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:

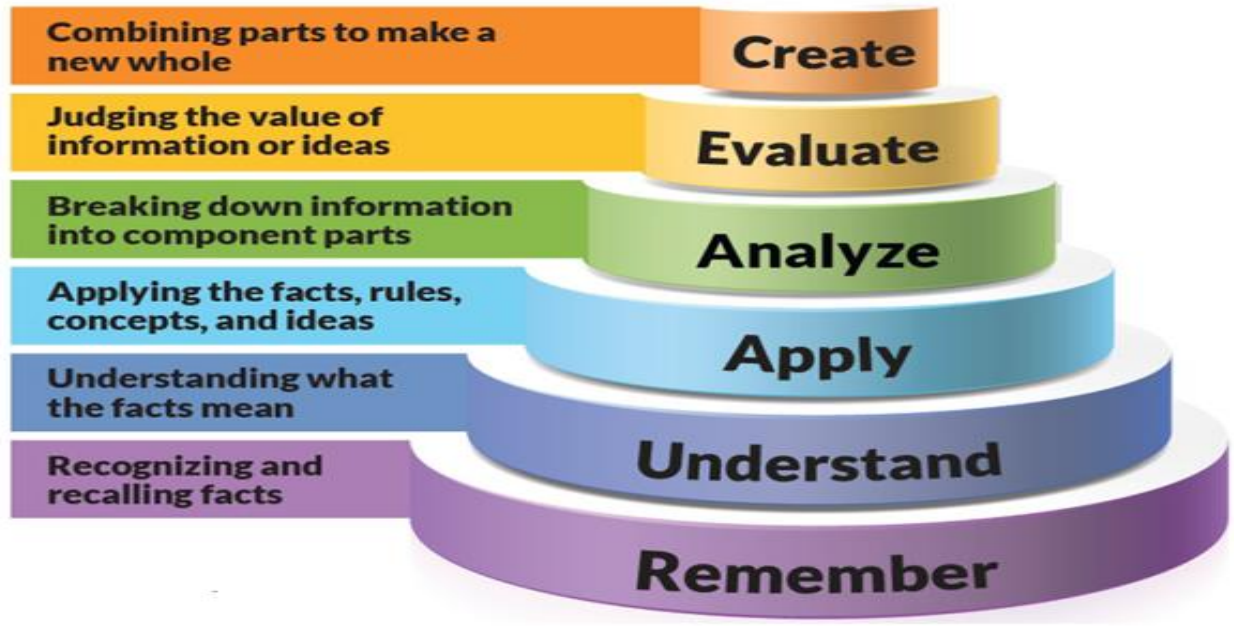
PEO1: To prepare the students as one of the problems solving engineers/technologists in water, land and environmental fields.

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 an Act No.30 of 2008 of A.P. State Legislature)
Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)

R 15 - ACADEMIC REGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES

Applicable for the students of M. Tech. (Regular) programme from the Academic Year ***2015-16*** and onwards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. Tech. DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work, failing which he shall forfeit his seat in M. Tech. programme.

2.2 The student shall register for all 88 credits and secure all the 88 credits.

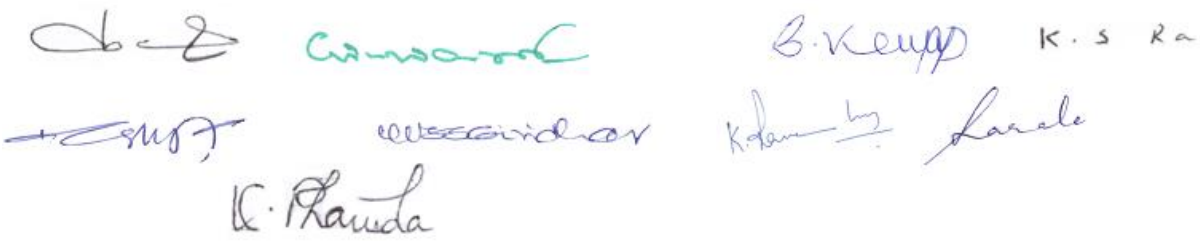
2.3 The minimum instruction days in each semester are 90.

3.0 COURSES OF STUDY

The following specializations are offered at present for the M. Tech. programme of study.

