ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABUS

M.TECH (WATER AND ENVIRONMENTAL TECHNOLOGY)

(Effective for the students admitted from academic year 2022-2023 onwards)

CENTRE FOR WATER RESOURCES

UNIVERSITY COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY, HYDERABAD
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

Kukatpally, Hyderabad, Telangana State, INDIA-500085.

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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

JNTUH UNIVERSITY COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY, HYDERABAD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
Kukatpally, Hyderabad – 500085

ACADEMIC REGULATIONS 2022 (R22)
Under Choice Based Credit System (CBCS)
For
M.TECH (Regular) Programme

1.0 Post-Graduate Degree Programmes in Engineering & Technology (PGP in E & T) Jawaharlal Nehru Technological University Hyderabad - University College of Engineering Hyderabad (JNTUH UCEH) offers **Tw**o Years (**Four** Semesters) full-time Master of Technology (M. Tech.) Degree Programme, under Choice Based Credit System (CBCS) in different specializations with effect from the academic year **2022-23.**

Eligibility for Admissions

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

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

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

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

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

The two-year M. Tech. program consists of **68** credits and the student has to register for all 68 credits and earn all 68 credits for the award of M. Tech. degree. There is **NO** exemption of credits in any case.

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

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

Semester Scheme

Each Semester shall have 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' and 'COURSE' imply the same meaning here and refer to 'Theory Subject', or 'Lab Course', or 'Design/Drawing Subject', or' Mini Project with Seminar', or 'Dissertation', as the case may be.

Credit Courses

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

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

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations and mandatory courses **(Non-credit Audit Courses)** will not carry any credits.

Subject Course Classification

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

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Core Courses (CoC)	PC- Professional Core	Includes subjects related to the parent discipline/department/ branch of Engineering
		Dissertation	M. Tech. Project or PG Project or Major Project
		Mini Project with Seminar	Seminar based on core contents related to Parent Discipline/ Department/ Branch of Engineering
2	Elective Courses (EtE)	PE - Professional Electives	Includes elective subjects related to the parent discipline/department/branch of Engineering
		OE - Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/department/ branch of Engineering

3	***Mandatory Courses***	--	***Non-Credit Audit Courses***

Course Registration

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

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

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).

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.

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

Attendance Requirements

The M.Tech programmes are offered based on a unit system with each subject being considered a unit. Attendance is calculated separately for each subject.

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

A student's Seminar report and presentation on Mini Project shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar presentation classes on Mini Project during that Semester.

Condoning of shortage of attendance (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and Medical grounds) in each subject (Theory/Lab/Mini Project with Seminar) of a semester shall be granted by the College Academic Committee on genuine reasons.

A prescribed fee per subject shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain relevant documents along with the request from the student.

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

A Student, whose shortage of attendance is not condoned in any Subject(s) (Theory/Lab/Mini Project with Seminar) in any Semester, is considered as 'Detained in that Subject(s), and is not eligible to write Semester End Examination(s) of such Subject(s), (in case of Mini Project with Seminar, his/her Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he/she has to seek re-registration for those Subject(s) in subsequent Semesters, and attend the same as and when offered.

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

a) A student shall put in a minimum required attendance in at least **three theory subjects (excluding mandatory (non-credit audit) course)** in first Year I semester for promotion to first Year II Semester.

b) A student shall put in a minimum required attendance in at least **three theory subjects (excluding mandatory (non-credit audit) course)** in first Year II semester for promotion to second Year I Semester.

Academic Requirements

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

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course, if he secures not less than:

- 40% of Marks (24 out of 60 marks) in the Semester End Examination;
- 40% of Marks in the internal examinations (16 out of 40 marks allotted for CIE); and
- A minimum of 50% of marks in the sum total of CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades this implies securing 'B' Grade or above in a subject.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Mini Project with seminar, if student secures not less than 50% marks (i.e. 50 out of 100 allotted marks). The student would be treated as failed, if student (i) does not submit a seminar report on Mini Project or does not make a presentation of the same before the evaluation committee as per schedule

or (ii) secures less than 50% marks in Mini Project with seminar evaluation. The failed student shall reappear for the above evaluation when the notification for supplementary examination is issued.

A student shall register for all subjects for total of **68** credits as specified and listed in the course structure for the chosen specialization, put in the required attendance and fulfill the academic requirements for securing 68 credits obtaining a minimum of **'B'** Grade or above in each subject, and all 68 credits securing Semester Grade Point Average **(SGPA) ≥ 6.0** (in each semester) and final Cumulative Grade Point Average **(CGPA)** (i.e., CGPA at the end of PGP) **≥ 6.0,** and shall pass all the mandatory Audit Courses to complete the PGP successfully.

Note: (1) The SGPA will be computed and printed on the marks memo only if the candidate passes in all the subjects offered and gets minimum B grade in all the subjects.
(2) CGPA is calculated only when the candidate passes in all the subjects offered in all the semesters

Marks and Letter Grades obtained in all those subjects covering the above specified 68 credits alone shall be considered for the calculation of final CGPA, which will be indicated in the Grade Card /Marks Memo of second year second semester.

If a student registers for extra subject(s) (in the parent department or other departments/ branches of Engineering) other than those listed subjects totaling to **68** credits as specified in the course structure, the performance in extra subject(s) (although evaluated and graded using the same procedure as that of the required 68 credits) will not be considered while calculating the SGPA and CGPA. For such extra subject(s) registered, percentage of marks and Letter Grade alone will be indicated in the Grade Card/Marks Memo, as a performance measure, subject to completion of the attendance and academic requirements as stated in items 5 and 6.1 - 6.3.

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

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

6. 8 A Student who fails to earn **68** credits as per the specified course structure, and as indicated above, within four academic years from the date of commencement of his first year first semester, shall forfeit his seat in M. Tech. programme and his admission **shall stand cancelled**.

Evaluation - Distribution and Weightage of Marks

The performance of a student in each semester shall be evaluated subject- wise (irrespective of credits assigned) for a maximum of 100 marks.

The performance of a student in every subject/course (including practicals and Project) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid-Term Examinations conducted, first Mid-Term examinations in the middle of the Semester and second Mid-Term examinations during the last week of instruction.

In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each mid- Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid-Term Examination for 30 marks:

    a. Part - A: Objective/quiz paper for 10 marks.

    b. Part – B: Descriptive paper for 20 marks.

The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks. The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The average of the two Mid Term Examinations shall be taken as the final marks for Mid Term Examination (for 30 marks).

The remaining 10 marks of Continuous Internal Assessment (out of 40) are distributed as:

2. Assignment for 5 marks. (Average of 2 Assignments each for 5 marks)

3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks before II Mid-Term Examination.

- The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores $\geq$ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled in spite of appearing the SEE.

The details of the end semester question paper pattern are as follows:

The Semester End Examinations (SEE), for theory subjects, will be conducted for 60 marks consisting of two parts viz. i) Part- A for 10 marks, ii) Part - B for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from each unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
- The duration of Semester End Examination is 3 hours.

For practical subjects there shall be a **Continuous Internal Evaluation (CIE)** during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marks for internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. 10 marks for viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

The Semester End laboratory Examination is held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

- The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled in spite of appearing the SEE.

For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Principal, on submission of panel of examiners by the HOD.

There shall be Mini Project with Seminar during I year II semester for internal evaluation of 100 marks. The Departmental Academic Committee (DAC) will review the progress of the mini project during the seminar presentations and evaluate the same for 50 marks. Mini Project Viva Voce will be evaluated by the DAC for another 50 marks before the semester end examinations. Student shall carryout the mini project in consultation with the mini project supervisor which may include critically reviewing the literature, project implementation and submit it to the department in the form of a report and shall make an oral presentation before the DAC consisting of Head of the Department, Mini Project supervisor and two other senior faculty members of the department. The student has to secure a minimum of 50% of marks in i) seminar presentation and ii) mini project viva voce, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when scheduled.

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

A Dissertation Review Committee (DRC) shall be constituted with the Head of the Department as Chairperson, Dissertation Supervisor and one senior faculty member of the Department.

Registration of Dissertation Work: A candidate is permitted to register for the Dissertation Work after satisfying the attendance requirement in all the subjects, both theory and laboratory.

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

If a candidate wishes to change his supervisor or topic of the Dissertation, he can do so with the approval of the DRC. However, the DRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of Dissertation 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.

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

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

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

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

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

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

Three copies of the Dissertation Thesis certified by the supervisor shall be submitted to the Department, after submission of a research paper related to the Dissertation work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.

The thesis shall be adjudicated by an external examiner selected by the Principal. For this, the HOD shall submit a panel of three examiners.

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

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

If he fails to fulfill the requirements as specified in 7.21, he will reappear for the Dissertation Viva-Voce examination **only after three months.** In the reappeared examination also, if he fails to fulfill the

requirements, he will not be eligible for the award of the degree, unless he is asked to revise and resubmit his Dissertation Work by the board within a specified time period (within four years from the date of commencement of his first year first semester).

The Dissertation Viva-Voce External examination marks must be submitted to the College Examination branch on the day of the examination.

For mandatory non-credit Audit courses, a student has to secure 40 marks out of 100 marks (i.e.40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. These marks should also be uploaded along with the internal marks of other subjects.

No marks or letter grades shall be allotted for mandatory non-credit Audit Courses. Only Pass/Fail shall be indicated in Grade Card.

Re-Admission/Re-Registration

Re-Admission for Discontinued Student

A student, who has discontinued the M. Tech. degree programme due to any reason whatsoever, may be considered for **'readmission'** into the same degree programme (with the same specialization) with the academic regulations of the batch into which he gets readmitted, with prior permission from the authorities concerned, subject to item 6.6.

If a student is detained in a subject (s) due to shortage of attendance in any semester, he may be permitted to **re-register** for the same subject(s) in the same category (core or elective group) or equivalent subject, if the same subject is not available, as suggested by the Board of Studies of that department, as and when offered in the subsequent semester(s), with the academic regulations of the batch into which he seeks re-registration, with prior permission from the authorities concerned, subject to item 3.2

A candidate shall be given only one-time chance to re-register and attend the classes for a maximum of two subjects in a semester, if the internal marks secured by a candidate are less than40% and failed in those subjects but fulfilled the attendance requirement. A candidate must re-register for failed subjects within four weeks of commencement of the class work, in the next academic year and secure the required minimum attendance. In the event of the student taking this chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stand cancelled.

Examinations and Assessment - The Grading System

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

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

% of Marks Secured in a subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points

90% and above (> 90%, ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (>80%, <90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (>70%, <80%)	A (Very Good)	8
Below 70% but not less than 60% (>60%, <70%)	B^+ (Good)	7
Below 60% but not less than 50% (>50%, <60%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

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

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

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

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'.

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

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

The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (□CP) 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

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

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

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

$$\text{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ ... for all S Semesters registered}$$

(ie., up to and inclusive of S Semesters, S ≥ 2),

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

Illustration of calculation of SGPA

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

SGPA = 59/21 = 7.57

Illustration of calculation of CGPA

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

CGPA = 612/96 = 6.37

Award of Degree and Class

If a student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of 68 Credits (with CGPA ≥6.0), shall be declared to have 'QUALIFIED'

for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with the specialization that he was admitted into.

Award of Class

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

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

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

11.0 Withholding of Results

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

General

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.

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

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

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

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

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

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

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in- charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	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.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any par there of inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in 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.

