxidants and Ozone, Hydrocarbons, Particulate Matter.

UNIT-III: Air Pollution Control Methods: Sources, Correction Methods, Cleaning of Gaseous Effluents, Particulate Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Selection a Particulate Collector, Control of Gaseous Emissions, Adsorption by Solids, Absorption by Liquids, Combustion - Behavior and Fate of Air Pollutants.

UNIT-IV: Control of Hazardous Emissions: Control of Sulphur Dioxide Emission, De Sulphurization of Flue Gases, Dry Methods, Wet Scrubbing Methods, Control of Nitrogen Oxides, odour control.

UNIT-V: Air Pollution from Automobiles: Genesis of Vehicular Emissions, Natural Pollution, Classification of Vehicles, Point Sources of Air Pollution from Automobiles, Fuel Tank, Carburetor, Crank Case, Exhaust Emissions, Mechanisms of Origin of Air Pollution from Automobiles, Automobile Air Pollution, Indian Scenario, Population and Pollution Loads of Vehicles, Automobiles Pollution Control, Control at Sources, Exhaust Gas Treatment Devices, Alternate Fuels Comparison, Thermal Reactor, Catalytic Converter, Automobile Emission Control, Legal Measures, Air Mod.

COURSE OUTCOMES

The student is expected to

CO1: The student is expected to understand the effects of air pollutants, the metrological aspects, plume behavior and atmospheric dispersion equation.
CO2: Acquire knowledge on sampling techniques and analyze air quality.
CO3: Understand and analyze the basic mechanisms involved, working principle and design aspects of various air pollution controlling equipments.
CO4: Identify the methods to control sulphurdioxide and nitrogen oxide emissions.
CO5: Gain knowledge on vehicular emissions and auto mobiles pollution control at sources along with legal measures.

TEXT BOOKS:

1. Air Pollution and Control Technologies by Prof.Y.Anjaneyulu, Allied publishers.
2. Air pollution by H.C.V Rao, McGraw Hill.
3. Air pollution by M.N Rao, McGraw Hill

REFERENCE BOOKS:

1) Fundamentals of Air Pollution by Daniel A. Vallero, 4th Edition, Elsevier Publisers, 2007
2) Air Pollution by S.K.Agarwal, APH Publishers, 2005.

WET-06 ENVIRONMENTAL LABORATORY

OBJECTIVES:

1. The physical, chemical parameters of the water and waste water samples are analyzed in the laboratory.
2. The significance of the results is compared with the Bureau of Indian standards.

1. pH
2. Electrical Conductivity
3. Nitrates
4. Chlorides
5. Sulphates
6. Alkalinity
7. Calcium
8. Magnesium
9. Fluorides
10. Dissolved Oxygen
11. Total Phosphorous
12. BOD
13. COD

SOLID WASTE PRACTICALS:

1. Moisture
2. pH
3. Bulk Density
4. Sodium (SAR)

WASTEWATER PRACTICALS:

1. pH
2. Electrical Conductivity
3. Turbidity
4. Total Solids
5. Suspended Solids
6. Dissolved Solids
7. Dissolved Mineral Matter
8. B.O.D
9. C.O.D
10. Influent into Activated Sludge Treatment Plant
11. Effluent from the Treatment Plant

COURSE OUTCOMES

Students will be able to

CO1: Perform common environmental experiments relating to water, wastewater and solid waste quality, and know which tests are appropriate for given environmental problems.

CO2: Statistically analyze and interpret laboratorial results.

CO3: Understand and use the water, wastewater and solid waste sampling procedures and sample preservations.

CO4: Demonstrate the ability to write clear technical laboratorial reports.

CO5: Understand the impact of water, wastewater and solid waste treatment on people and the environment.

WET-07 GROUNDWATER LABORATORY

OBJECTIVES:

1. To prepare ground water contour map.
2. To learn about ground water contour map and its analysis.
3. To estimate the resistivity and thickness of various layers by conducting vertical electrical sounding.
4. To know the lateral & vertical homogeneity of earth by conducting seismic refraction & resistivity imaging.
5. To determine aquifer characteristics namely transmissivity and storage coefficient.

(1) Preparation of Groundwater contour map.