1. Advanced Manufacturing Systems
2. Aerospace Engineering/ Aeronautical Engineering
3. Automation
4. Biomedical Signal Processing and Instrumentation
5. Bio-Technology
6. CAD/CAM
7. Chemical Engineering
8. Communication Systems
9. Computer Networks

10. Computer Networks and Information Security
11. Computer Science
12. Computer Science and Engineering
13. Computers and Communication Engineering.
14. Construction Management
15. Control Engineering
16. Control Systems
17. Cyber Forensic / Cyber Security & Information Technology
18. Design for Manufacturing/ Design and Manufacturing
19. Digital Electronics and Communication Engineering.
20. Digital Electronics and Communication Systems
21. Digital Systems and Computer Electronics
22. Electrical Power Engineering
23. Electrical Power Systems
24. Electronics & Instrumentation
25. Electronics and Communication Engineering
26. Embedded Systems
27. Embedded Systems and VLSI Design
28. Energy Systems
29. Engineering Design
30. Environmental Engineering
31. Geoinformatics and Surveying Technology
32. Geotechnical Engineering.
33. Heating Ventilation & Air Conditioning.
34. Highway Engineering
35. Image Processing
36. Industrial Engineering and Management
37. Information Technology
38. Infrastructure Engineering
39. Machine Design
40. Mechatronics.
41. Microwave & Radar Engineering
42. Nano Technology
43. Neural Networks
44. Parallel Computing
45. Power and Industrial Drives
46. Power Electronics
47. Power Electronics and Electrical Drives
48. Power Engineering and Energy Systems
49. Power Plant Engineering & Energy Management
50. Power System Control and Automation
51. Power System with Emphasis H.V. Engineering / H.V. Engineering
52. Production Engineering.
53. Real Time Systems
54. Software Engineering
55. Structural Engineering
56. Systems & Signal Processing
57. Thermal Engineering.
58. Transportation Engineering
59. VLSI
60. VLSI and Embedded System/ Electronics Design Technology
61. VLSI Design



62. VLSI System Design
63. Web Technologies
64. Wireless and Mobile Communication

and any other programme as approved by the University from time to time.

3.1 Departments offering M. Tech. Programmes with specializations are noted below:

Civil Engg.	Construction Management Environmental Engineering Geoinformatics and Surveying Technology Geotechnical Engineering Highway Engineering Infrastructure Engineering Structural Engineering Transportation Engineering
EEE	Control Engineering Control Systems Electrical Power Engineering Electrical Power Systems Power and Industrial Drives Power Electronics Power Electronics and Electrical Drives Power Engineering and Energy Systems Power Plant Engineering & Energy Management Power System Control and Automation Power System with Emphasis H.V. Engineering / H.V. Engineering
ME	Energy Systems Engineering Design Heating Ventilation & Air Conditioning Machine Design Power Plant Engineering & Energy Management Thermal Engineering.
ME (Manufacturing)	Advanced Manufacturing Systems Automation CAD/CAM Design for Manufacturing/ Design and Manufacturing Industrial Engineering and Management Production Engineering
ME (MECHATRONICS)	Mechatronics.
BME & EIE	Biomedical Signal Processing and Instrumentation Electronics & Instrumentation
ECE	Communication Systems Computers and Communication Engineering. Digital Electronics and Communication Engineering. Digital Electronics and Communication Systems Digital Systems and Computer Electronics Electronics and Communication Engineering Embedded Systems Embedded Systems and VLSI Design Microwave & Radar Engineering

	Systems & Signal Processing VLSI VLSI and Embedded System/ Electronics Design Technology VLSI Design VLSI System Design Wireless and Mobile Communication
CSE	Computer Networks Computer Networks and Information Security Computer Science Computer Science and Engineering Cyber Forensic / Cyber Security & Information Technology Image Processing Information Technology Neural Networks Parallel Computing Real Time Systems Software Engineering Web Technologies
Aeronautical Engg.	Aerospace Engineering
Bio-technology	Bio-Technology
Chemical Engg.	Chemical Engineering
Nano Technology	Nano Technology

4 Course Registration

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him 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 Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of classwork 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 will also not be considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. 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 ATTENDANCE

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

5.1 Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if his attendance is less than 75%.

5.2 Condonation of shortage of attendance in each subject up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

5.3 Shortage of Attendance below 65% in each subject shall not be condoned.

5.4 Students whose shortage of attendance is not condoned in any subject are not eligible to write their end semester examination of that subject and their registration shall stand cancelled.

5.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

5.6 A Candidate shall put in a minimum required attendance at least three (3) theory subjects in I Year I semester for promoting to I Year II Semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

5.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

6 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1 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 instructions. Each mid-term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (10 marks) consisting of 5 sub-questions carrying 2 marks each, and Part B with 3 questions to be answered out of 5 questions, each question carrying 5 marks. The details of the Question Paper pattern for 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 a compulsory question consisting of 5 questions, one from each unit and carries 5 marks each.
- Part-B to be answered 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered.