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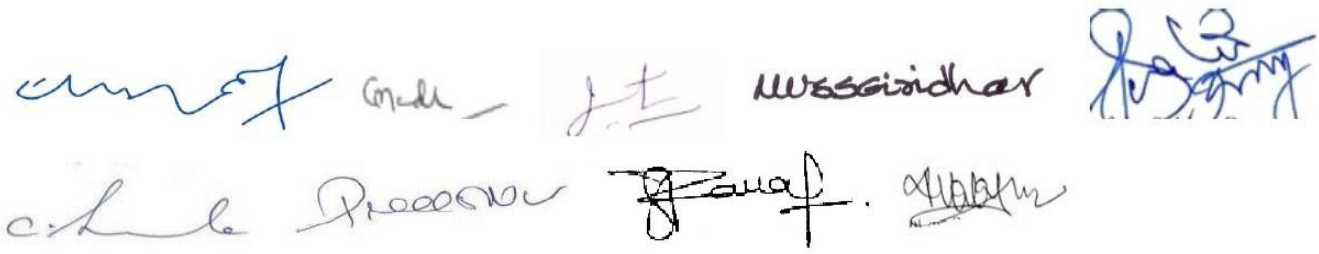
COURSE STRUCTURE

SEMESTER-I

Course Number	Subject	Scheme Of Studies Per Week			Credits	Internal Marks	External Marks
		L	T	P			
1WETPC01	**Program Core – I** Surface Water Hydrology	3	0	0	3	40	**60**
1WETPC02	**Program Core – II** Ground Water Hydrology	3	0	0	3	40	**60**
1WETPE03	**Program Electives- I** • Advanced Fluid Mechanics • Water Quality Modeling and Management • Finite Elements in Water Resources Engineering	3	0	0	3	40	**60**
1WETPE04	**Program Electives- II** • Water Resources Systems Analysis • River Basin Management • Water Distribution System • Industrial Waste Water Treatment • WEB GIS • Environmental Engineering-I	3	0	0	3	40	**60**
1A01	**Research Methodology & Intellectual Property Rights**	2	0	0	2	40	**60**
1A02	**Audit course-I**	2	0	0	0	0	**0**
1WETL05	**Lab- I** Hydraulics and Hydrology Laboratory	0	0	4	2	40	**60**
1WETL06	**Lab- II** Environmental Laboratory	0	0	4	2	40	**60**
TOTAL		**16**	**0**	**08**	**18**	**280**	**420**

SEMESTER-II

Course Number	Subject	Scheme Of Studies Per Week			Credits	Internal Marks	External Marks
		L	T	P			
2WETPC07	**Program Core – III** Geospatial Applications in Water Resources	3	0	0	3	40	**60**
2WETPC08	**Program Core – IV** • Irrigation Engineering	3	0	0	3	40	**60**
2WETPE09	**Program Electives- III** • Fluvial Hydraulics • Urban Hydrology • River Engineering • Environmental Impact Assessment	3	0	0	3	40	**60**
2WETPE10	**Program Electives- IV** • Sustainable Water Resources Development • Climate Change Adaptation and Mitigation • Environmental Engineering-II • Python Script Programming	3	0	0	3	40	**60**
2A03	**Audit Course-II**	2	0	0	0	00	**00**
2WETL11	**Lab- III** GIS and Image Processing Laboratory	0	0	4	2	40	**60**
2WETL12	**Lab - IV** Water Resources Modeling Laboratory	0	0	4	2	40	**60**
2WET13	**Mini project with Seminar**	2	0	0	2	40	**60**
TOTAL		**16**	**0**	**08**	**18**	**280**	**420**



SEMESTER-III

Course Number	Subject	Scheme Of Studies Per Week			Credits	Internal Marks	External Marks
		L	T	P			
3WETPE14	**Program Elective- V** • Application of Soft Computing Techniques • Advanced Numerical Methods • Municipal Solid Waste Management • Hydro Power Engineering • Micro Irrigation Technologies • Design of Hydraulic structures • WEB Development	**3**	**0**	**0**	**3**	40	**60**
3WETOE15	**Open Elective** • Business Analytics • Industrial Safety • Operations Research • Cost Management of Engineering Projects • Composite Materials • Waste to Energy • Environmental Statistics	**3**	**0**	**0**	**3**	40	**60**
	Dissertation – I						
	a) Dissertation Work Review-I			**0**	**0**	**0**	**0**
3WET16	**b) Dissertation Work Review -II**	**0**	**0**	**20**	**10**	**100**	**0**
TOTAL		**06**	**0**	**20**	**16**	**180**	**120**

SEMESTER-IV

Course Number	Subject	Scheme Of Studies Per Week			Credits	Internal Marks	External Marks
		L	T	P			
4WET17	**Dissertation II** **Project Work Review - III**	0	0	32	16	100	**100**
Total		**0**	**0**	**32**	**16**	**100**	**100**

CENTRE FOR WATER RESOURCES

JNTUH UNIVERSITY COLLEGE OF ENGINEERING SCIENCE AND TECHNOLOGY, HYDERABAD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

R22 Course structure scheme for M. Tech 2022-23

M.TECH (Water and Environmental Technology - Regular)

SEMESTER-I

PROGRAMME CORE-I / 1WETPC01

SURFACE WATER HYDROLOGY

OBJECTIVES:

- To acquire knowledge about hydrologic cycle, precipitation its measurement and analysis of rainfall along with its abstractions.
- To understand evaporation, infiltration and measurement of flow.
- To know about hydrograph, hydrograph separation, DRH and ERH.
- To create awareness regarding floods and flood routing.
- To understand different flood frequency methods estimation, determination of storage capacity and models in reservoir design.

UNIT-I: Introduction, Hydrologic Cycle and its Different Components, Hydrological System Concept, Surface Water Resources of India, Hydrology and Climate Change, Different Forms of Precipitation and Indian Monsoon, Measurement and Analysis of Precipitation, Precipitation Data Quality and Presentation, Areal Precipitation and Frequency Analysis, Analysis of Precipitation_ IDF and PMP

UNIT-II: Introduction to Evaporation and Evapometers, Estimation of Evaporation and Control Measures, Evapotranspiration, Initial Loss and Infiltration Process, Modeling of Infiltration Capacity, Infiltration Indices, Measurement of Flow Velocity, Area-Velocity and Moving-Boat Methods, Dilution Technique, Electromagnetic and Ultrasonic Methods, Indirect Stream flow Measurement, Stage-Discharge Relationship and Rating Curve

UNIT-III: Introduction and Catchment Characteristics, Estimation of Runoff Volume Empirical Models, Conceptual Models, Flow Characteristic Curves and Estimation of Reservoir Storage, Concept of Droughts and Environmental Flows, Basics of Hydrographs, Base Flow Separation, DRH and ERH, Introduction to Unit Hydrographs, Direct Runoff Hydrograph, Derivation, Different Durations_ Method of Superposition, Durations_ Method of S-Curve, Synthetic Unit Hydrograph, Instantaneous Unit Hydrograph

UNIT-IV: Introduction to Floods and Rational Method, Flood Peak Discharge and Catchment Characteristics, Estimation of Peak Flood Flow, Flood Control and its Status in India, Introduction to Flood Routing, Reservoir Routing Modified Method, Reservoir Routing Goodrich Method & Runge-Kutta Method Channel Routing Parameters of Muskingum Method, Channel Routing Muskingum Method & Hydraulic Flood Routing

UNIT-V: Types of Data Series and Concept of Return Period, Introduction to Frequency Analysis, Parametric Methods of Frequency Analysis, Frequency Analysis with Extreme Value Type-I Distribution, Confidence Interval and Standard Error in the Frequency Estimates, Various Issues behind Frequency Analysis, Basics of Hydrologic Design, Risk Analysis to Determine Return Period, Hydro-economic Analysis to Determine Return Period, Uncertainty in Hydrologic Analysis, Estimated Limiting Storm and Design Flood, Design Storm, Hydrologic Design of Reservoirs Introduction and Determination of Storage Capacity, Determination of Storage Capacity and Models in Reservoir Design

COURSE OUTCOMES

The student is expected to

CO1: Learn about precipitation and its measurement, analysis and interpretation.
CO2: Know about abstractions to rainfall, infiltration, evaporation, infiltration and measurement of flow
CO3: Gain Knowledge about hydrograph, hydrograph separation, DRH and ERH.
CO4: Familiarize regarding floods and flood routing.
CO5: Acquire knowledge about different flood frequency methods estimation, determination of storage capacity and models in reservoir design.

Web sources: https://archive.nptel.ac.in/courses/105/105/105105214/

Text books:

- A Text Book on Hydrology by P.Jayarami Reddy, Laxmi publishers, 2011, 530 pp.
- A text book on Hydrology (Principles, analysis, Design) by H.M.Raghunadh, New age international publishers, 2015, 463 pp.

Reference books:

- Hydrology and Water Resources Engg by K.C.Parti, Narosa Publishers, 2001.
- Hydrology Water Quantity & Quality control,by Wanisliste & Elenlin, John Wiley, 1997.
- Applied Hydrology by Ven Te Chow, David R.Maidenment & Larry W.Mays, McGraw-Hill, 1988.

PROGRAMME CORE-II/1WETPC02

GROUND WATER HYDROLOGY

OBJECTIVES:

- To understand the concepts of occurrence and movement of groundwater.
- To know about flow of water through porous medium and their governing equations.
- To acquire knowledge about ground water exploration techniques.
- To understand about groundwater recharge and saline water intrusion into the groundwater.
- To understand about various ground water modelling and management techniques.

Unit-I: OCCURRENCE AND MOVEMENT OF GROUND WATER:

Origin & age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration & saturation, aquifers and their characteristics/classification, groundwater basins & springs, Darcy's Law, permeability & its determination, Dupuit assumptions, heterogeneity &anisotropy, Ground water flow rates & flow directions, general flow equations through porous media.

UNIT-II: ADVANCED WELL HYDRAULICS:

Steady/ unsteady, uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer, well flow near aquifer boundaries/ for special conditions, partially penetrating/horizontal wells & multiple well systems, well completion/ development/ protection/ rehabilitation/ testing for yield.

UNIT-III: SURFACE/ SUB-SURFACE INVESTIGATION OF GROUND WATER:

Geological /geophysical exploration/ remote sensing / electric resistivity /seismic refraction based methods for surface investigation of ground water, test drilling & ground water level measurement, sub-surface ground water investigation through geophysical / resistivity /spontaneous potential /radiation / temperature / caliper / fluid conductivity / fluid velocity /miscellaneous logging.

UNIT-IV: ARTIFICIAL GROUND WATER RECHARGE & SALINE WATER INTRUSION IN AQUIFERS:

Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, water spreading.

Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, upcoming of saline water, fresh-saline water relations on oceanic islands, seawater intrusion in Karst terrains, saline water intrusion control.

UNIT-V: MODELING AND MANAGEMENT OF GROUND WATER:

Ground water modeling through porous media /analog / electric analog / digital computer models, ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifers, stream-aquifer interaction.

COURSE OUTCOMES

The student is expected to

CO1: To understand the concepts of occurrence and movement of groundwater along with the hydraulic properties.
CO2: Know about the behaviour and movement of groundwater in different types of aquifers.
CO3: Gain knowledge on surface and sub-surface investigation of ground water.
CO4: Familiarize with artificial groundwater recharge and to control the intrusion of the sea water into the groundwater.
CO5: Understand the modelling of the aquifer and also to manage the groundwater.

Web sources: https://nptel.ac.in/courses/105105042

TEXT BOOKS:

- Ground Water Hydrology by D.K. Todd, John Wiley & Sons, 1976.
- Ground water Hydrology by H.M.Raghunath, Wiley Eastern Limited, 1986.
- Numerical Ground Water Hydrology by A.K.Rasthogi, Penram International Publishing, 2007
- Groundwater Assessment, Development and Management by K.R.Karanth, Tata Mc.Graw Hill 1987.
- Hydrogeology by K.R.Karanth, Tata Mc.Graw Hill 1987.

REFERENCE BOOKS:

- Concepts and Models in Groundwater Hydrology by P.A.Domenico.McGraw-Hill Inc, 1972.
- Groundwater by S.Ramakrishnan, S. Ramakrishnan, 1998
- Ground Water Resources Evaluation by W.C.Walton, Mc Graw Hill, 1976.
- Geohydrology by Davis, S.N. and DeWeist, R.J.M.1966. John Wiley and sons, inc.
- Hydrogeology of Telangana State by Dr.Pandith Madhnure, Ground Water Department, August 2021, Pg.1-127

PROGRAMME ELECTIVE –I/ 1WETPE03

ADVANCED FLUID MECHANICS

OBJECTIVES:

- To understand basic knowledge about fluid properties.
- To learn and apply fluid statics for solving fluid problems.
- To acquire the fluid kinematics knowledge for solving fluid kinematics problems in fluid mechanics.
- To understand and solve problems on dynamics of ideal and real fluids.
- 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, Vapor 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 Description of fluid, 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: Fluid Dynamics Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line for 3-D flow, Navier–stokes equations, Momentum equation and its application – forces on pipe bend, Flow through Venturimeters and Orifice meter, Pitot tube.

UNIT-IV: LAMINAR FLOW Reynold's experiment- Characteristics of laminar and turbulent flows. Flow between parallel plates, flow through long tubes.

FLOW THROUGH PIPES – Laws of fluid friction – Darcy's equation, minor losses Pipes in series- pipes in parallel-total energy line and hydraulic gradient line. variation of friction factor with Reynold's number- Moody' chart.

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 to

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: Apply Bernoulli's equation to fluid flow problems, imbibe the equations of real fluids like Navier Stokes equation to solve problems.

CO4: Apply appropriate equations and principles to analyze pipe flow problems.

CO5: Acquire knowledge on boundary layer flow for various expressions and equation on laminar and turbulent boundary, Integral momentum and boundary layer separation.

TEXT BOOKS:

1. P.N. Modi and S.M. Seth, Fluid Mechanics (18th edition) Standard Book House, 2017.
2. A.K. Jain, Fluid Mechanics, Khanna publishers,2010
3. R. K. Bansal, A text book of Fluid Mechanics and Hydraulic Machines (7th edition) Laxmi publications(P) ltd; New Delhi, 2000
4. Fluid Mechanics by victor L.Streeter, Mc Graw Hill 1985.
5. Fluid Mechanics and machinery by D.Rama Durgaiah, New age international (p) ltd., Publishers 2002.
6. A text book of Fluid Mechanics and Hydraulic Machines by R. K. Rajput, S. Chand Technical

REFERENCE BOOKS:

1. Fluid Mechanics by F.M. White, Mc Graw Hill, 2005.
2. L. Victor, Streeter and E. Benjamin Wylie, Fluid Mechanics, Tata McGraw Hill,1985.
3. M. Franck White, Fluid Mechanics, Tata McGraw Hill,2017.
4. K. Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill,2001.