(2) To determine the Resistivity and Thickness of various sub-surface layers vertically below the central point using Schlumberger method (One Dimensional)

(3) To determine Resistivity and Induced Polarization by using ABEM SAS 1000 Terrameter (Two Dimensional)

(4) To determine the depth of the sub-surface layers by conducting Seismic Refraction method

(5) To determine sub-surface layers resistivity, fluid resistivity and spontaneous potential by using by using ABEM SAS 300 Well Logger (Sub-surface method)

(6) To investigate underground shallow and deeper pipelines and to understand the various anomalies in the sub-surface by using Ground Penetrating Radar with 100 MHz and 400 MHz antennas

(7) To determine the aquifer characteristics such as Transmissivity (T) and Storage Coefficient (S) by conducting pumping tests

(8) To determine physical structure present in bedrock using Very Low Frequency (VLF) Technique

(9) To determine Magnetic effects of sub-surface layers by using Proton Precision Magnetometer

COURSE OUTCOMES

Students will be able to

CO1: Exploring the ground water using electrical resistivity methods.
CO2: Exploring the ground water using seismic methods.
CO3: Identifying civil utility using Ground Penetrating Radar.
CO4: Determination of aquifer characters using pumping tests.
CO5: Identifying various layers of the subsurface using well lagging techniques.

SECOND SEMESTER

CORE COURSE (CC) WET- 09

GEOSPATIAL APPLICATIONS TO WATER RESOURCES

OBJECTIVES:

1. To understand basic concepts of remote sensing for its applications in the area of water resources
2. To acquire knowledge on geographical information systems
3. To get the concepts and applications of data acquisition and data input for water resources project
4. To get the basic and applied knowledge on how to use global positioning systems
5. To understand the applications of remote sensing and geographical information systems in the field of water and environmental technology

UNIT-I: Basic Concepts and Foundation of Remote Sensing: Elements involved in Remote Sensing, Electromagnetic spectrum, Remote Sensing Terminology, Energy Sources, Energy Interactions with Earth Surface Features and Atmosphere, Resolution, Sensors and Satellites, Visual Interpretation Techniques-Basic Elements, Interpretation for Terrain Evaluation, Spectral Properties of Water Bodies

UNIT-II: Geographical Information Systems(GIS): Introduction, GIS Definition and Terminology, GIS Categories, Components of GIS, Fundamental Operations of GIS, A theoretical Framework for GIS, GIS Types of Data Representation, Raster Data Structures, Vector Data Structures, Comparisons between Data Structures.

UNIT-III: Data Acquisition and Data Input: Introduction, Existing Data Sets, Developing Own Data, Digitization and Scanning, Preprocessing- Format Conversion, Data Reduction and Generalization, Error Detection and Editing, Merging, Edge Matching, Rectification and Registration, Interpolation.

UNIT-IV: Global Positioning System (GPS): Introduction, background, the space segment, the control segment, and the user segment, the performance of GPS- factors influencing GPS accuracy, GPS positioning. Base line data computation, Coordinate change and satellite positions, GPS receivers, Fundamentals of GPS application for various results, broad view of GPS applications.

UNIT V: Remote Sensing & GIS Applications: Land Use/Land Cover in Water Resources, Rainfall-Runoff Modeling, Flood Plain Zoning, Drought Assessment and Monitoring, Cropping Patterns, Condition of Crops, Estimation of Sediment Load.

COURSE OUTCOMES

The Student is expected to

CO1: Develop the knowledge on basic concepts of remote sensing, elements involved in remote sensing, its energy sources and interaction with earth's surface features and foundations of remote sensing.

CO2: Comprehend the concepts of Geographical Information System (GIS), components of GIS, types and data structures.

CO3: Understand how the data sets are acquired and developed, and can carry out the preprocessing of data inputs.

CO4: Improve the learning on global positioning system (GPS), factors influencing GPS, GPS signal characteristics, mathematical model and GPS applications.

CO5: Identify the importance of Remote sensing and GIS in various applications like water resources, drought assessment, flood plain zoning etc.,

TEXT BOOKS:

1. Remote Sensing and Image Interpretation by T.M. Lillesand & R.W. Kifer.
2. GIS by Michel Dimmar.
3. A text Book of RS &GIS by M.Anji Reddy, BS Publishers.

REFERENCE BOOKS:

1. Introduction to Remote Sensing, 5th edition, by Campbell Guilford press, 2011
2. Remote Sensing by Kevin, ELBS Publishers, 1990.
3. Fundamentals of Remote Sensing by Joseph, 2nd, Universities Press, 2005.
4. GIS an Introduction by Nadine schuwrman, Blackwell publishers, 2004.
5. Use of GIS in practical Hydrology by Mcijroff *et al*, ITC Netherlands, 1995.
6. Application of remote sensing to hydrology including groundwater by Farsworth, R.K., Bawetl, E.C. & Dhanju, M.S., IHP, UNESCO, 1984.

CORE COURSE (CC) WET- 10

IRRIGATION MANAGEMENT

OBJECTIVES:

1. 1. To know the fundamentals of soils physical & chemical properties with respect to soil water plant relationship.
2. To learn to estimate water requirement of various principal crops.
3. To learn the design and development of various irrigation methods.
4. To know survey and design of land grading, conveyance of water through field channels and through underground pipe lines.
5. To learn salt problems in irrigated areas and design of drainage systems.