6.2 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.

6.3 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 the same to be informed to the Director of Evaluation in 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.

6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

6.5 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the students' 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 consisting of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Director of Evaluation. For this, the Principal of the College shall submit a panel of 3 examiners. There are no internal marks for the Comprehensive Viva-Voce and evaluates for maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

6.6 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the Semester End Examination and a minimum aggregate of 50% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.

6.7 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to reappear for the Semester End Examination in that subject.

6.8 A candidate shall be given one chance to re-register for the subjects if the internal

marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.

6.9 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the Semester End Examination in that subject. He shall re-register for the subject when next offered.

7 Examinations and Assessment - The Grading System

7.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

7.2 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 (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
80% and above (≥ 80% , ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (≥ 70% , < 80%)	A^+ (Excellent)	9
Below 70% but not less than 60% (≥ 60% , < 70%)	A (Very Good)	8
Below 60% but not less than 55% (≥ 55% , < 60%)	B^+ (Good)	7
Below 55% but not less than 50% (≥ 50% , < 55%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

7.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

7.4 A student not appeared for examination then 'Ab' Grade will be allocated in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered.

7.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.

7.6 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'.

7.7 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

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

7.9 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

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

where 'i' is the Subject indicator index (takes 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.

7.10 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

CGPA = $\{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \}$ ... 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' from the 1st Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes 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.

7.11 For Calculations listed in Item 7.6 – 7.10, 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.

8. EVALUATION OF PROJECT/DISSERTATION WORK

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

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

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

8.3 After satisfying 8.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

8.4 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.

8.5 A candidate shall submit his project status report in two stages at least with a gap of 3 months between them.

8.6 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 registration 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.

8.7 After approval from the PRC, the soft copy of the thesis should be submitted to the University for ANTI-PLAGIARISM for the quality check and the plagiarism report should be included in the final thesis. If the copied information is less than 24%, then only thesis will be accepted for submission.

8.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

8.9 For Project work Review I in II Year I Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review I. If he fails to fulfill minimum marks, he has to reappear during the supplementary examination.

8.10 For Project work Review II in II Year II Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The PRC will examine the overall progress of the Project Work and decide the Project is eligible for final submission or not. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review II. If he fails to fulfill minimum marks, he has to reappear during the supplementary examination.

8.11 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external marks of 150 and the same evaluated by the External examiner appointed by the University. The

candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

8.12 If he fails to fulfill as specified in 8.11, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.

8.13 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 3 examiners, eminent in that field, with the help of the guide concerned and Head of the Department.

8.14 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.

8.15 If the report of the examiner is favourable, 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.

8.16 The Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination.

9. AWARD OF DEGREE AND CLASS

9.1 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 $\geq$ 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 specialization as he admitted.

9.2 **Award of Class**

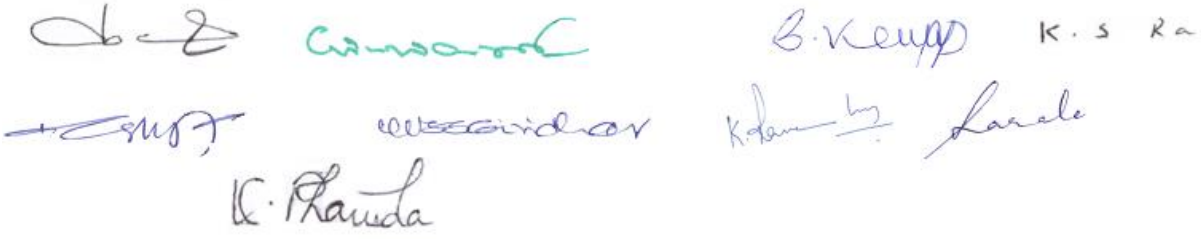
After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

Class Awarded	CGPA
First Class with Distinction	$\geq$ 7.75
First Class	6.75 $\leq$ CGPA < 7.75
Second Class	6.00 $\leq$ CGPA < 6.75

9.3 A student with final CGPA (at the end of the PGP) < 6.00 will not be eligible for the Award of Degree.

10. 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 of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.



11. TRANSITORY REGULATIONS

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier or equivalent subjects at a time as and when offered.

11.2 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 R15 Academic Regulations.