E-RESOURCES & OTHER DIGITAL MATERIAL

1. Fluid Mechanics virtual labs. http://eerc03-iiith.vlabs.ac.in/
2. https://nptel.ac.in/courses/Webcourse-contents/IIT- %20Guwahati/fluid_mechanics/index.htm
3. https://nptel.ac.in/courses/105105119.

PROGRAMME ELECTIVE –I/ 1WETPE03

WATER QUALITY MODELLING AND MANAGEMENT

OBJECTIVES:

- To know concepts of water quality.
- To know about sources of water and estuaries.
- To know about modeling and transport processes
- To know about contaminant transport models.
- To understand about water quality management.

UNIT-I:Water Quality Parameters: Water quality description, various characteristics of water, water quality criteria and standards, elements of reaction kinetics, spatial and temporal aspects of contaminant transport, transport mechanism-advection, diffusion, dispersion.

UNIT-II:Surface Water Quality: River and streams, convective diffusion equation and its application. Estuaries, Estuarine hydraulics, Estuarine water quality models; Lakes and reservoirs, eutrophication.

UNIT-III:Mathematical modeling of environmental systems: Numerical/mathematical modeling of environmental systems, subsystems, and pollutant transport processes Contaminant transport in unsaturated flows, solute transport models for conservative species, solute transport in spatially variable soils.

UNIT-IV:Contaminant transports: Contaminant transports in ground water advection, dispersion, one dimensional transport with linear adsorption, dual porosity models, numerical models, bio degradation reaction.Groundwater hydrographs.

UNIT-V:Water quality management: Water quality management, socio-economic aspects of water quality management, management alternatives for water quality control, waste load allocation process, lake quality management, and groundwater remediation.

COURSE OUTCOMES

The student is expected to

CO1: Become familiar with water quality standards, contamination of water along with contaminant transport mechanism.

CO2: Know about sources of water, water quality models and eutrophication.

CO3: Gain knowledge about solute transport models and contaminant transport in unsaturated flows.

CO4: Learn about different mechanisms like advection, dispersion and different models like dual porosity model and numerical models.

CO5: Acquire knowledge about water quality management, control including groundwater remediation

TEXT BOOKS:

- Anu Ramaswami, Jana B Milford , Michell J.Small, Integrated Environmental Modeling - Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons, 2005.
- Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, 1998.
- Snape J.B., Dunn I.J.,Ingham J., and Prenosil J., Dynamics of environmental bioprocesses, modelling and simulation Weinheim: VCH, 1995.

REFERENCE BOOKS:

- International Water Association - Activated sludge modelling ASM1 and ASM2
- Chapra S. C., Surface Water Quality Modeling, McGraw-Hil, Inc., New York, 1997.
- Garde R. J., and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi
- Thomann, R.V. and Mueller, J.A. Principles of surface water quality modeling and control, Pearson, 1987
- Chapra, S.C. Surface water quality modelling, Waveland Press, INC., 1997
- Schnoor, J.L., Environmental Modeling Wiley, John & Sons, 1997
- Thomann, R.V., Systems Analysis and Water Quality Management, McGraw Hill, 1972

PROGRAMME ELECTIVE –I/ 1WETPE03

FINITE ELEMENTS IN WATER RESOURCES ENGINEERING

OBJECTIVES:

- To understand basics of finite elements as applicable in the water resources area and fluids

UNIT-I

Introduction; Finite Element Method, Concepts of elements and nodes, degrees of freedom. Relation between nodal degrees of freedom and generalized coordinates, convergence requirements, natural coordinate systems, shape functions, element stiffness matrix.

UNIT- II

Basic Concepts of FEA: Advantages, Disadvantages and Limitations of FEA, Errors and Accuracy of FEA. Basic steps in finite element analysis Isoparametric elements: Computation of stiffness matrix for iso parametric elements, direct stiffness method of analysis and solution technique, assemblage of elements, direct stiffness method, boundary conditions and reaction.

UNIT- III

Analysis of framed structures; Two dimensional truss element, two dimensional beam element, stiffness matrix for a two dimensional beam element with 6 d.o.f., element load vector, transformation matrix, computation of stress resultants, shear deformation, plane stress and plane strain analysis, nodal load vector, rectangular elements, 8 noded rectangle, isoparametric elements

UNIT-IV

Applications of FEM: Finite Element Formulation: Displacement based finite element formulation, Pressure based finite element formulation. Steady State Flow: Introduction, Galerkin`s Method, Triangular elements, Assembly of conductance matrix, Boundary conditions. Region near a well example, Seepage through Dam, Poisson's equation.

UNIT-V

Transient Flow: Introduction, Galerkin`s Method, Rectangular elements, Assembly of matrix differential equations, Solving the matrix differential equations, Boundary conditions Reservoir Problem.
Advective-Dispersive Transport: Introduction, Dispersion, Solute transport equation, Solute dispersion in uniform flow field.

Text/Reference Books:

1. C.S.Krishnamoorthy, " Finite element analysis, theory and programming", Tata McGraw Hill
2. Cook R.D., Malkus, D.S. and Plesha, M.E., Concepts and Applications of Finite Element Analysis, Third Edition, John Wiley.
3. O.C. Zienkiewicz, The Finite Element Method, Tata McGraw-Hill.
4. Pinder, G. F., Gray, W. G., Finite Elements in Subsurface Hydrology, Academic Press, 1977.
5. Huyakorn, P.S and Pinder, C. F., Computational Methods in Sub-Surface Flow, Academic Press, 1983.
6. Connor, J.C. and Brebbia, C. A., Finite Element Techniques for Fluid Flow, Butterworth, 1976.
7. Taylor, C. and Hughes, T. J. Finite Element programming of the NavierSotckes Equation, Pinerdge Press, 1980.
8. Finlayson, B. A., The method of Weighted Residuals and Variational Principles, Academic Press, 1972.
9. Wang H.F and Anderson M P, Introduction to Groundwater Modelling, Academic Press 1982.

Course Outcomes:

Upon successful completion of course the students will be able to:

1. Ability to know about ordinary and partial differential equations and finite difference methods
2. Ability to know application of various hydrodynamic techniques to steady and unsteady flows
3. Ability to know application of finite element method to steady and unsteady flows
4. Ability to perform computer programming of these computational methods

PROGRAMME ELECTIVE –II/ 1WETPE04

WATER RESOURCES SYSTEMS ANALYSIS

OBJECTIVES:

- To understand the concepts of water resources planning and management and the role of optimization models
- The various methods of linear programming are discussed in this unit.
- The application of dynamic programming for resource allocation and goal programming are dealt in this unit.
- Gradient based research techniques and simulation concepts are discussed here.
- 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:

- Introduction to operation research – Tata Mc. Grawhill Publications, 2005.
- Water Resources System Analysis – S.Vedula & P.P.Mujumdar, 2016.

REFERENCE BOOKS:

- Water Resources Economics – L.D.James & R.Lee, McGraw-Hill Inc., 1971.
- Water System by Warren A. *Hall* & John A. *Dracup,* McGraw-Hill Inc.1970.
- Water Resources project Economic by Kuiper.E, Newnes-Butterworth, 1971.
- Water resources system planning and management, by Chaturvedi, M.C., McGraw Hill Education India Pvt Ltd, 1998.

PROGRAMME ELECTIVE –II/ 1WETPE04

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, river basin organizations, functions and powers.

UNIT-V: Soil Erosion & Sedimentation: Theory of soil erosion, sediment transport, reservoir sedimentation, control measures, catchment treatment.Annual sediment yield estimation from a basin, catchment treatment, control measures, dam safety, dredging reservoirs, dam break analysis

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:

- Mechanics of Sediment Transport and Alluvial Stream Problems by Garde, R.J. and Rangaraju, K.G., Wiley Eastern Limited, 1979.
- Flow through Open Channels by Ranga Raju, K.G., Tata McGraw-Hill, 1981.

PROGRAMME ELECTIVE –II/ 1WETPE04

WATER DISTRIBUTION SYSTEMS

OBJECTIVES:

1. Introduction to Water Distribution Networks
2. Methods for Analysis
3. Types of Analysis
4. Methods for Designs

UNIT-I: General Hydraulic Principles, Head loss formulae- Darcy-Weisbach formula, Hazen – Williams formula, Modified Hazen-Williams formula, Series and Parallel connection of Pipes, Equivalent Pipes, Analysis of branched Water Distribution Networks.

UNIT-II: Formulation of Equations for looped Water Distribution Networks, Analysis of flow in looped networks using Hardy Cross, Newton-Raphson and Linear Theory method, Introduction of Gradient method and other methods of analysis.

UNIT-III: Reservoirs, Pumps and Valves (check valve, flow control valve and pressure reduces valve) in Water distribution systems. Flow dependent analysis of multi-reservoir systems, Introduction to head-dependent analysis.
Node flow analysis of water distribution networks: Node head–flow relationships, Direct and Indirect methods, Application of NFA technique to serial networks.

UNIT-IV: Optimal and Economical diameter of pumping main, Design of pumping main considering diameter as continuous as well as discrete variable. Water hammer consideration. Design of water distribution networks using Critical Path Method, Formulation of optimization model, Application of Cost-head loss ratio method and Linear Programming Technique to optimal design of branched networks.

UNIT-V: Determining number of branching configuration for a looped network, Use of path concept and minimum spanning tree concept, Application of critical path method for design of looped networks. Introduction to methods for Looped WDNs.

REFERRENCE:

1. 1.Bhave, P. R. and Gupta R., Analysis of Water Distribution Networks, Narosa Publishing Co, New Delhi.
2. Bhave P. R., Optimal Design of Water Distribution Networks Narosa Publishing Co, New Delhi.
3. Jeppson R.W., Analysis of flow in pipe networks, Ann Arbon Science, Michigan USA.
4. Walksi T-M, Analysis of water distribution System Van Nostand Reinheld G, New York USA, 1984.
5. CPHEEO, Manual on Water Supply and Treatment, Ministry of Urban Development GOI.

PROGRAMME ELECTIVE –II/ 1WETPE04

INDUSTRIAL WASTE WATER TREATMENT

OBJECTIVES:

The course will address the following:

1. Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.
2. To impart knowledge on selection of treatment methods for industrial wastewater.
3. To know the common methods of treatment in different industries
4. To acquire knowledge on operational problems of effluent treatment plant.

UNIT – I

Industrial water Quantity and Quality requirements: Boiler, Cooling, Domestic/Canteen and Process waters for Textiles, Food processing, Dairy, Aqua industry, Sugar mills, Brewery and distillery Industries, Fertilizer industry, Power plants. Advanced water treatment -Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour. Use of Municipal wastewater in Industries.

UNIT – II

Basic theories of Industrial Wastewater Management: Industrial waste survey -Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis - Wastewater characterization- Toxicity of industrial effluents- Common methods of Treatment of wastewaters - Unit operations and processes- Volume and Strength reduction – Neutralization – Equalization and proportioning- recycling, reuse and resources recovery. Miscellaneous Treatment: Biological treatment of sewage- Primary, secondary and Tertiary treatment of sewage.

UNIT – III

Industrial wastewater disposal management: Discharges into Sewers, Streams- Oxygen sag curve, Lakes-eutrophication and oceans and associated problems, Land treatment – sewage sickness, Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastewaters- Effluent Disposal Method.

UNIT – IV

Process and Treatment of specific Industries-1: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants. Case studies.

UNIT – V

Process and Treatment of specific Industries-2: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Aqua industry, Pharmaceutical Plants. Case studies.

TEXT BOOKS:

1. Industrial Wastewater Treatment by KVSG Murali Krishna, Paramount Publishers, Visakhapatnam, 2019
2. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, NewDelhi.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi
4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala,
5. Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition.

REFERENCES:

1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition
2. Wastewater Engineering by Metcalf and EddyInc, Tata McGrawhillCo., New Delhi
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India.
4. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.

PROGRAMME ELECTIVE –II/ 1WETPE04

WEB GIS

OBJECTIVES:

1. To know Fundamentals of Web.
2. To know about Java Script.
3. To know about Programming in Web GIS
4. To have exposure to handling Geographical Data in Internet Environment
5. To understand about Publishing the Geo-spatial data

UNIT I: Fundamentals of Web: Introduction to web & Mark up languages, Different tags of HTML, Marquee List, frames ,I-frames and creation of form document, CSS: Block level and Inline elements, Types of style sheets, Box model, Different fonts, Animation, Static layout.

UNIY II: Java Script for Form validation: Introduction to java script: Syntax, Statements, Comments, Popup Boxes: Alert, Confirm, Prompt, Variables, Operators, Conditional Statements, Loops, Events, Cookies. Page Printing, Page redirection, Built-in Objects, Debugging, HTML DOM.

UNIT III: Programming in Web GIS: Introduction to different 2D and 3D view, working with Map views, Constructors, Map view properties and methods.

UNIT IV: Display Geographical Data in Internet Environment: Base maps, Map Rendering, Query task, Point graphics, Working with base map tools, Feature Layer Query, Geometric engine.

UNIT V: Publishing the Geo-spatial data: Search widget, Publishing of Geospatial data in Local server and Global server, Geo-coding, Validating and Analyzing the results.