UNIT-1: Introduction: Irrigation Development in India, Necessity, Scope, and Benefits of Irrigation, Types of Irrigation, Physical and Chemical properties of soils, Soil Nutrients, Classification of Irrigable Soils, Suitability of Soils for Irrigation, Soil Water plant Relations in Irrigation, Measurement of Soil Moisture, Field Capacity, Temporary and Permanent Wilting Points, Hydraulic Conductivity, Water movement through soils.

UNIT-II: Water Requirement of Crops: Meteorological Parameters needed in estimating water requirement of crops, Their measurements, Methods for estimating evapotranspiration of crops, Consumptive Use, Irrigation Requirement of Principal Crops, Duty, Delta and Base Period and Inter-relationships, Factors Affecting the Duty, Cropping Patterns, Irrigation Efficiencies.

UNIT-III: Methods of Irrigation: Surface Irrigation Methods, Border, Check, Furrow, Sub-irrigation Methods and their Relative Merits, Principles of Design of Surface Irrigation Methods, Micro- Irrigation, Sprinkler and Drip Irrigation Methods and their advantages and disadvantages, Design principles and Methods for Evaluation.

UNIT-IV: Land Grading and Field Layout: Criteria for Land Leveling, Land Grading Survey and Design, Equipment of Land Grading, Field Layout suiting different crops. Conveyance of Irrigation Water, Field Channels, Different lining materials, Design of field channels, best hydraulic section, Conveyance of water through underground pipe lines.

UNIT-V: Drainage of Irrigated Lands: Salt problems in Soil and Water, Water logging in irrigated areas, Causes, Methods for Controlling water logging, Drainage, Surface and Subsurface Drainage Systems, Suitability of these methods, Design of Drainage Systems, Reclamation and Management of Salt Affected Soils.

COURSE OUTCOMES

The Student is expected to

CO1: Understanding irrigation development in India and soil water plant relationships.
CO2: Estimation of crop water requirements.
CO3: Application of various irrigation methods and their design.
CO4: Determining of land leveling for irrigation and design of surface and subsurface field water conveyance.
CO5: Understanding salt problems in irrigated lands and designing suitable drainage methods.

TEXT BOOKS:

1. Irrigation: Theory and Practice by Michael. A.M 2nd Edition, Vikas Publishing House,
2. Land and Water Management Engineering by V.V.N. Murthy, Kalyani Publishers, 2008.
3. Irrigation –Theory and Practice" by Withers and Vipond, S, Cornell University Press, 1980.

REFERENCE BOOKS:

1. Soil and Water Management Systems by Scwabe G.O., Fangmeir, D.D. and Elliot W.J, John Wiley & Sons, 1996.
2. Irrigation, Drainage and Salinity by Hutchinson.
3. Irrigation and Water Resources Engineering by Asawa,G.L ,New age Publishers,2005.
4. Irrigation Principles and Practice by Hansen, V.E., Israelson O.S. and Stringham G.C. John Wiley & Sons, N York.

CORE COURSE (CC) WET- 11

ADVANCED WASTE WATER TREATMENT TECHNOLOGIES

OBJECTIVES:

1. The objective of this unit is to collection and conveyance of waste water along with the study of sewers
2. The students understand about different waste water treatment methods
3. The students learn biological and low cost treatment of waste water
4. The students understand the tertiary treatment of waste waters along with few case studies
5. It enables the students to know about wetlands and its role in the treatment of waste waters

UNIT-I: Wastewater Collection and Conveyance: Design of sanitary sewer, design criteria including CAD design, partial flow in sewers, economics of sewer design; sewer appurtenances, material, construction, inspection and maintenance of sewers, Design of sewer outfalls-mixing conditions, corrosion and the role, conveyance of corrosive wastewaters.

UNIT-II: Wastewater Treatment: Domestic and Industrial, primary and secondary treatment systems, pumps and pumping, degree of treatment and design periods, screening, types of screens, bar screens, fine screens, grit chambers and oil and grease removal devices, Design of wastewater treatment plant including CAD design.

UNIT-III: Biological treatment systems: Trickling filters, low and high rate activated sludge process, design of surface aerators, mechanical diffused aeration, modifications, extended aeration systems, oxidation ditch, rotating biological contractor, sludge treatment and disposal, low cost waste treatment systems.

UNIT-IV: Tertiary treatment systems: Removal of final suspended solids, micro straining, coagulation and filtration, removal of Dissolved solids, adsorption, solvent extraction, ion exchange, Introduction to Osmosis, reverse osmosis, Reverse osmosis technique for Sea water desalination, electro dialysis, Specific Industrial Wastewater Treatment – Case studies on pharmaceutical and chemical industries.