12 GENERAL

12.1 **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.

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

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

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

12.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

12.6 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.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	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 of 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. In case 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 of 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 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	In case 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.

	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 part thereof 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 clause 6 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 clauses 1 to 11 shall 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-15 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
WET-04	Environmental Chemistry and Microbiology	25	75	4	--	4
FOUNDATION COURSE (FC)						
WET-05	Hydraulic Structures Applied Statistical Methods Water Supply and Treatment Technologies	25	75	4	--	4
OPEN ELECTIVE (OE)						
WET-06	Geo-Physical Exploration and Watershed Management River Basin Management Air pollution and Control Technologies	25	75	4	--	4
LABORATORY						
WET-07	Environmental Laboratory	25	75	--	6	3
WET-08	Seminar –I	50	--	--	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	Water Resources System Analysis	25	75	4	--	4
WET-12	Advanced Wastewater Treatment Technologies	25	75	4	--	4
FOUNDATION COURSE (FC)						
WET-13	Fluvial Hydraulics Solid and Hazardous Waste Management Urban Hydrology	25	75	4	--	4
OPEN ELECTIVE (OE)						
WET-14	Sustainable Water Resources Development Environmental Impact Assessment Hydropower Development	25	75	4	--	4
LABORATORY						
WET-15	Computational Water Resources Laboratory	25	75	--	6	3
WET-16	Seminar – II	50	--	--	6	2
Total credits:				**24**	**8**	**28**

SECOND YEAR

THIRD SEMESTER

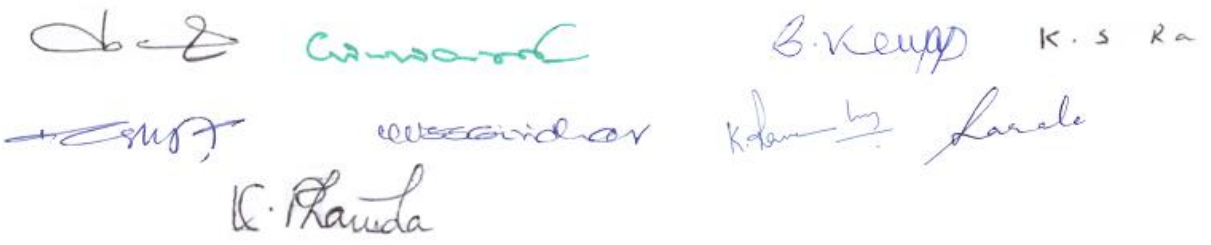
SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
WET-17	Comprehensive Viva-Voice	--	100	--	--	4
WET-18	Project work Review – I	50	--	--	24	12
	Total				**24**	**16**

FOURTH SEMESTER

SUBJECT CODE	Name of the course	Int. Marks	Ext. Marks	L	P	C
WET-19	Project work review-II	50	--	--	8	4
WET-20	Project Evaluation (Viva-Voce)	--	150	--	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.

CORE COURSE (FC) WET-04

CC: 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.

FOUNDATION COURSE (FC) WET-05

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 andsafety 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-05

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-05

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.

OPEN ELECTIVES (OE) WET-06

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 identify groundwater by using various geophysical techniques.
3. To know the construction of various water wells.
4. To learn design, development and completion of water wells.
5. To know the various watershed 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-06

OE: 2 RIVER BASIN MANAGEMENT

OBJECTIVES:

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-06

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-07 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.

SECOND SEMESTER

CORE COURSE (CC) WET- 09

CC 01: 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

CC 02: IRRIGATION MANAGEMENT

OBJECTIVES:

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

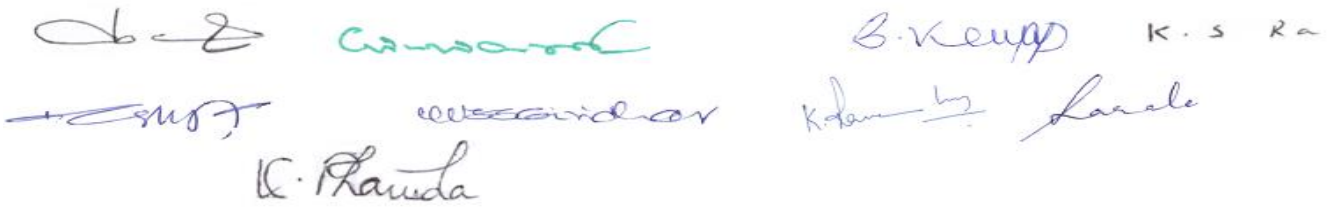
CO1: Understanding irrigation development in India and soil water plant relationships.
CO2: Estimation of crop water requirements.
CO3: Application of various irrigation methods and their design.
CO4: Determining of land leveling for irrigation and design of surface and subsurface field water conveyance.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