COURSE OUTCOMES:

The student will be able to

CO1: Comprehend basic programming including HTML & CSS to implement high quality web mapping applications.

CO2: Familiarize with the usage of Java Script for form validation of web page

CO3: Gain an understanding of the basic concepts of programming using web GIS

CO4: Have the basic knowledge of techniques to distribute, process and display geographical data in the Internet environment, and

CO5: Develop the skill for publishing the geospatial data

TEXT BOOKS:

1. An Introduction to Web design and programming, McGraw Hill, Wang, Thomson.
2. Ajax: The Complete Reference – Thomas A. Powel, McGraw Hill, 2008.
3. JavaScript 2.0 Complete Reference, 2nd Edition by Thomas A. Powel, McGraw Hill.

PROGRAMME ELECTIVE –II/ 1WETPE04

ENVIRONMENTAL ENGINEERING-I

OBJECTIVES:

- To acquire knowledge on various water sources, collection and intake systems.
- To understand conveyance and pumping, Philosophy of Water Treatment
- To obtain knowledge on coagulation and flocculation
- To gain knowledge on water losses in water distribution system and water balance
- To attain knowledge smart metering and sensing devices, IoT and automation in water supply

UNIT–I Introduction, Background and Course Introduction, Water Sources and availability, Water Uses, Water Supply: Key Issues and Concerns, Concept of Water Demand, Components of Water Demand, Unlisted, Fluctuations in Water Demand, Population Forecasting, Demand Forecasting and Design Capacities, Water Sources and Collection of Water, Surface Water Intakes Systems, Groundwater Intake, Well Interference's, Well losses and Efficiency

UNIT-II Raw water-Conveyance and Pumping, Practice Problems, Raw Water Storage, Treated Water Storage, Placement, Design and Construction of Storage Reservoirs, Water Quality and Water Pollutants, Water Quality Parameters, Philosophy of Water Treatment, Water Treatment Units Sedimentation

UNIT-III Coagulation and Flocculation: Theory, Selection and Application, Design Operation and Process Control, Filtration Theory and Slow Sand Filters, Rapid Sand Filter: Filter Media and Components and Pressure Filters, Disinfection Basic, Chlorination, Other Disinfection Method: Ozone and UV Disinfection, Sludge Management, Advanced and Alternate Treatment Systems, Advanced Oxidation Processes and Membrane Process

UNIT–IV Basic of Water Distribution System, Water Distribution Networks, Analysis of Water Distribution Networks, Water Losses in Water Distribution System, Water Balance for Water Loss Assessment and Performance Indicators, Continuous (24*7) water supply systems, District metered area (DMA) for zoning in water distribution networks

UNIT–V Software for water distribution networks design and analysis, Demonstration on EPANET and GEMS, Concept of smart water supply systems, Smart Metering and sensing devices, IoT and Automation in Water Supply, Examples of Automation and Smart Water Supply Systems, Economics of Water Supply Systems, Capital and Operational cost of Water Supply Systems, Pricing Waters, Water Pricing Models, Case Studies and Practice Problem on Water Pricing

COURSE OUTCOMES

The Student is expected to

- gain knowledge on various water sources, collection and intake systems.
- familiarize water conveyance and pumping, Philosophy of Water Treatment
- understand on coagulation and flocculation
- acquire knowledge on water losses in water distribution system and water balance
- attain knowledge smart metering and sensing devices, IoT and automation in water supply

Web links: https://archive.nptel.ac.in/courses/105/105/105105201/

TEXT BOOKS:

- Rural, Municipal and Industrial Water Management, KVSG Murali Krishna, Reem Publications, New Delhi, 2012
- Elements of Environmental Engineering – K. N. Duggal, S. Chand & Company Ltd., New Delhi, 2012.

REFERENCE BOOKS:

- Environmental Engineering – Howard S. Peavy, Donald R. Rowe, George Tchobanoglus – McGraw-Hill Book Company, New Delhi,1985.
- Water Supply Engineering – P. N. Modi.
- Water Supply Engineering – B. C. Punmia
- Water Supply and Sanitary Engineering – G. S. Birdie and J. S. Birdie
- Environmental Engineering, D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.

CORE/ 1A01

RESEARCH METHODOLOGY AND IPR

UNIT 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:

Students will be able to

CO1: Understand research problem formulation.
CO2: Analyze research related information
CO3: Follow research ethics
CO4: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO5: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO6: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

TEXT BOOKS:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students, Kenwyn, South Africa: Juta & Co., 1996.
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2014.

REFERENCE BOOKS:

- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Mayall, W.H. "Industrial Design", McGraw Hill, 1992.
- Niebel, Benjamin W., "Product Design", McGraw Hill, 1974.
- Morris Asimow, "Introduction to Design", Englewood Cliffs, N.J., Prentice-Hall [1962]
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

AUDIT COURSE -1/ 1A02

ENGLISH FOR RESEARCH PAPER WRITING

UNIT –I: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT-III: Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT-IV: Key skills are needed when writing a Title; key skills are needed when writing abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT-V: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT-VI: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

COURSE OUTCOMES:

Students will be able to:

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Ensure the good quality of paper at very first-time submission

SUGGESTED STUDIES:

- Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
- Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

AUDIT COURSE -1/ 1A02

DISASTER MANAGEMENT

UNIT-1: Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT-IV:Disaster Preparedness and Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And CommunityPreparedness.

UNIT-V: Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies forSurvival.

UNIT-VI: Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation inIndia.

COURSE OUTCOMES:

Students will be able to:

CO1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarianresponse.
CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflictsituations.
CO4: Critically understand the strengths and weaknesses of disaster managementapproaches, planning and programming in different countries, particularly their home country or the countries they work in

SUGGESTED READINGS:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal bookCompany, 2007.
- Sahni, PardeepEt. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, NewDelhi, 2010.
- Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., NewDelhi, 2007.

AUDIT COURSE -1/ 1A02

SANSKRIT FOR TECHNICAL KNOWLEDGE

OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in theworld.
- Learning of Sanskrit to improve brainfunctioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memorypower.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancientliterature.

UNIT-I:

- Alphabets inSanskrit,
- Past/Present/FutureTense,
- Simple Sentences

UNIT-II:

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT-III:

- Technical concepts of Engineering-Electrical, Mechanical, Architecture,Mathematics

COURSE OUTCOMES:

Students will be able to

CO1: Understand basic Sanskritlanguage.
CO2: Understand Ancient Sanskrit literature about science & technology.
CO3: Develop logic instudents being a logical language.

SUGGESTED READING

- "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi
- "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New DelhiPublication
- "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi.

AUDIT COURSE -1/ 1A02

VALUE EDUCATION

OBJECTIVES:

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT-I:

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgments.

UNIT-II:

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism, Love for nature, Discipline.

UNIT-III:

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity anddiscipline.
- Punctuality, Love andKindness.
- Avoid faultThinking.
- Free from anger, Dignity of labor.
- Universal brotherhood and religioustolerance.
- Truefriendship.
- Happiness Vs suffering, love fortruth.
- Aware of self-destructivehabits.
- Association andCooperation.
- Doing best for savingnature

UNIT-IV:

- Character and Competence –Holy books vs Blind faith.
- Self-management and Goodhealth.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role ofWomen.
- All religions and samemessage.
- Mind your Mind,Self-control.
- Honesty, Studyingeffectively

COURSEOUTCOMES:

Students will be able to

CO1: Gain knowledge of self-development
CO2: Learn the importance of Human values
CO3: Develop the overallpersonality

LAB 1/ 1WETL05

HYDRAULICS AND HYDROLOGY LABORATORY

OBJECTIVES:

1. To prepare and analyze ground water contour map.
2. To estimate the resistivity and thickness of various layers by conducting vertical electrical sounding.
3. To know the lateral & vertical homogeneity of earth by conducting seismic refraction & resistivity imaging.
4. To know about lift, drag, pressure distribution and surface profiles.
5. To know about the characteristic curves and frictional losses.

List of Practicals

- Preparation of Groundwater contour map.
- To determine the Resistivity and Thickness of various sub-surface layers vertically below the central point using Schlumberger method (One Dimensional)
- To create Resistivity image by using ABEM SAS 1000 Terrameter (Two Dimensional)
- To determine the thickness of the sub-surface layers by conducting Seismic Refraction method
- To determine sub-surface layers resistivity, fluid resistivity and spontaneous potential by using by using ABEM SAS 300 Well Logger (Sub-surface method), vertical section of bore well
- To investigate underground shallow and deeper pipelines and to understand the various anomalies in the sub-surface by using Ground Penetrating Radar with 100 MHz and 400 MHz antennas
- To determine the aquifer characteristics such as Transmissivity (T) and Storage Coefficient (S) by conducting pumping tests
- To study the pressure distribution on Aerofoil and Cylindrical model.
- To study the Lift and Drag on Aerofoil.
- To study the characteristics curves for Wind Tunnel.
- To compare the theoretical and actual pressures at cavitation condition.
- To verify Darcy's Law.
- To find out the coefficient of Permeability of a given medium.
- To determine the coefficient discharge for Rota meter at different fluorides.
- To plot the surface profile of a forced vortex and free vortex by measurement of the surface profile coordinates.
- To find out the depth of flow along the test length of the flume
- To plot a specific energy curve for a constant discharge.
- To study and calibrate the Pitot static tube.
- To determine the frictional head loss between reservoir and surge tower.
- To measure open channel flow using IOT technologies

COURSE OUTCOMES

Students are expected to

CO1: Explore the groundwater using electrical resistivity and seismic methods.
CO2: Identify civil utility using Ground Penetrating Radar.
CO3: Determine of aquifer characters using pumping tests and well logging techniques.
CO4: Study the characteristics curves and specific energy curves.
CO5: Determine the frictional losses, coefficient of discharge and surface profiles coordinates.

LAB 2/ 1WETL06

ENVIRONMENTAL LABORATORY

OBJECTIVES:

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

List of Practicals

- To determine the presence of Total Suspended solids in the given wastewater sample.
- To determine the amount of Total dissolved solids present in the given wastewater sample.
- To estimate the concentration of nitrates present in the Groundwater and Surface water Samples.
- To estimate the chlorides concentration in the given Groundwater and Surface water Samples.
- To estimate the concentration of Sulfates present in the given Groundwater and Surface water Samples.
- To determine the Alkalinity of the given Groundwater and Surface water Samples.
- To determine the Total Hardness for Groundwater Sample and Surface water Sample.
- To determine the Calcium and Magnesium Hardness of Groundwater Sample and Surface water Sample.
- To estimate the Fluorides concentration in the given Groundwater and Surface water Samples.
- To estimate the dissolved oxygen content present in the given Groundwater and Surface water samples.
- To estimate the phosphates concentration in the given Groundwater and Surface water Samples.
- To estimate the biological oxygen demand present in the given Groundwater, Surface water and wastewater samples.
- To estimate the chemical oxygen demand present in the given Groundwater, Surface water and wastewater samples.
- To determine the heavy metals present in the given Groundwater, Surface water and wastewater samples.
- To determine the total organic carbon present in the given wastewater sample.
- To determine the E coli and fecal coliform bacteria present in the given wastewater sample
- Field trips to STPs

COURSE OUTCOMES

Students will be able to

CO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
CO2: Statistically analyze and interpret laboratorial results.
CO3: Understand and use the water and wastewater sampling procedures and sample preservations.
CO4: Demonstrate the ability to write clear technical laboratorial reports.
CO5: Understand the impact of biological parameters on wastewater.

SEMESTER-II

PROGRAMME CORE-III/2WETPC07

GEOSPATIAL APPLICATIONS IN WATER RESOURCES

OBJECTIVES:

- To understand basic concepts of remote sensing for its applications in the area of water resources.
- To acquire knowledge on remote sensing systems.
- To get the concepts of geographical information systems.
- To get the basic digital image processing and applied knowledge on how to use SRTM data.
- To understand the applications of remote sensing and geographical information systems in the field of water resources.

UNIT-I: Introduction and Basic concepts: Basic Concepts of Remote Sensing, Air-borne and Space-borne sensors, active and passive remote sensing, ERM spectrum, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves.

UNIT-II: Remote Sensing Systems: Satellites and orbits, Geo-synchronous, sun synchronous and polar orbiting satellites, Spatial, Spectral and radiometric resolutions, temporal resolution, Multispectral, thermal and hyperspectral remote sensing, remote sensing satellites and their features.

UNIT-III: Geographical Information Systems (GIS): Introduction, Information systems, digital information systems, data types – raster, vector, Triangulated irregular network (TIN), data representation, spatial & non spatial distribution, Topology, Structure of GIS, Applications. Spatial data analysis- Buffer, erase, interpret, update. Spatial functions-interpolation, Thiessen polygon, Inverse Distance Weighted (IDW) - spline- Data visualization, characteristics of maps.