UNIT-V: Wetlands: Introduction, Definition, Classification, Delineation, Identification Methods, Importance Of Wetlands, Human Impacts, Wetland Protection, Mitigation, Wetland Management, Designed Ecosystem, Water and Treated Wastewater Recycling and Reuse, Soil Filters, Constructed Wetlands.

COURSE OUTCOMES

The student is expected to

CO1: To know about sewerage systems, design and appurtenances.

CO2: Learn primary treatment of both domestic and industrial waste water along with design of waste water treatment using CAD.

CO3: Gain knowledge about secondary or biological treatment of waste water sludge treatment and disposal, low cost waste treatment systems like oxidation pond and oxidation ditch.

CO4: Understand various tertiary treatment systems, desalination and reverse osmosis and be familiar with different case studies on treatment of pharmaceutical and chemical industrial effluents.

CO5: Know about wetlands and its role in the treatment of wastewater, constructed wetlands, recycle and reuse of treated wastewater.

TEXT BOOKS:

1. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata Mc Graw Hill Book Company, 2003.
2. Waste Water Treatment by Kaira & Christian, Prentice Hall International, 2006.
3. Sewage disposal and Air pollution engineering by S.K.Garg, Khanna Publishers, 2008

REFERENCE BOOKS:

1. Manual on Sewerage and Sewage Treatment, 2nd Edition, December, 1993 Published by CPHEEO, Ministry of Urban Development, GOI, New Delhi.
2. Manual on Water Supply and Treatment, 3rd Edition- Revised & Updated, May, 1999 Published by CPHEEO, Ministry of Urban Development, GOI, New Delhi
3. Water Supply and Sanitary Engineering G.S. Bridie & J.S. Brides, Dhanpat Rai & Sons 1993.

FOUNDATION COURSE (FC) WET- 12

FC: 01 FLUVIAL HYDRAULICS

OBJECTIVES:

1. To acquire basic concepts of free surface flow and its distribution along with applications of various basic equations.
2. To understand the concepts of gradually varied flow for steady state condition.
3. To understand the concepts of gradually rapid flow for steady state condition.
4. To get the knowledge on non-dimensional members and applications to hydraulic models
5. To acquire the concepts and basic design rules for design of stable channels

UNIT-I: Basic Concepts of Free Surface Flow: Basic Principles of Free Surface Flow, Types of Channels, Flow Regimes, Velocity Equations, Most Economic sections, Uniform Flow Computations, Velocity and Pressure Distribution, Energy Principles and its Applications, Specific Energy, Critical Depth, Critical Flow Computations, Momentum Equation and its Applications, Specific force Diagram.

UNIT-II: Steady Gradually Varied Flow: Dynamic Equation, Characteristics of Flow Profiles, Practical Problems, Gradually Varied Flow Analysis and Computation.

UNIT-III: Steady Rapidly Varied Flow: Hydraulic Jump, Types of hydraulic jump, Hydraulic jump Analysis, Length of the jump, Expression for energy loss during the jump, Jump in Sloping Channels. Unsteady Rapidly Varied Flow- Dam Break Problem, Moving Hydraulic Jump, Positive and Negative Surges.

UNIT-IV: Hydraulic similitude: Dimensions and dimensional homogeneity, Rayleigh's method, Buckingham's pi- theorem method, Froude's, Reynolds, Mach's and Weber's laws of similitude, simple applications to hydraulic models, Distorted models, Scale effect.

UNIT-V: Design of stable Channels: Design of Unlined channels in alluvial transporting canals by kennedy's and Lacey's theories.

COURSE OUTCOMES

The student is expected to

CO1: To learn about types of flows and flow profiles, varied flow analysis and computation.
CO2: Understand dam break analysis, formation of jump on sloping channels, surges and its types.
CO3: Know about different methods of dimensional analysis and its applications.
CO4: Gain knowledge about different dimensionless members and their model laws and flow fields in which they are applicable, kinds of similarity and types of models and scale effect.
CO5: Be thorough with design of alluvial channels, different theories and their relative merits and demerits.

TEXT BOOKS:

1. Open Channel Hydraulics by Chow,. V.T., Mc Graw Hill Inc. N York, 2009.
2. Open Channel Flow by Henderson, Mc Millan Pub. London, 1996.
3. Flow in Open Channels by Subramanya, K, Tata Mc Graw Hill Pub., 2009.

REFERENCE BOOKS:

1. Mechanics of Sediment Transportation and Alluvial Stream Problems by Garde and Ranga Raju, K.G. Wiley Eastern, N Delhi, 1980.
2. Open –Channel Flow by Chaudhry M.H, Prentice Hall of India, N Delhi, 1994.
3. Open Channel Hydraulics by French, R.H. Mc Graw Hill Pub Co., N York, 1986.
4. Open Channel Flow by M.Hanif Chaudhry, Elsevier Publishers, 2006.