CC 03: 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

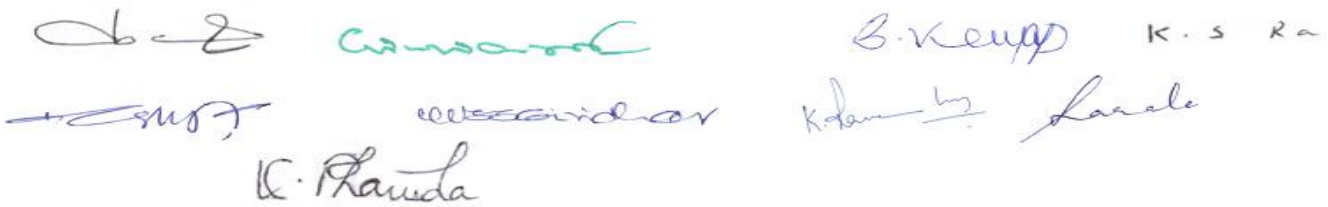
CO1: To develop objective function and constraints for various water resources optimization problems.
CO2: To develop linear programming models for water resources problems by using graphical and simplex and revised simplex techniques, to carry out sensitivity analysis and post optimality analysis.
CO3: 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.



CORE COURSE (CC) WET- 12
CC 04: 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- 13

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- 13

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, its 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.

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”.

OPEN ELECTIVES (OE) WET-14

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.

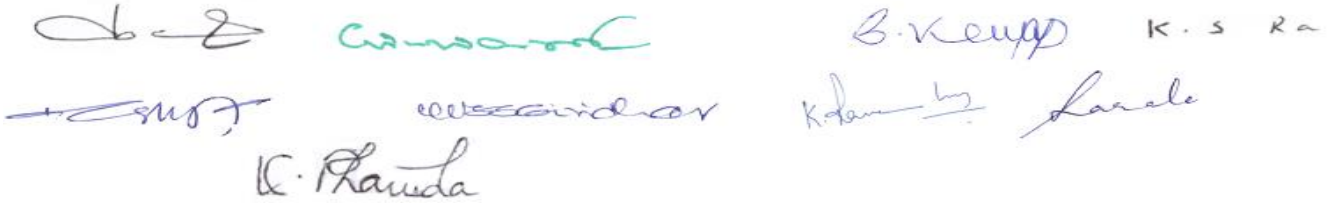
COURSE OUTCOMES

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-14

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-15 COMPUTATIONAL WATER RESOURCES LABORATORY

OBJECTIVES:

1. To identify ground water by using Electrical Resistivity and Seismic Methods.
2. To identify various layers of the subsurface using well lagging techniques.
3. To calibrate the discharges by various measuring devices.
4. To prepare various thematic maps.
5. To integrate various thematic maps by applying GIS softwares.

1. Geophysical Prospecting for Ground Water with Electrical Resistivity and Seismic Methods.
2. Geophysical Prospecting with Magnetic and Electromagnetic methods
3. Well-Logging techniques in Resource Evaluation
4. Ground water modeling using MODFLOW Software
5. Pumping tests in evaluation of T & S
6. Calibration of discharges with Triangular and Rectangular Notches and Weirs in Open channels
7. Calibration of Venturi meter, Orifice meter, Venturi flume and Parshal flume
8. Preparation of Thematic Maps using SOI Topo Sheets and Satellite Imageries.
9. Preparation of Base Map.
10. Preparation of Contour Map.
11. Preparation of Drainage Map.
12. Preparation of Slope Map.
13. Preparation of Land Use and Land Cover Maps.
14. Digitization of Various Thematic Maps.
15. Integration and Application of GIS software's like Arc GIS 9.1, ILWIS and ERDAS.

COURSE OUTCOMES

The Student is expected to

CO1: Exploring the ground water using electrical resistivity methods, seismic methods
CO2: Determination of aquifer characters using pumping tests and calibrating the discharges by various measuring devices
CO3: Identify and Generate different types of maps using remote sensing and GIS softwares.
CO4: Prepare the maps for the delineated catchment area using GIS and Integrate the GIS and remote sensing maps.
CO5: Apply the concept of geomatics for watershed analysis and rainfall-runoff modelling