UNIT-IV: Digital Image Processing-Information Extraction Module: Supervised and Unsupervised classification, Fuzzy classification, Image transformations, Ratio images, Vegetation indices, Principal Component Analysis. Digital Elevation Modelling - Introduction, Sources of Digital Elevation Data, Types of DEM, Radar Interferometry, Shuttle Radar Topographic Mission (SRTM) data, DEM for slope, aspect, flow direction, flow pathways, flow accumulation, streams, catchment area delineation

UNIT-V: Remote Sensing Applications: Land use/land cover mapping, Watershed Management, Rainfall-runoff modelling, Irrigation management, Flood mapping, Drought assessment, Environmental monitoring

Web links: https://archive.nptel.ac.in/courses/105/108/105108077/
https://archive.nptel.ac.in/courses/105/103/105103193/
https://archive.nptel.ac.in/course.html

COURSE OUTCOMES

The Student is expected to
CO1: able to understand basic concepts of remote sensing for its applications in the area of water resources.
CO2: able to acquire knowledge on remote sensing systems.
CO3: get the concepts of geographical information systems.
CO4: get the basic digital image processing and applied knowledge on how to use SRTM data
CO5: understand the geospatial applications of remote sensing and geographical information systems in the field of water resources.

TEXT BOOKS:

- Remote Sensing and Image Interpretation by T.M. Lillesand & R.W. Kifer, 2015.
- GIS by Michel Dimmar.
- A text Book of RS &GIS by M.Anji Reddy, BS Publishers, Rpt. 2019.

REFERENCE BOOKS:

1. Introduction to Remote Sensing, 5th edition, by Campbell Guilford press, 2011
2. Remote Sensing by Kevin white, 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.

PROGRAMME CORE-IV/2WETPC08

IRRIGATION ENGINEERING

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 the groundwater hydrology and management of salt affected spoils.
5. To learn about drainage of irrigated lands.

UNIT-1: Introduction: Irrigation potential of water, Benefits of irrigation, Advantages and Disadvantages of irrigation, Surface irrigation systems, Irrigation terminology, Soil-water-plant-atmosphere, Soil properties, Basic soil water relationships, water in the soil, water content and equivalent depth, inter-relationships, Soil water, Soil water availability to plant, Permanent wilting point (PWP), Available Water (AW), Readily Available Water (RAW), Maximum Available Deficiency (MAD), Soil water potential, Gravitational potential, Matric potential, Soil water potential measurement, Soil Water Release Curve, Matric Potential and Soil Texture.

UNIT-II: Crop Water Requirements: Filed water balance, evapotranspiration, crop water requirement, irrigation scheduling, irrigation water conveyance, irrigation channel design, measurement of irrigation water: open channel & pipe. 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 the*i*r Relative Merits, Principles of Design of Surface Irrigation Methods, Micro- Irrigation, Sprinkler and Drip Irrigation Methods and their advantages and disadvantages.

UNIT-IV: Ground Water Hydrology: Irrigation wells and Water-lifting devices-pumps, centrifugal pumps-basics & power requirement, pump characteristic curves, management of salt affected soils: Saline and alkali soils, Management of Salt affected soils.

UNIT-V: Drainage of Irrigated Lands: Agricultural drainage: Introduction, Field drainage system, Surface & Subsurface drainage system, design of Surface & Subsurface drainage system, Combined drainage system, Construction of pipe drains, Non-conventional drainage, economics of drainage project, case study of drainage system, drainage model, irrigation efficiency, irrigation economics, irrigation model, Performance Evaluation of Drainage Systems.

Course outcomes:

The student is expected to

CO1: Study the fundamentals of soils physical & chemical properties with respect to soil water plant relationship.
CO2: To estimate water requirement of various principal crops.
CO3: Design and development of various irrigation methods.
CO4: Study the groundwater hydrology and management of salt affected spoils.
CO5: Study about drainage of irrigated lands.

Web source: https://archive.nptel.ac.in/courses/126/105/126105010/

TEXT BOOKS:

- Irrigation: Theory and Practice by Michael. A.M 2nd Edition, Vikas Publishing House, 2009.
- Land and Water Management Engineering by V.V.N. Murthy, Kalyani Publishers, 2008.
- 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, Hutchinson & Company (Publishers) Ltd.1975.
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 1963.

PROGRAMME ELECTIVE-III/2WETPE09

FLUVIAL HYDRAULICS

OBJECTIVES:

- To acquire basic concepts of free surface flow and its distribution along with applications of various basic equations.
- To understand the concepts of gradually varied flow for steady state condition.
- To understand the concepts of gradually rapid flow for steady state condition.
- To get the knowledge on non-dimensional members and applications to hydraulic models.
- 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:

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

PROGRAMME ELECTIVE-III/2WETPE09

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 Modeling: Analysis of hydrologic changes due to urbanization, Approaches to study, Data collection and analysis, Probabilistic and statistical approaches, Principles of storm water modeling. Theme park of metro water works.

UNIT- III: Urban Drainage Systems: Sanitary and combined sewer systems, components, Design considerations for fixing sewer capacity, Infiltration into and ex-filtration 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. Storm water management practices as per CPHEEO manual.

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:

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

REFERENCE BOOKS

- Overtens D.E., and Medows M.E., "Storm water Modeling" Academic Press, 2nd Edition. 1976.
- Grigg, N.S, "Urban Water Infrastructure Planning, Management, and Operations", John Wiley & Sons, 2nd Edition, 1986.
- Viessman W.I., Knapp J.W., Lewis G.L., and Henbrough, T.E., "Introduction to Hydrology" 1988.

PROGRAMME ELECTIVE-III/2WETPE09

RIVER ENGINEERING

OBJECTIVES:

1. To understand flow regimes in river flows
2. To find out sediment loads from river

UNIT-I: Origin and properties of sediments: Nature of sediment problems, origin and formation of sediments, properties of sediments, incipient motion of sediment particles, tractive force approach, cohesive materials.

UNIT-II: Regimes of flow: Description of regimes of flow, ripple, dune, antidote, prediction of regimes of flow. Resistance to flow & velocity distribution in alluvial streams: velocity distribution in turbulent flow over rough boundaries, resistance and velocity distribution in alluvial streams.

UNIT-III: Bed load transport & saltation: Bed load equations, bed load equations based upon dimensional considerations and semi-theoretical equations, general comments on bed load equations, saltation.

UNIT-IV: Suspended load transport: Mechanism of suspension, equation of diffusion, sediment distribution equation, relations for suspended load, wash load, transport of suspended sediment.

UNIT-V: Total load transport: sediment samplers design of canals carrying sediment laiden water Types of sediment samplers, Design of channels carrying sediment laiden water, Sediment transport through pipes

REFERENCE BOOKS:

1. Garde R J and RangaRaju K G, Mechanics of Sediment Transportation and Alluvial Stream Problems Wiley Eastern Ltd., 1985.
2. Yang C.T., Sediment Transport- Theory and Practice, The McGraw Hill Companies Inc. 1996.
3. Chang H.H., Fluvial Processes in River Engineering John Wiley 1988.
4. Simons D.B. and Senturk F., Sediment Transport Technology, Water Resources Publications, Fort Collins, Colorado 1977

PROGRAMME ELECTIVE-III/2WETPE09

ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:

- To understand the concept, historical context and wider importance of EIA as a planning tool.
- Students learn about EIA legal policy and regulatory framework.
- Students will be able to understand the Environmental impact Assessment process
- To acquire knowledge about EIA methods.
- Students Illustrate and evaluate the management plans.

UNIT-I: Introduction:

State of Global Environment for Air - sequential transition in the environmental movement, economic development process, air pollutants, particulate matter PM and its components and ground level ozone, effect of climate change on human health, Biodiversity - meaning of biodiversity, sixth mass extinction, its significance, benefits and one health, e interconnections between people, biodiversity and health and provisions of ecosystems, key pressures on biodiversity, impacts on the World's Biomes, Oceans and Coasts- extent of problems, significance of oceans and coasts on human life, concept of healthy ocean, challenges for sustainable use and management of marine and coastal ecosystems, Issues on tropical coral reef, fishing, debris, sand mining, deep sea mining and ocean noise, Land and Soil- land resource and the Sustainable Development Goals, drivers and pressures on land resources, key state and trends in case of land, key impacts of changes in landuse and dynamics, Fresh Water - importance of freshwater, pressures on freshwater, water and land use, global state and trends of freshwater, water quality, freshwater ecosystems.

UNIT –II: EIA legal Policy and Regulatory Framework:

Definition, Process and Purpose of EIA, EIA Impact Areas, Current And Emerging EIA Impact Areas- Typology of Environmental Impacts, Nature of environmental impacts, magnitude or severity of impacts, biophysical impacts, Assessment of impacts for soil, geology, water, Flora, Fauna and Biodiversity, noise, transport, landscape and visual, socio-economic impact, health and safety, emerging impact areas, wider impact considerations. Evolution of EIA, current status of EIA worldwide, factors influencing EIA systems, key role of international organizations. Contextualizing EIA in India on global context, initial environmental movement in India, evolution of EIA in India, global environmental timeline from 1970 to 1999, Global Environmental timeline from 2000 to 2021, EIA-Law, Policy and Institutional Arrangements for EIA Systems like Air, Water, Soil, Land & Geology, Ecology, Coastal Ecology and Geomorphology, Noise, Ecosystem Services, Cultural Heritage and Healthy, Land Acquisition, Resettlement & Livelihoods, Land Acquisition in Indian Context, Socio-economic Impacts, Transport, Landscape and Visual.

Unit-III: EIA Procedure:

EIA Process- Starting and Initial Stage, Impact Prediction, Impact Evaluation, Mitigation and Enhancement, Participation, Presentation and Review. Air Assessment and Water Assessment.

UNIT-IV: EIA Methodologies:

EIA Methods for Soil, Land and Geology, Climate and Climate Change. EIA Methods for Ecology -Definitions and Concepts, Baseline Study, Impact Prediction and Evaluation, EIA Methods for Ecosystem Services, Coastal Ecology and Geomorphology, Transport, Landscape and Visuals, Cultural heritage, Health, Socio economic impacts, Land Acquisition, Resettlements and Livelihoods, resource efficiency, Risk and risk management, Cumulative effects.

UNIT-V: Management Plans:

Environmental management plans, widening the scope for strategic environmental assessment,
Reporting and Review of EIA quality, EIA case studies.

COURSE OUTCOMES

The Student is expected to
CO1: Understand the concept of global environment.
CO2: Interpret the legal policies concerned to EIA systems.
CO3: Recognize the EIA procedure and the impact assessment.
CO4: Identify the methodologies adopted to carry out EIA.
CO5: Gain technical knowledge about environmental management plans.

Web Sources: https://nptel.ac.in/courses/124107160

TEXT BOOKS:

- Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, ValliManickam, B.S. Publication, Sultan Bazar, Hyderabad 2020.
- Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers, 1988.

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, 2003.

PROGRAMME ELECTIVE-IV/2WETPE10

SUSTAINABLE WATER RESOURCES DEVELOPMENT

OBJECTIVES:

- It is intended to create awareness among students about sustainability of water resources goals and policy approaches.
- Students understand national water policy, challenges, global issues and concerns as a part of sustainable water resources development.
- Students are exposed to local, regional and global perspective of sustainable water resources management.
- Students learn about various economic water issues and water conservation.
- 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. Sustainable development goals – Net zero

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:

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

PROGRAMME ELECTIVE-IV/2WETPE10

CLIMATE CHANGE ADAPTATION AND MITIGATION

OBJECTIVES:

- To understand the concept, historical context and wider importance of Climate change and its impacts.
- To understand the framework of climate risk assessment.
- To develop solutions for climate change adaptation and mitigation for different sectors.
- To understand the Indian and international climate change policy and finances.

UNIT-I: Introduction: Weather and Climate, Variability, Basic Concept of Climate Change, Sources of Green House Gases (GHGs), natural and anthropogenic contribution towards climate change, different climatic models, GCM, RCM and projections, impact of climate change on different sectors, impact of CC globally, impact of CC in India, Climate change education and awareness.

UNIT-II: Climate Risk Assessment (CRA): Definitions, Climate hazards, Floods, droughts, heat waves, cyclones, storm surge, climate impacts, susceptibility, climate risk, vulnerability, social vulnerability, adaptive capacity, Gender aspects, Participatory rural appraisal (PRA), focused group discussions, CRA for different sectors like Urban, Agriculture, Forest, Industry, Tools for carrying out CRA and ranking methods.

UNIT-III: Climate Change Adaptation: Definitions, Adaptation and Disaster Risk Reduction, losses and opportunities, Soft and Hard measures, different types of adaptation, adaptation for different sectors community, urban, agriculture, forest, industry, cost-benefit analysis of adaptation measures, prioritization, water audits and water footprints estimation and associated measures. Concepts of smart cities, sustainable cities, integrated water management,

UNIT-IV: Climate Change Mitigation: Definitions, Technological options to reduce emissions, fossil fuel, successful case studies, energy efficiency, renewable energy, solar, wind, bio-gas, low carbon development, sustainable transportation, clean development mechanism, carbon sequestration, carbon footprints and emissions estimation, Cost of mitigation, cost-benefit analysis, Business models to promote energy efficiency ESCO, venture capital, prioritization of mitigation measures, Life Cycle Assessments and Extended Producer Responsibilities, Circular Economy, analysis of co-benefits of adaptation and mitigation, Food-water-energy nexus.