FOUNDATION COURSE (FC) WET- 12

FC: 02 SOLID AND HAZARDOUS WASTE MANAGEMENT

OBJECTIVES:

1. The students are expected to learn about solid waste, characteristics and its disposal methods
2. It creates awareness regarding hazardous waste, characterization and control.
3. The students learn about management, minimization and audit of hazardous waste
4. The students understand bio and electronic waste, it's safe disposal and 3R concept.
5. The students acquire knowledge about methods of remediation of waste land followed by reclamation

UNIT-I: Introduction: Definition of Solid Wastes, Domestic Solid Wastes, Types of Domestic Solid Wastes, Collection, Transportation, Characteristics of Solid Waste, Segregation, Types of Disposal Methods, Sanitary Land Fill, Incineration, Composting, Vermin Compost, Recovery of Energy from Solid Wastes.

UNIT-II: Hazardous Wastes: Introduction, Physical and Biological Routes of Transport of Hazardous Substances, Environmental Laws, Indian Scenario, Special Hazardous Wastes, Hazardous Waste Sources and Characterization Categories and Control, Sampling and Characterization. Analysis of Hazardous Wastes,

UNIT-III: Hazardous Waste Management and waste minimisation Technologies: Waste Recovery Processes, Solidification, Stabilization and Encapsulation, Biological Processes, Thermal Processes. Storage and Transportation Including Optimization, Disposal Facilities, TSDF Cradle to Grave Concept, Land Disposal of Wastes, Land Fills, incineration, Underground Disposal, Sea Disposal, Pollution Prevention and Recycling, Environmental Facility Assessment and Audit Waste Minimization, Hazardous Waste Remediation Technologies.

UNIT-IV: Biomedical & Electronic Waste: Hospital/Biomedical Waste Management Including Collection, Transportation, Treatment and Safe Disposal. Zero Waste Technology, Re-Use and Recycling of Wastes, Recovery of By-Products and Energy Audit

UNIT-V: Waste Land Remediation and Reclamation: Definition of Waste Land, Characteristics of Waste Land, Physical, Chemical and Biological Pollution of Soils, Dumping, land Fills, Leachate Problems, Remediation Methods-Physical, Chemical and Biological Methods.

COURSE OUTCOMES

The student is expected to

CO1: To know about solid and hazardous waste transportation, environmental laws and analysis of hazardous waste.
CO2: Learn waste recovery processes, cradle to grave concept of handling hazardous waste.
CO3: Understand disposal of hazardous waste both on surface and underground and waste minimization and hazardous waste remediation technologies.
CO4: Be familiar with collection transportation treatment and safe disposal of both biological and electronic waste and be conversant with reuse and recycling of wastes, recovery of by products and energy audit.
CO5: Gain knowledge about waste land characteristics and its remediation, different kinds of pollution of soils, remediation methods.

TEXT BOOKS:

1. Solid and Hazardous Waste Management by M.N.Rao & Razia Sultana, B.S.Publishers, 2011.
2. Hazardous Waste Management by Charles A.Wentz, McGraw Hill Publishers.
3. Standard Hand Book of Hazardous Waste Treatment and Disposal by H.M. Free man, McGraw Hill, 1997.

REFERENCE BOOKS:

1. Integrated Solid Waste Management by Goerge Tchobanolous, Hilary Theisen & Samuel A.Vigil.
2. CPCB Manual on Solid Waste Management, 2003.

FOUNDATION COURSE (FC) WET- 12

FC: 03 URBAN HYDROLOGY

OBJECTIVES:

1. The students understand urban hydrological cycle, impact of urbanization on quality of water and erosion due to urban runoff.
2. It gives an idea about probabilistic and statistical approaches, data collection and analysis of storm water.
3. The students learn urban drainage systems and design considerations for sewers.
4. The students understand the storm water management and mitigation of urban storm runoff.
5. The students are expected to learn maintenance of urban drainage systems and regulations.

UNIT- I: Urban Hydrologic Process: Process of urbanization – Water in Urban ecosystem – Urban water subsystems – Urban hydrologic cycle. Impact of urbanization on urban runoff and stream flow quantity – Impact of urbanization on quality of runoff and stream flow – Erosion due to urban runoff

UNIT- II: Storm water Modelling: Analysis of hydrologic changes due to urbanization- Approaches to study – Data collection and analysis – Probabilistic and statistical approaches.

UNIT- III: Urban Drainage Systems: Sanitary and combined sewer systems – components – Design considerations for fixing sewer capacity – Infiltration into and exfiltration from sewers -causes – Infiltration inflow analysis – Field investigations – Control measures.

UNIT- IV: **Storm Water Management**: Urban storm runoff quantity and quality management – Mitigation of damaging effects of urban storm runoff

UNIT-V: Urban Drainage Systems Maintenance: Maintenance management of UDS and its subsystems – Drainage system – Storm drain conveyance system – Pump stations – Open channel – Illicit connections and discharges – Spill response – Other considerations, limitations and regulations.

COURSE OUTCOMES

The student is expected to

CO1: To know about impact of urbanization on urban runoff urban water sub systems, urban hydrologic cycle.
CO2: Learn modeling of storm water, probabilistic and statistical approaches of analysis of storm water data.
CO3: Understand urban drainage systems, sewers, components, design considerations, infiltration and exfiltration in sewers, field investigations and control measures.
CO4: Be well acquainted with storm water management, monitoring run off, quantity and quality, measures to mitigate damaging effects of urban storm runoff.
CO5: Be familiar with maintenance of urban drainage systems, pump stations, illicit connections, limitations and regulations.

TEXT BOOKS:

1. Stephenson. D, "Storm Water Hydrology and Drainage", Elsevier Publications, 2nd Edition, 1981.
2. Hall.J.M, "Urban Hydrology", Elsevier Applied Science Publishing Company, 1st Edition, 1984.

REFERENCE BOOKS

1. Overtens D.E., and Medows M.E., "Storm water Modeling" Academic Press, 2nd Edition. 1976.
2. Grigg, N.S, "Urban Water Infrastructure Planning, Management, and Operations", John Wiley & Sons, 2nd Edition, 1986.
3. Viessman W.I., Knapp J.W., Lewis G.L., and Henbrough, T.E., "Introduction to Hydrology".

FOUNDATION COURSE (FC) WET- 12

FC: 04 WATER RESOURCES SYSTEM ANALYSIS

OBJECTIVES:

1. To understand the concepts of water resources planning and management and the role of optimization models
2. The various methods of linear programming are discussed in this unit.
3. The application of dynamic programming for resource allocation and goal programming are dealt in this unit.
4. Gradient based research techniques and simulation concepts are discussed here.
5. In this unit the economics and management of water resources are understand in detail.

Unit-I: Introduction: concepts of systems analysis, definition, systems approach to water resources planning and management, role of optimization models, objective function and constraints, types of optimization techniques.

Unit-II: Linear Programming: Formulation linear programming models, graphical method, simplex method, application of linear programming in water resources. Revised simplex method, duality in linear programming, sensitivity and past optimality analysis.

Unit-III: Dynamics Programming: Belman's of principles of optimality forward and backward recursive dynamic programming, case of dimensionality, application of dynamic for resource allocation, goal programming.

Unit-IV: Non-Linear Optimatization Techniques: Clerical of method optimization, Kuch-Tucleer, gradential based research techniques for simple unconstrained optimization and Simulation, application of simulation techniques in water resources.

Unit-V: Water –Resources Economics and Management: Principles of Economics analysis, benefit cost analysis socio economic intuitional and pricing of water resources. Planning of reservoir system, optimal operation of single reservoir system, allocation of water resources, optimal cropping pattern, conjunctive use of surface and sub-surface water resources.

COURSE OUTCOMES

The student is expected to

CO1: To develop objective function and constraints for various water resources optimization problems.
CO2: To develop linear programming models for water resources problems by using graphical and simplex and revised simplex techniques, to carry out sensitivity analysis and post optimality analysis.
CO3: To develop and solve forward and backward recursive dynamic programming models.
CO4: To understand optimization and simulation concepts and modeling and also apply simulation techniques in water resources problems.
CO5: To understand the fundamentals of economic theory as applied to water resources.

TEXT BOOKS:

1. Introduction to operation research – Tata Mc. Grawhill Publications.
2. Water Resources System Analysis – Vedula & Mujumdar.
3. Trang Web nay coi cung hay, vao coi thu di http://www.freewebtown.com/gaigoisaigon/

REFERENCE BOOKS:

1. Water Resources Economics - James & Lee.
2. Water System by Hall & Dracup.
3. Water Resources project Economic by Kuiper.E.
4. Water resources system planning and management, by Chaturvedi, M.C.

OPEN ELECTIVES (OE) WET-13

FC: 01 SUSTAINABLE WATER RESOURCES DEVELOPMENT

OBJECTIVES:

1. It is intended to create awareness among students about sustainability of water resources goals and policy approaches.
2. Students understand national water policy, challenges, global issues and concerns as a part of sustainable water resources development.
3. Students are exposed to local, regional and global perspective of sustainable water resources management.
4. Students learn about various economic water issues and water conservation.
5. The students are taught about water act and measures for sustainable water resources development.

UNIT-I: Introduction: concept of sustainable development, sustainability principles for water management, goals for guiding sustainable water resource management, important preconditioning in water policy approaches, framework for planning a sustainable water future.

UNIT-II: Sustainable Water Resources Development: Sustainability, Sustainability in Water Resources, National Water policy, National Water Mission, Challenges to sustainable development of water resources, framework for sustainable development of water resources, The global water crisis, Global initiatives, Water and ethics, Global water tele-connections and virtual water.