UNIT-V: Climate Change Finance and Policy: Sources of climate change finance, national and international funding agencies, UN, WB, ADB, Green Climate Fund, International treaties on climate change, UN framework for climate change, Montreal and Kyoto Protocol, United Nations Sustainable Development Goals, Indian Policies on Climate Change, Paris Agreement, India's Intended Nationally Determined Contributions (INDC), National Action Plan for Climate Change, State Action Plan for Climate Change

COURSE OUTCOMES

The Student is expected to

CO1: Understand the basic concept of climate change and its impacts on earth and India.
CO2: Evaluate the climate risk for different sectors.
CO3: Develop an adaptation plan for various sectors and prioritize the measures based on impact and cost-benefit analysis.
CO4: Propose mitigation measures; carry out carbon emission reduction and cost benefit analysis.
CO5: Understand the international and national policies on climate change along with sources of finance for implementing CCA and CCM measures.

TEXT BOOKS:

- Climate Change Modeling, Mitigation, and Adaptation. American Society of Civil Engineers. Zhang, T. C., Ojha, C. S. P., & Kao, C. M. (2013, March).
- Handbook of climate change mitigation and adaptation Chen, W. Y., Suzuki, T., & Lackner, M. (Eds.). (2016) New York: Springer.
- Climate Change by Joseph Romm, 2015.

REFERENCE BOOKS:

- IPCC fifth assessment report: Technical Summaries for Working Group I-III (freely available online athttp://www.ipcc.ch/report/ar5/)

PROGRAMME ELECTIVE-IV/2WETPE10

ENVIRONMENTAL ENGINEERING-II

OBJECTIVES:

- To provide the knowledge about characterization of wastewater generated in a community.
- To understand the treatment of wastewater and the need for its treatment.
- To acquire knowledge on secondary treatment of wastewater.
- To know about advanced wastewater treatment techniques.
- To understand about wastewater recycling and public acceptance for the reused water.

UNIT-I: Wastewater Generation and Characteristics:

Sources and Types of Wastewater, Pollutants in Wastewater: Point and Non-point Sources, Wastewater Generation and Quantity Estimation, Quantity Estimation of Sewage, Population Forecasting Methods, Quantity Estimation of Sewage Flow and Practice Problems, Waste water Quality Parameters characteristics and Practice Problems, Fate and Transport of Contaminants Discharged in River, Effects on DO and BOD in Natural Purification of Rivers.

UNIT-II: Preliminary and Primary Treatment Processes:

Concept of Mass Balance, Mass Balance Application in Specific Cases, Mass Balance in Reactors: Analysis and Practice Problems, Basic of Municipal Wastewater Treatment, Wastewater Treatment Units: Screening, Grit Removal and Equalization, Primary Sedimentation, Biological Treatment of Wastewater, Microbial Growth and its Kinetics, Activated Sludge Process, Trickling Filter and Rotating Biological Contactor.

UNIT-III: Secondary Treatment Processes and Sludge Management:

Introduction to Anaerobic Treatment of Wastewater, Anaerobic Degradation Processes, Anaerobic Degradation Characteristics and Applications, Anaerobic Treatment of Wastewater: UASB and Other High Rate Anaerobic Processes, Biogas Production.

Wastewater Sludge: Quantity and Characteristics, Sludge Processing and Sludge Thickening, Sludge Stabilization and Conditioning, Dewatering, Hygienisation Disposal and Reuse.

UNIT-IV: Tertiary (Advanced) Treatment of Wastewater:

Tertiary Treatment: Nutrients Removal, Adsorption and Ion Exchange, Membrane Processes, Disinfection and Chemical Treatments, Option and Conventional Approach of Wastewater Treatment System, Wetlands, SBR and SBBR, MBR and MBBR.

UNIT-V: Wastewater Recycling:

Concept of Wastewater Reuse and Recycling, Opportunities, Potential and Requirements, Centralized Vs Decentralized Recycling, Challenges, Risks and Research Trends in Wastewater Reuse and Recycling, Decision Making, Public Acceptance for Recycled Water Use, Global Practices and Case Studies.

COURSE OUTCOMES

The Student is expected to

CO1: Understand the concepts of wastewater generation and their characteristics.
CO2: Evaluate the mass balance in the wastewater and also to understand about primary and biological treatment of wastewater.
CO3: Familiarize with secondary treatment of wastewater and sludge management.
CO4: Acquire knowledge on tertiary treatment of wastewater.
CO5: Understand the importance of wastewater reuse and recycling.

Web sources: https://nptel.ac.in/courses/105105178

TEXT BOOKS:

- Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill edition.
- Elements of Environmental Engineering, K. N. Duggal, S. Chand & Company Ltd. New Delhi,2012.

REFERENCE BOOKS:

- Industrial Water and Wastewater Management, K.V.S.G. Murali Krishna.
- Wastewater Treatment for Pollution Control and Reuse, Soli. J Arceivala, Sham R Asolekar, Mc.Graw Hill, New Delhi; 3rdEdition
- Environmental Engineering –II: Sewage disposal and Air Pollution Engineering, Garg, S. K., Khanna Publishers
- Sewage treatment and disposal, P. N. Modi & Seth.
- Environmental Engineering, Ruth F. Weiner and Robin Matthews – 4th Edition Elsevier,2003
- Environmental Engineering, D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011

PROGRAMME ELECTIVE-IV/2WETPE10

PYTHON SCRIPT PROGRAMMING

OBJECTIVES:

1. To introduce the fundamental concepts of scripting language.
2. To familiarize with the OOPS concepts
3. To comprehend Modules and regular expressions in scripting environment.
4. To acquire working knowledge of File and Database Connections, and
5. To have an exposure to UI programming.

UNIT 1: Fundamentals of Python: Introduction to Python; Installation of python; Code execution ways; Data types Control statements (if, if else); Iterators and generators (For, While, yield), Operators; Functions in python.

UNIT 2: Introduction to OOPS: Features of OOPS; Classes and Objects; Types of class methods; Inheritance; Encapsulation, Abstraction; Polymorphism; Exception handling.

UNIT 3: Introduction to Modules and regular expressions: Introduction to regular expression; Working strings using RE; Working with files using RE; Introduction to modules; Creating own modules; In-built modules and GIS modules; Common usage models for Excel, Database.

UNIT 4: File and Database Connections: Reading and writing data from notepad and Excel; Installation of database (MySQL for python); Database Connections (MySQL); Working with queries (Update, delete, Insert, Retrieving).

UNIT 5: Introduction to UI programming: Introduction to TKINTER module; Root window; Containers; Canvas; Frames; UI Elements (Button, Message, Text, Menu etc…).

COURSE OUTCOMES:

The student will have exposure to

CO1: Fundamentals of PYTHON

CO2: Familiar with various elements of Python script programming, namely OOPS

CO3: Integration of Modules and regular expression in PYTHON.

CO4: Data base programming

CO5: With abovementioned background they will be able to develop small application

TEXT BOOKS:

1. Core python Programming by Dr Nageswrara rao.
2. Python Cookbook by Brian Jones
3. Dive into Python 3 Mark Piligrim

AUDIT COURSE-2/2A03

CONSTITUTION OF INDIA

OBJECTIVES:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indiannationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

UNIT-I:History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working).

UNIT-II: Philosophy of the IndianConstitution: Preamble, Salient Features.

UNIT-III: Contours of Constitutional Rights &Duties:

- FundamentalRights
- Right toEquality
- Right toFreedom
- Right againstExploitation
- Right to Freedom ofReligion
- Cultural and EducationalRights
- Right to ConstitutionalRemedies
- Directive Principles of StatePolicy
- FundamentalDuties.

UNIT-IV:Organs ofGovernance:

- Parliament
- Composition
- Qualifications andDisqualifications
- Powers andFunctions
- Executive
- President
- Governor
- Council ofMinisters
- Judiciary, Appointment and Transfer of Judges,Qualifications
- Powers andFunctions

UNIT-V: LocalAdministration:

- District's Administration head: Role andImportance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of MunicipalCorporation.
- Panchayati raj: Introduction, PRI:Zilla Panchayat.
- Elected officials and their roles, CEO Zilla Panchayat: Position androle.
- Block level: Organizational Hierarchy (Differentdepartments),
- Village level: Role of Elected and Appointedofficials,
- Importance of grass rootdemocracy

UNIT-VI: Election Commission:

- Election Commission: Role andFunctioning.
- Chief Election Commissioner and ElectionCommissioners.
- State Election Commission: Role andFunctioning.
- Institute and Bodies for the welfare of SC/ST/OBC andwomen.

COURSE OUTCOMES:

Students will be able to:

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of1956.

SUGGESTED READING

- The Constitution of India, 1950 (Bare Act), Government Publication, 2015.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2016.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

AUDIT COURSE-2/2A03

PEDAGOGY STUDIES

OBJECTIVES:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT-I: Introductionand Methodology:

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

UNIT-II:Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries.

- Curriculum, Teacher education.

UNIT-III:Evidence on the effectiveness of pedagogical practices

- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:Professional development: alignment with classroom practices and follow- up support

- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large classsizes

UNIT-V: **Research gaps and future directions**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

COURSE OUTCOMES:

Students will be able to understand:

CO1: What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
- Agrawal M (2004) curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3):361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London:DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3):272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read'campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdfHYPERLINK "http://www.pratham.org/images/resource%20working%20paper%202.pdf".

AUDIT COURSE-2/2A03

STRESS MANAGEMENT BY YOGA

OBJECTIVES:

- To achieve overall health of body and mind.
- To overcome stress.

UNIT-I: Definitionsof Eight parts of yog. (Ashtanga)

UNIT-II: Yam and Niyam.

Do`s and Don'ts in life.

- Ahinsa, satya, astheya, bramhacharya andaparigraha
- Shaucha, santosh, tapa, swadhyay,ishwarpranidhan.

UNIT-III: Asan andPranayam

- Various yog poses and their benefits for mind &body

ii) Regularization of breathing techniques and its effects-Types ofpranayam

COURSE OUTCOMES:

Students will be able to:

CO1: Develop healthy mind in a healthy body thus improving social healthalso

CO2: Improve efficiency

SUGGESTED READING

- 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal,Nagpur
- "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department),Kolkata

AUDIT COURSE-2/2A03

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES:

- To learn to achieve the highest goalhappily.
- To become a person with stable mind, pleasing personality anddetermination.
- To awaken wisdom instudents.

UNIT-I: Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22(wisdom)
- Verses- 29,31,32 (pride &heroism)
- Verses- 26,28,63,65(virtue)
- Verses- 52,53,59(dont's)
- Verses- 71,73,75,78(do's)

UNIT-II: Approach to day to day work andduties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41,47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23,35,
- Chapter 18-Verses 45, 46, 48.

UNIT-III: Statements of basicknowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62,68
- Chapter 12 -Verses 13, 14, 15, 16,17,18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18,38,39
- Chapter18 – Verses37,38,63

COURSE OUTCOMES:

Students will be able to

CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal inlife

CO2: The person who has studied Geeta will lead the nation and mankind to peace andprosperity

CO3: Study of Neetishatakam will help in developing versatile personality ofstudents.

SUGGESTED READING

- "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
- Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, NewDelhi.

LAB

GIS AND IMAGE PROCESSING LABORATORY

OBJECTIVES:

1. To delineate the watershed area.
2. To prepare various thematic maps.
3. To carry out geometric correction of satellite data using ground control points (GCPs) and preparing mosaics of satellite images.
4. To generate Digital Elevation Models (DEM) and NDVI of AOI.
5. To prepare Land use/land cover maps using unsupervised and supervised classification algorithms.

List of Practicals

- Geo Referencing of the Scanned Toposheet/maps using ground control points.
- To delineate the Boundary for the Watershed/ Catchment Area.
- To prepare the Base map for the given study Area.
- To prepare the Drainage map for the Delineated Catchment Area
- To prepare the Contour map for the Delineated Catchment Area
- To Generate the Slope map for the given study Area.
- To prepare the Land Use Land Cover map for the given study Area.
- To Import the raw Satellite data into Raster Image.
- To create a Subset for the Satellite Image
- To Mosaic the satellite Images
- Preparation of DEM map of the study area
- Preparation of drainage maps of area of interest.
- To Execute Unsupervised Classification for the Delineated Study Area
- To generate the Land Use/Land Cover for the area of interest using Supervised Classification
- To generate NDVI (Normalized Differential Vegetative Index) map.

COURSE OUTCOMES

The Student is expected to

CO1: Identify and generate different types of maps using GIS software.

CO2: Prepare the maps for the delineated catchment area using GIS.

CO3: Carry out geometric correction of satellite data using ground control points (GCPs), and preparing mosaics of satellite images.

CO4: Generate Digital Elevation Models (DEM) and NDVI from satellite image of AOI.

CO5: Prepare Land use/land cover maps using unsupervised and supervised classification algorithms.

LAB 4/2WETL12

WATER RESOURCES MODELLING LABORATORY

OBJECTIVES:

1. To apply SWAT and CROPWAT softwares in watershed analysis.
2. To identify rainwater harvesting structures.
3. To prepare Priority watershed maps, flood maps showing inundated areas, Surface water body inventory maps and drought maps.
4. To apply EPANET for designing pipe network distribution.
5. To model the aquifer parameters.