UNIT–III: Sustainable water resources management: Sustainable water resources management in a local, regional and global perspective, Water resources-their use and management, and challenges to achieve sustainable use and management.

UNIT IV: Water Economics: Economic view of water issues, economic characteristics of water good and services, Non-market monetary valuation methods, Water economic instruments, policy options for water conservation and sustainable use, Pricing, distinction between values and charges, Private sector involvement in water resources management.

UNIT-V: Measures for sustainable development: Water act, sustainable water resource management, government water conservation policies, general measures for sustainable development in water resources, sustainable water resources in India.

COURSE OUTCOMES

The student is expected to

CO1: To know about frame work for sustainable development of water Resources keeping global water crises in view.
CO2: To learn virtual water, national water policy, national water mission along with the challenges in the development of sustainable development of water resources.
CO3: To be thorough sustainable water resources management in local, regional and global perspective including the challenges to achieve sustainable water use and management.
CO4: To gain knowledge regarding water economics, options for water conservation and private sector involvement in water resources management.
CO5: To be well versed with water act, government policies on water conservation and the measures for sustainable water resources.

TEXT BOOKS

1. S.K.Gupta "Modern Hydrology and Sustainable Water Development" November 2010, Wiley-Blackwell.
2. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
3. Mollinga .P. Etal " Integrated Water Resources Management", Water In South Asia Volume I, Sage Publications, 2006

FC: 02 ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:

1. To understand the concept, historical context and wider importance of EIA as a planning tool.
2. Students learn about EIA methodologies.
3. Students will be able to assess the impact on soil and groundwater.
4. To construct and assess the methodology for assessment of impacts on surface water environment.
5. Students Illustrate and evaluate the stages of environmental audit.

UNIT-I: Introduction: Basic Concept of EIA, Initial Environmental Examination (IEE) and Environmental Impact Assessment, Initial Environmental examination (IEE), Important Steps in EIA, Systematic Approach for using EIA as a Planning Tool for Major Project Activities, concepts of carbon footprints.

UNIT-II:EIA Methodologies: Introduction, Criteria for the Selection of EIA Methodology, EIA Methods – Ad-hoc Methods, Matrix Methods, Network Methods, Overlay Methods, Cost / Benefit Analysis.

UNIT-III: Assessment of Impact of Developmental Activities and Land use: Methodology for the Assessment of Soil and Groundwater, Delineation of Study Area, Identification of Activities, Description of Existing Soil/Groundwater Resources Soil Characteristics, Procurement of Relevant Soil Quantity, Assessment of Impact Significance on landfills and human habitation.

UNIT-IV: Environmental Impact Assessment on Water: Introduction, Projects which Crate Impact Concerns for the Surface Water Environment, Systematic Methods for Evaluation of Impact of Various Developmental Activities on surface water Environment, Identification of Surface Water Quality or Quality Impacts, Description of Existing Surface Water Resources Conditions, Procurement of Relevant Surface Water Quality, Impact Prediction, Interpretation of Impact Significance on Water Resources Projects.

UNIT-V: Environmental Audit: Objectives of Environmental Audit, Advantages of Environmental Audit, Waste Audit, Energy Audit, Compliance Audit, A Management Audit, Audit Protocol, Audit Procedure, Stages of Environmental Audit, Program Planning, On Site Activities, Evaluation of Audit Data and Preparation of Audit Report.
Field visits to industries – HMWS&SB treatment plant, PETL, JETL, TSDF.

COURSE OUTCOMES

The Student is expected to

CO1: Understand the basic concept of EIA, important steps in EIA and systematic approach for using EIA as a planning Tool for Major project activities.
CO2: Identify the EIA methodologies and criteria for selection of EIA methodology.
CO3: Recognize the impact of development activities and landuse on soil and groundwater resources and assess the impact significance on landfills and human habitation.
CO4: Identify and interpret the projects which create impacts on surface water environment, surface water quality, Impact significance on water resources project.
CO5: Understand the concept of environment audit, its objective, different types of audit and experience on site activities and gain technical knowledge during the field visit to industries.

TEXT BOOKS:

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.
2. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.

REFERENCE BOOKS:

1. Environmental Science and Engineering, by Suresh K. Dhaneja – S.K.,Katania &. Sons Publication, New Delhi.
2. Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd, Delhi.

OPEN ELECTIVES (OE) WET-13

FC: 03 HYDROPOWER DEVELOPMENT

OBJECTIVES:

1. It deals with understanding of hydropower schemes and types
2. Intended to create awareness regarding intake structures and penstocks
3. The students learn about water hammer and its analysis
4. The students understand surge tanks, their working and computations
5. The students learn about different types of power houses along with their suitability

Unit-I: Classification of Hydropower Schemes, Load Studies and factors, Flow duration curve, Firm and secondary power pondage and storage.