List of Practicals

- To introduce SWAT modeling software.
- Application of Geomatics for watershed analysis using SWAT.
- Application of Geomatics for rainfall-runoff modeling using freeware.
- Evapotranspiration modeling using CROPWAT.
- Preparation of groundwater table of area of interest using Geomatics
- Identification of harvesting structures in the given area.
- Preparation of prioritization of watershed maps.
- Preparation of flood maps and flood inundated areas.
- Preparation of drought maps and drought analysis.
- Preparation of surface water body inventory of the given study area.
- To design the pipe distribution by EPANET and GIS pipe.
- To model groundwater resources using MODFLOW.

COURSE OUTCOMES:

The Student is expected to

CO1: Apply the concept of geomatics for watershed analysis and rainfall-runoff modeling using SWAT.
CO2: Execute Evapotranspiration modeling using CROPWAT.
CO3: Identify harvesting structures in given area.
CO4: Priority watershed maps, flood maps including inundated areas, Surface water body maps, drought maps and their analysis.
CO5: Design the pipe distribution network and model the groundwater resources.

CORE/2WET13

MINI PROJECT WITH SEMINAR

The mini project will be based on the work done during the industrial training/internship of two months provided during semester break.

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done

- Along with the report on identification of topic for the work and
- The methodology adopted involving scientific research, collection and analysis of data,
- Determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

COURSE OUTCOMES:

CO1: Students will get an opportunity to work in actual industrial environment if they opt for internship.

CO2: In case of mini project, they will solve a live problem using software/analytical/computational tools.

CO3: Study different techniques used to analyze complex systems

CO4: Students will learn to write technical reports.

CO5: Students will develop skills to present and defend their work in front of technically qualified audience.

SEMESTER-III

PROGRAMME ELECTIVE –V/3WETPE14

APPLICATION OF SOFT COMPUTING TECHNIQUES

OBJECTIVES:

- To familiarize with soft computing concepts.
- To gain knowledge about basics of ANN and neural network modeling.
- To understand basics of the fuzzy logic concepts, fuzzy principles and relations.
- To apply knowledge of neuro fuzzy application and formulate neuro fuzzy modeling.

UNIT-I:

Introduction to Artificial Intelligence. Basics of MATLAB. Programming in MATLAB: Scripts and Functions, Graphics

UNIT-II:

Fundamental concepts of Artificial Neural Networks: Model of a neuron, activation functions, neural processing, Network architectures, learning methods.

UNIT-III: Neural network Models: Feed forward Neural Networks, Back propagation algorithm, Applications of Feed forward networks, Recurrent networks, Hopfield networks, Hebbian learning, Self organizing networks, unsupervised learning, competitive learning.

UNIT-IV:

Fuzzy Set Theory: Basic definitions and terminology and membership functions – Formulation and parameters, basic operations of fuzzy sets – complement, intersection vision, T-norm and T- conorm.
Fuzzy Reasoning and Fuzzy Inference: Fuzzy relations, Fuzzy rules, Fuzzy reasoning, Fuzzy Inference Systems, Fuzzy modeling, Applications of Fuzzy reasoning and modeling in Civil Engineering Problems.

UNIT-V:

Neuro - Fuzzy Modelling: Neuro-Fuzzy inference systems, Neuro-Fuzzy control.
Applications of Neuro-Fuzzy computing: Hydrologic Modelling time series Analysis and modeling, , Prediction of watershed runoff, Optimal reservoir operation.

Text/Reference Books:

1. Jang, JSR, C.T. Sun and E. Mizutani (1997), "Neuro-Fuzzy and Soft Computing", Prentice Hall, NJ.
2. Haykin, S.(1994), "Neural Networks, A Comprehensive Foundation", McMillan College Publishing Company
3. Kosko, B. (1997),"Neural Networks and Fuzzy Systems", Prentice Hall of India Pvt. Ltd., New Delhi
4. Rao V and H. Rao, (1996), "C++" Neural Networks and Fuzzy Logic, BPB Publications, NewDelhi.
5. Pratap R (2010). Getting Started with MATLAB, OXFORD Publication.

Course outcomes:

Upon completion of this course students will be able to:

1. List the facts and outline the different process carried out in fuzzy logic and ANN.
2. Apply Soft computing techniques to solve character recognition, pattern classification, regression and similar problems.
3. Explain the concepts of soft computing and familiar with various computing software.
4. Evaluate various techniques of soft computing to defend the best working solutions.

PROGRAMME ELECTIVE –V/3WETPE14

ADVANCED NUMERICAL METHODS

OBJECTIVES:

1. To apply Computer oriented methods for solving numerical problems in science and engineering
2. To solve Numerically systems of simultaneous linear equations, nonlinear algebraic equations (root solving), differentiation and integration, ordinary differential equations, interpolation.

UNIT-I: Introduction: Introduction to numerical methods and analysis and computer programming; Error Analysis: Approximations; Round off and Truncation errors; Error Analysis. Roots of Equations (single variable): Method of Bisection, Regular Falsi, Secant Method, Fixed point Method, Newton Raphson method, Multiple roots. Analysis and order of convergence. Polynomials: Mueller's method, Bairstow's method.

UNIT-II: Solution of Linear System of Equations: Dense, Sparse and Banded systems, Direct Methods -Gauss Elimination, Gauss-Jordan, LU decomposition, Thomas Algorithm. Condition number of matrix, effect of round-off errors. Iterative improvement of solution by direct methods. Iterative methods: Jacobi and Gauss Seidel iteration, rate of convergence of iterative methods. Successive over Relaxation. Solution of Nonlinear System of Equations: Iterative methods, Fixed Point iteration, Newton-Raphson method.

UNIT-III: Approximation Theory: Approximation of Continuous functions -basis functions, norms and semi-norms, inner product, formulation of least square problem, derivation of normal equations, orthogonal basis functions. Tchebycheff and Legendre polynomials. Interpolating polynomials: Newton's divided difference polynomial, Lagrange polynomials. Interpolation using spline functions: linear, quadratic and cubic splines. Polynomial regression of discrete data. Transformation of nonlinear problems to linear approximation problems.

UNIT-IV:Eigenvalues and Eigenvectors: Power method, inverse power method. Fadeev-Leverrier method for formulation of the Characteristic polynomials, QR decomposition.

Numerical Differentiation: Introduction to finite difference approximations, truncation error analysis. Finite difference approximations on irregular grid. Richardson's extrapolation. Numerical Integration: Rectangular rule, Trapezoidal Rule and Simpson's rule. Local and global error analysis.

UNIT-V: Romberg Integration. Gauss Quardrature, Improper Integrals. ODE, Initial Value Problems: Euler's method, improvement of Euler's method, Runge-Kutta Methods, Multi Steps Methods. Predictor Corrector Methods. ODE, Boundary Value Problems: Decomposition into Linear System of ODEs, Shooting Method, Direct Method. Partial Differential Equations: Elliptic, Parabolic and Hyperbolic Equations, Explicit and Implicit Methods, Crank Nicholson Method.

REFERENCES:

- Jain M.K, SRK Iyenge and RK Jain, "Numerical Methods for Scientific&Engg. Computation".
- Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
- Gerald C.F and PO Wheatley "Applied Numerical Analysis".
- Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand &Sons.
- Johnson R.A "Probability and Statistics for Engineers."
- Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)", Willey Publication.

COURSE OUTCOMES:

After the completion of the course the students will be able to

1. Familiarize with finite precision computation, numerical solutions of nonlinear equationsin a single variable.
2. Familiarize with numerical interpolation and approximation of functions, numerical integration and differentiation.
3. Familiarize with numerical solution of ordinary differential equations.
4. Familiarize with calculation and interpretation of errors in numerical methods

PROGRAMME ELECTIVE –V/3WETPE14

MUNICIPAL SOLID WASTE MANAGEMENT

OBJECTIVES:

- The students are expected to learn about solid waste, characteristics and its collection methods
- It creates awareness regarding waste handling and processing.
- The students learn about biological treatment of solid waste.
- The students understand about managing the municipal solid waste.
- The students acquire knowledge about legislation.

UNIT –I: Introduction: Introduction to solid waste, Functional elements, Types and sources of solid waste, Sampling and characteristics, Estimation of solid waste quantity, Factors affecting solid waste generation rate, Handling, separation and storage at source, Processing at source, Primary collection, Types of collection system, Analysis of collection system,

UNIT-II: Waste Handling and Processing: Need and types of transfer station, Transport means and methods, Unit operation for component separation, Material recovery facilities (MRF), Recycling of dry waste components, Waste as a fuel, Incineration/Combustion, Flue gas characteristics and treatment, Solid residue generation, characterization and treatment, Waste-to-energy (WtE) plants (case studies) pyrolysis and gasification.

UNIT –III: Biological Treatment of Solid Waste: Definition and phases of composting, Factors affecting composting process, Types of composting, Compost quality, Vermicomposting, Definition, stages and factors affecting anaerobic digestion, Pre-treatment and co-digestion for enhancement of biogas production, Types of biogas digesters, Site selection and types of landfill, Leachate collection and treatment, Landfill gas collection and treatment, Design of landfill & Bio-mining of old dumpsite.

UNIT-IV: Solid Waste management: Construction and demolition waste, Management of bio-medical, e-waste and inert waste, Integrated solid waste management (ISWM), Municipal solid waste management rules.

UNIT-V: Integrated solid waste management and legislation: Financing in MSWM projects, Public-Private-Partnership (PPP), Public-Private-Partnership (PPP) in MSWM projects.

COURSE OUTCOMES

The student is expected to

CO1: To know about characteristics and collection of waste.
CO2: Learn about waste handling and processing.
CO3: Understand about treatment of solid waste.
CO4: Be familiar with the management of the municipal solid waste.
CO5: Gain knowledge about finance and legislation of municipal solid waste.

Web sources: https://nptel.ac.in/courses/105103205

TEXT BOOKS:

- Handbook of Solid Waste Management, 2nd Edition by George Tchobanoglous and Frank Kreith, 2002, McGraw-Hill Companies, Inc.
- Municipal Solid Waste Management Processing, Energy Recovery, Global Examples by P. Jayarama Reddy, 2011, BS publishers.

REFERENCE BOOKS:

1. Integrated Solid Waste Management by George Tchobanolous, Hilary Theisen& Samuel A.Vigil, McGraw-Hill Companies, Incorporated, 1993.
2. CPCB Manual on Solid Waste Management, 2003.

PROGRAMME ELECTIVE –V/3WETPE14

HYDRO POWER ENGINEERING

OBJECTIVES:

- It deals with understanding of hydropower schemes and types
- Intended to create awareness regarding intake structures and penstocks
- The students learn about water hammer and its analysis
- The students understand surge tanks, their working and computations
- 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, fore bay trash rack, gates and tier operation, air vent, 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:

- Hydropower structure by R.S.varshney, 2014.
- Water Power Engineering by M.M. Dandekar, K. N.Sharma, Vikas Publishing House2013.
- Fluid Transients by V.L.Streeter, Prentice Hall, 1993.

PROGRAMME ELECTIVE –V/3WETPE14

MICRO IRRIGATION TECHNOLOGIES

OBJECTIVES:

- The students understand the concept of micro irrigation, survey of fields and data to be collected in the design of irrigation system.
- The students gain knowledge about drip and sprinkler irrigation systems including their design and their suitability to different crops.
- The students gain knowledge about land scaping for irrigation, poly houses, farm houses.
- The students became familiar with Automation and Fertigation.
- The students learn installation, operation and maintenance of piping system.

UNIT I: Field Data Collection: Introduction to Survey of fields, Introduction to survey for Pipelines, Soil and Water Sample collection procedures, Data to be collected from field and their importance in design of an irrigation system.

UNIT II: Drip and Sprinkler Irrigation Systems: Preparation of Drawings, Estimate and Bill of Quantities, Use of item codes. Worked out Examples for Tree Crops, Row Crops & Intercrops, Introduction of sprinkler Irrigation systems, types of sprinklers, Mini and Micro sprinklers, Preparation of designs, drawings, Estimate and Bill of Quantities, Use of item codes.

UNIT III: Landscape Irrigation System: Site specific installation requirement, Understanding the landscape architects plan, Irrigation system for road dividers, poly houses, farm houses, sports ground – GUN sprinkler, Design of Sprinkler Irrigation Systems for Turf and Golf Courses, Use of treated wastewater.

UNIT IV: Automation and Fertigation: Concept, Necessity, Advantages, Types, Components, Design, preparation of Bill of quantities, Preparation of irrigation and fertigation schedule, Fertigation with alkaline water, Fertigation with acid water, Special instruction on use of equipment.

UNIT -V: Installation, Operation and Maintenance of Irrigation Systems: Planning for trenching work, transportation and storage of PVC/HDPE pipes, Lowering, Laying and Jointing of pipes and installation work, Design, Operation & maintenance of lift irrigation piping. Operation and Maintenance of Micro Irrigation Systems: Daily, weekly and monthly maintenance, Chemical Treatments, their importance, procedures, calculations of chemical doses.