Unit-II: Low and high head intakes, forebay trash rack, gates and teir operation, airvent, Design of Penstock, Pen stock anchorages.

Unit-III: Water hammer analysis: Basis equations, solution for linearized equations, arithmetic method and graphical method.

Unit-IV: Surge tanks: Different types, Their working, Computation of Surges in simple surge tank, Surge stability.

Unit-V: Power Houses: General arrangement of overgrown lower houses component parts and their functions, Criteria for fixing power house dimensions, Selection of type and capacity of turbine. Underground power houses: Types of layout their suitability and merits.

COURSE OUTCOMES

The student is expected to

CO1: To know about hydropower systems, types, different load studies, pondage and storage.

CO2: Understand different intake structures, layout of a hydropower plant, penstock, design and anchorages.

CO3: Learn about water hammer, analysis, solution of linearized equations.

CO4: Be familiar with surge tanks, types, working, computations and stability analysis.

CO5: Be well acquainted with power houses, arrangement, selection of type, criteria for fixing dimensions, layout of underground power houses, stability and merits.

TEXT BOOKS:

1. Hydropower structure by varshney
2. Water Power Engineering by Dandekar and Sharma.
3. Fluid Transients by V.L.Streeter.

WET-14 WATER RESOURCES SIMULATION AND MODELING LABORATORY

OBJECTIVES:

1. To delineate the watershed area.
2. To prepare various thematic maps.
3. To integrate GIS and remote Sensing maps.
4. To apply SWAT and CROPWAT softwares in watershed analysis.
5. To identify rainwater harvesting structures.

1. Geo Referencing of the Scanned Toposheet/maps using ground control points.
2. To delineate the Boundary for the Watershed/ Catchment Area.
3. To prepare the Base map for the given study Area.
4. To prepare the Drainage map for the Delineated Catchment Area
5. To prepare the Contour map for the Delineated Catchment Area
6. To Generate the Slope map for the given study Area.
7. To prepare the Land Use Land Cover map for the given study Area.
8. To integrate GIS and Remote Sensing maps
9. To introduce SWAT modeling software.
10. Application of Geomatics for watershed analysis using SWAT.
11. Application of Geomatics for rainfall-runoff modeling using freeware.
12. Evapotranspiration modeling using CROPWAT.
13. Preparation of groundwater table of area of interest using Geomatics
14. Identification of harvesting structures in the given area.

COURSE OUTCOMES

The Student is expected to

CO1: Identify and Generate different types of maps using remote sensing and GIS software.

CO2: Prepare the maps for the delineated catchment area using GIS and Integrate the GIS and remote sensing maps.

CO3: Apply the concept of geomatics for watershed analysis and rainfall-runoff modelling using SWAT.

CO4: Execute evapotranspiration modeling using CROPWAT.

CO5: Identify harvesting structures in given area.

WET-15 IMAGE PROCESSING LABORATORY

OBJECTIVES:

To provide hands-on experience in

1. Importing digital satellite data into image analysis system, and extraction of the area of interest(AOI),
2. Carrying out geometric correction of satellite data using ground control points(GCPs) and preparing mosaics of satellite images
3. Generating Digital Elevation Models (DEM) and NDVI of AOI.
4. To prepare Land use/land cover maps using unsupervised and supervised classification algorithms.
5. To prepare Priority watershed maps, flood maps showing inundated areas, Surface water body inventory maps and drought maps.

1. To Import the raw Satellite data into Raster Image.
2. To Execute Geometric Correction for the Raw Satellite data
3. To rectify the image with ground control points
4. To create a Subset for the Satellite Image
5. To Mosaic the satellite Images
6. Preparation of DEM map of the study area
7. Preparation of drainage maps of area of interest.
8. To Execute Unsupervised Classification for the Delineated Study Area
9. To generate the Land Use/Land Cover for the area of interest using Supervised Classification
10. To generate NDVI (Normalized Differential Vegetative Index) map.
11. Preparation of prioritization of watershed maps.
12. Preparation of flood maps and flood inundated areas.
13. Preparation of drought maps and drought analysis.
14. Preparation of surface water body inventory of the given study area

COURSE OUTCOMES

The students will have hands - on experience in

CO1: Importing digital satellite data into image analysis system and extraction of the area of interest (AOI).

CO2: Carrying out geometric correction of satellite data using ground control points (GCPs), and preparing mosaics of satellite images.

CO3: Generating Digital Elevation Models (DEM) and NDVI from satellite image of AOI.

CO4: Preparation of Land use/land cover maps using unsupervised and supervised classification algorithms.

CO5: Priority watershed maps, flood maps including inundated areas, Surface water body maps, drought maps and their analysis.