COURSE OUTCOMES:

The student is expected to

CO1: The design of an irrigation system.
CO2: Know about design of drip and sprinkler irrigation systems.
CO3: Understand the concepts of land scaping.
CO4: Gain knowledge on automation and fertigation.
CO5: Familiarize with operation and maintenance of irrigation systems.

TEXT BOOKS:

- Micro Irrigation Scheduling and Practices (Innovations and Challenges in Micro Irrigation) by Megh R. Goyal, Balram Panigrahi, Sudhindra N. Panda, Apple Academic Press, 2017
- Land and Water Management Engineering by V.V.N. Murthy, Kalyani Publishers, 2008.
- Irrigation –Theory and Practice" by Withers and Vipond, S, Cornell University Press, 1980.

REFERENCE BOOKS:

- Irrigation: Theory and Practice by Michael. A.M 2nd Edition, Vikas Publishing House,2009.
- Irrigation Principles and Practice by Hansen, V.E., Israelson O.S. and Stringham G.C. John Wiley & Sons, N York 1963.

PROGRAMME ELECTIVE –V/3WETPE14

DESIGN OF HYDRAULIC STRUCTURES

Course Objectives:

1. To understand the basics of hydro power, classification of hydro plants.
2. To know the basics of Hydraulic structures along with the design of different components associated with it.
3. To analyze various hydraulic structures like concrete dam and spillway.
4. To get knowledge of various types of dam and understand different elements of dam.

UNIT-I: Introduction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

UNIT-II: Classification of Hydel Plants: Run off river plants, general arrangement of runoff river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three-unit arrangement, reversible pumps turbines, problems of operation, power house, efficiency of P-S plants.

UNIT-III: Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. **Intakes:** Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels.

UNIT-IV: Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

Concrete Dams: Investigation and Planning. Forces on Concrete dams, Types of loads, Stability analysis. Safety criteria, Gravity analysis, Internal stress calculation and Galleries. Joints and keys and cooling arrangement. Water stops at joint, closing gaps. Buttress and Arch Dam. Mass concrete for dams: Properties and quality control. Pressure grouting.

UNIT-V: Spillway: Types, Design principles of Ogee spillway, side channel spillway, Chute spillway, Siphon Spillway, shaft Spillway, Gates & Valves. Energy dissipators and stilling basin design. Outlet works.

Earth and rock fill Dams: subsurface explorations methods, cutoff trenches, sheet piling cutoffs, upstream blankets, horizontal drainage blankets and filters, toe drains and drainage trenches, pressure relief well. Seepage through embankments, Stability analysis of slopes of homogeneous and zoned embankment type under different reservoir conditions, Upstream and downstream slope protection measures.

COURSE OUTCOMES:

Upon completion of this course students will be able to:

1. Enhance knowledge on various concepts of hydro power generation and types of Hydel plants.
2. Select type of hydraulic structure and estimate tidal power, capacity and water load lines throughout various hydraulic structures.
3. Perform structural design and analyze the various aspects of different hydraulic structures.
4. Be able to select the type of dam, design and to construct.

PROGRAMME ELECTIVE –V/3WETPE14

WEB DEVELOPMENT

OBJECTIVES:

1. To provide an exposure to concepts of HTML5
2. To provide hands on experience on working with HTML5 concepts
3. To provide an exposure to applying styles with CSS3
4. To study concepts of DotNet basics.
5. To provide a glimpse of working with windows services

UNIT-I: HTML5: HTML 5, Overview of HTML 5, HTML5 Syntax, Forms, Form Elements, New attributes for <form>, New attributes for <input>,Video and Audio, Types of Elements, HTML5 NEW ELEMENTS, Migration from HTML4 to HTML5, HTML5 DEPRECATED TAGS, HTML5 DEPRECATED ATTRIBUTES.

UNIT-II: Advanced concepts of HTML5: App Cache or Offline Applications, Web Storage, Web Workers, Server Sent Events - One Way Messaging, MathML, Geolocation, Drag and Drop API, File API, WEB SQL, Canvas Overview, SVG.

UNIT-III: CSS3: CSS 2.0 vs CSS 3.0,Introduction to css3,whats new in css3.0,border, background, Gradients, Linear Gradients, Radial Gradients, text effects, FONT Face, Google fonts, 2D Transforms, 3D Transforms, Box Resize, Box Sizing, Outline, Animations, Selectors, Multiple Columns, Converting Layout to HTML 5 & CSS 3.

UNIT-IV: WORKING With DOTNET: Introduction to Microsoft .NET framework: arrays, operators, flow control statements, functions and properties, C#.NET Language Basics-Working with Data Types -Type Conversion, Boxing & Unboxing, Conditional Statements (if, switch condition), operators, Looping Arrays, Enumerations.

UNIT-V: Creating Web Services: Windows forms and Event Controls., Understanding the services, Windows service Architecture, Windows Services- Service base class, Service Process installer, Service Installer, Creating a Windows Service, Installing and uninstalling windows services, Google Earth, KML Virtual Earth & Bhuvan.

COURSE OUTCOMES:

The students will have exposure to

CO1: Fundamentals of HTML5.
CO2: Various types of tags in HTML5.
CO3: Familiarization with CSS3.
CO4: Concepts and working knowledge in DotNet.
CO5: Concepts and creation of web services.

TEXT BOOKS:

1. The Complete Reference: HTML and CSS, 2nd & 5th Editions by Thomas A. Powel, McGraw Hill.
2. Ajax: The Complete Reference – Thomas A. Powel, McGraw Hill, 2008.
3. Web Technologies by Puntem bekhar Edition-2

REFERENCE BOOKS:

1. Professional AJAX – Nicholas C Zakas et al, Wrox publications, 2006.
2. An Introduction to Web design and programming, Wang, Thomson.
3. Visual C# .NET Programming

OPEN ELECTIVE/3WETOE15

BUSINESS ANALYTICS

OBJECTIVES:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision-making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT I: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNIT-II: Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

UNIT-IV: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

UNIT-VI: Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES:

Students will be able to

CO1: Demonstrate knowledge of data analytics.

CO2: Think critically in making decisions based on data and deep analytics.

CO3: Use technical skills in predicative and prescriptive modeling to support business decision-making.

CO4: Translate data into clear, actionable insights.

REFERENCE BOOKS:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FTPress.
- Business Analytics by James Evans, persons Education.

OPEN ELECTIVE/3WETOE15

INDUSTRIAL SAFETY

UNIT-I:Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types ofmaintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III: Wear and Corrosion and Their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT-IV: Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

REFERENCE BOOKS:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services, 1987.
- Maintenance Engineering, H. P. Garg, S. Chand andCompany1986.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman &Hall London, 1975.

OPEN ELECTIVE/3WETOE15

OPERATIONS RESEARCH

OBJECTIVES:

- The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints
- The objective of this course is to enable the student to understand and analyze managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively.
- To learn and solve problems on scheduling models.
- To understand and solve problems on dynamics assignment, transportation, etc.

UNIT I: Basics of Operational Research, Optimization Techniques, Model Formulation, models, General L.R Formulation.

UNIT II: Formulation of a LPP - Graphical solution - Simplex Techniques -revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT III: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem – Network analysis: CPM/PERT

UNIT IV: Scheduling - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models.

UNIT V: Transportation and Assignment Problem- Finding basic feasible solutions –Optimality test, Assignment model: formulation, Hungarian method for optimal solution, travelling salesman problem.

COURSE OUTCOMES:

CO1: Students should able to solve linear programming problems using appropriate techniques and optimization

Solvers, interpret the results obtained.

CO2: Students should able to apply the concept of non-linear programming and formulate Network models for service and manufacturing systems

CO3: Students should able to carry out scheduling models.

CO4: Student should able to model the real world problems.

CO5: Student should able to understand variety of problems such as assignment, transportation, etc.

REFERENCES BOOKS:

- H.A. Taha, Operations Research, An Introduction, PHI,2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi,2008
- Hitler Libermann Operations Research: McGraw Hill Pub.2009
- Pannerselvam, Operations Research: Prentice Hall of India2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

OPEN ELECTIVE/3WETOE15

COST MANAGEMENT OF ENGINEERING PROJECTS

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

REFERENCE BOOKS:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2008.
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan, S. Mark young, Anthony A. Atkinson, Management &Cost Accounting, person education(US) 1994.
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. PHI Learning.
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd., 2007.

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COMPOSITE MATERIALS

UNIT–I: **Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: **Reinforcements:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition,2007.

REFERENCE BOOKS:

- Hand Book of CompositeMaterials-ed-Lubin, 1997.
- Composite Materials – K.K.Chawla, Springer international ediotion 2006.
- Composite Materials Science and Applications – Deborah D.L.Chung, Springer international ediotion 2010.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi, CRC Press 2002.

OPEN ELECTIVE/3WETOE15

WASTE TO ENERGY

UNIT-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES BOOKS:

- Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OPEN ELECTIVE/3WETOE15

ENVIRONMENTAL STATISTICS

OBJECTIVES:

- To understand the concept, historical context and wider importance of Climate change and its impacts.
- To understand the framework of climate risk assessment
- To develop solutions for climate change adaptation and mitigation for different sectors
- To understand the Indian and international climate change policy and finances

UNIT-I: Introduction to Statistics: introduction to data, Types of data, sources of paid and free data, role of environmental statistics, Environmental Sampling, types of sampling, population, descriptive and inferential statistics, mean, standard deviation, standard error, median, mode, quartiles, kurtosis, variance and their significance, Exploratory data analysis and data visualization, hands-on in MS Excel.

UNIT-II: Introduction to R: What is R? R command and Scripts, R packages, R Working directory, R functions, getting data into R, Data cleaning, sub-setting and combining data, data transformation in R, carry out all basic analysis in R in both descriptive and inferential statistics

UNIT-III: Probability and Statistic: Experiments, Counting rules, events and probability, conditional probability and Bayes theorem, Discrete Probability distribution, Binomial and Poison Probability, Continuous probability distribution, Normal Probability distribution, interval estimation, Hypothesis test, Type I and Type II errors, inference of population mean known and unknown, use of environmental data, hands-on in Excel and R.

UNIT-IV: Analysis of Variance, Correlation and Regression: ANOVA, ANCOVA, simple regression model, Non-linear regression, coefficient of determination, t-test, F-Test, point and interval estimation, residual analysis, multiple regression, logistic regression, forecasting methods, Time series, Temporal data, autoregressive modeling, use of environmental data, hands-on excel and R.

UNIT-V: Spatial Statistics: Raster and Vector data reading and analysis in R, spatial point pattern analysis, local and global statistics, complete spatial randomness (chi-square, distance methods, Ripley's K-function), spatial measurements (autocorrelation, Morans I, Geary's c, semi variogram), Spatial correlation, spatial regressions, spatial prediction (simple, ordinary, universal kriging) hands on in R using environmental data,

COURSE OUTCOMES

The Student is expected to

CO1: Understand the data, sampling procedures, descriptive and inferential statistics in environmental data

CO2: Use R and MS Excel for basic statistical analysis for environmental data

CO3: differentiate discrete and continuous probabilities and its application in environmental science, carry out various test and hypothesis

CO4: use correlation, regression and analysis of various in R and Excel for interpreting environental data and use it for decision making

CO5: Understand the concept of spatial statistics and use it for environmental data for decision making

TEXT BOOKS:

- Piegorsch, W. W., & Bailer, A. J. (2005). Analyzing environmental data. John Wiley & Sons.
- Qian, S. S. (2016). *Environmental and ecological statistics with R*. Chapman and Hall/CRC.

REFERENCE BOOKS:

- Probability and statistics applications for environmental science by Shaefer, S. J., & Theodore, L. (2007). CRC Press.
- Statistical geoinformatics for human environment interface by Myers, W. L., & Patil, G. P. (2012). . Chapman and Hall/CRC.
- Statistics for environmental engineers by Brown, P. M. B. L. C., &Hambley, D. F. (2002).

DISSERTATION-I

DISSERTATION WORK REVIEW-I

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review.

The preliminary results (if available) of the problem may also be discussed in the report.

The work has to be presented in front of the examiners panel set by Head DRC.

The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

COURSE OUTCOMES:

CO1: Studentswill be exposed to self-learning various topics.
CO2: Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
CO3: Students will learn to write technical reports.
CO4: Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

DISSERTATION WORK REVIEW-II/3WET16

It is a continuation of Project work started in semester III.

He has to submit the report in prescribed format and also present a seminar.

The dissertation should be presented in standard format as provided by the department.

The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.

The report must bring out the conclusions of the work and future scope for the study.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator.

The candidate has to be in regular contact with his guide.

COURSE OUTCOMES:

CO1: Students will be able to use different experimental techniques.
CO2: Students will be able to use different software/ computational/analytical tools.
CO3: Students will be able to design and develop an experimental set up/ equipment/test rig.
CO4: Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
CO5: Students will be able to either work in a research environment or in an industrial environment.
CO6: Students will be conversant with technical report writing.
CO7: Students will be able to present and convince their topic of study to the engineering community.

Eligibility Criteria:

M.Tech (Water and Environmental Technology)	B.E./B.Tech/AMIE in Civil Engineering/ Agricultural Engineering/ Environmental Engineering and equivalent.