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Department of Civil Engineering
University college of Engineering Kakinada
Jawaharlal Nehru Technological University Kakinada

M.Tech(Water Resources Engineering)

R23 Regulations

BOS Meeting Held on 8th 9th and 10th September 2023

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THE UNIVERSITY OF THE SOUTH PACIFIC
SCHOOL OF DISTANCE EDUCATION
P.O. BOX 11111, SUVA, FIJI

M. TECH (WATER RESOURCES ENGINEERING)

1999

1999

ACADEMIC REGULATIONS (R23)

COURSE STRUCTURE

For

M.Tech Two Year Programme

(Applicable for the batches admitted from the A.Y. 2023-24)



**UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)JAWAHARLAL
NEHRU TECHNOLOGICAL UNIVERSITY KAKINADAKAKINADA – 533003,
ANDHRA PRADESH, INDIA**



UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
(Established by Andhra Pradesh Act No.30 of 2008)
Kakinada – 533 003, Andhra Pradesh (India)

ACADEMIC REGULATIONS R23 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2023-24 onwards. The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

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

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

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 The student shall register for all 68 credits and secure all the 68 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 PROGRAMMES OF STUDY

The following specializations are offered by various departments at present for the M. Tech Programme of study.

Department	Programme
Civil Engg.	1. M.Tech- Structural Engineering 2. M. Tech- Soil Mechanics and Foundation Engineering 3. M.Tech-Water Resource Engineering (UA)
EEE	1. M.Tech- High Voltage Engineering 2. M.Tech- Advanced Electrical Power System 3. M.Tech- Power Electronics and Drives

ME	1. M.Tech- CAD/CAM 2. M.Tech- Machine Design 3. M.Tech-Thermal Engineering
ECE	1. M.Tech- Computer and Communication 2. M.Tech- VLSI and Embedded Systems 3. M.Tech- Instrumentation and Control Engineering (UA)
CSE	1. M.Tech- Computer Science and Engineering 2. M.Tech- Artificial Intelligence and Machine Learning 3. M.Tech-Cyber Security

4.0 ATTENDANCE

- 4.1** The faculty handling the course will finalise the attendance as per schedule / before the last instructional day of the course and submit to the Principal through the head of the department.
- 4.2** A student with less than 75% of consolidated attendance (and/or less than 50% in each and every course), will not be permitted to appear for the end- semester examinations, irrespective of the reason for the shortfall of the attendance. Further, a student with less than 75% of attendance in Dissertation Phase-2 (IV Semester) will not be permitted to submit his project work.
- 4.3** The student is however permitted to avail Academic/Medical Leave/ NCC / NSS / Cultural / Sports/ Minor Medical exigencies etc., up to 10% for attending academic related activities like, Industrial Visits, Seminars, Conferences, Competitions etc., with the prior approval of the HoD. After the event, the student should submit the relevant documents for proof to the HoD for approval of the Academic Leave.
- 4.4** Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%, and minimum of 50% in each and every course including laboratory, Dissertation phase-1, Dissertation Phase-2) for a maximum of **ONE time** shall be granted by the College Academic Committee. A prescribed fee shall be payable towards condonation of shortage of attendance.
- 4.5** Shortage of Attendance below 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.
- 4.6** A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next.
- 4.7** If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

5.0 EVALUATION

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

- 5.0** For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The weightage of Internal marks for 40 consists of Descriptive – 32 and Assignment – 08 (open book exam). Descriptive exam shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 8 marks. The descriptive examination conducted for 32 marks are to be added to the assignment 8 marks for finalizing internal marks for 40. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Semester End Exam Paper contains FIVE mandatory questions (one question from one unit) with internal choice, each carrying 12 marks for a total of 60marks.
- 5.1** For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded as internal marks, based on the day to day work-10 marks, Record-10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-15, Experimentation-25, Results-10 , Viva-voce-10.
- 5.2** For **Mini Project with seminar**, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For Mini Project with seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 40% marks and remaining 60% marks are awarded by the project review committee.
- 5.3** A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together. For integrated courses, student should secure the minimum academic requirements in both theory and practical together.
- 5.4** In case the candidate does not secure the minimum academic requirement in any subject(as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given a chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the college by paying the requisite fees before the start of the semester in which re-registration is required.
- 5.5** In case the candidate secures less than the required attendance in any re registered

subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.

- 5.6 Laboratory examination for M. Tech. programmes must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher from the same department and the second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective HoD.
- 5.7 Student is allowed to register for 12 week SWAYAM / NPTEL MOOC courses (recommended by HoD/BoS) and can obtain required credits during II Semester itself. In any case, if a student fails in obtaining credits, he is allowed to repeat the initially opted course / change to another MOOC course or regular course and will be considered as regular candidate only. After successful completion, by end of III/IV Semester, he needs to submit the course certificate (through HoD) to the exam section to perform credit transfer.
- 5.8 In addition to credit courses, for completing the programme and obtaining degree, a student needs to complete audit courses. Audit courses will be conducted, evaluated as normal credit courses, and the assessment will be graded as Pass/Fail.
- 5.9 Students shall undergo mandatory summer internship (2 credits) for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of Head of the Department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For internship, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF PROJECT/DISSERTATION (Phase-I and II):

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

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.
- 6.2 Registration of Dissertation / Project Work: The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters.
- 6.3 A candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work (published base paper(s) / real time project / industry oriented) for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).
- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (PRC) shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

- 6.5** A candidate shall present seminar on his project work status in two stages at least with a gap of **THREE** months between them. If the candidate is absent to any of these two seminars, he should again attend the seminar within two weeks by providing proper evidence to the Project Review Committee regarding his absence.
- 6.6** A candidate is permitted to submit Project Thesis (Dissertation) only after successful completion of theory and practical course **with the approval of PRC** not earlier than 40 weeks from the date of registration of the project work.
- 6.7** Continuous assessment of Dissertation-I and Dissertation-II during the Semester will be monitored by the PRC.
- 6.8** There will be pre-submission seminar at the end of academic term. **After the approval the student has to submit the detail report.**
- 6.9** The candidate may be allowed to submit the project report if the project work is published or accepted in a reputable national or international journal or conference.
- 6.10** Three copies of the Project Thesis certified by the supervisor shall be submitted to the College along with plagiarism report (<40%).
- 6.11** The thesis shall be adjudicated by one examiner selected by the Principal, from the panel of 5 examiners, eminent in that field, submitted by the guide concerned and head of the department.
- 6.12** If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Principal.
- 6.13** If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor/ Internal examiner, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for a maximum of 100 Marks. **Out of 100 marks, supervisor awards 30 marks and remaining 70 marks are awarded by the board.**
- 6.14** The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.
- 6.15** If the report of the Viva-Voce is unsatisfactory (i.e., <50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Institution.

7.0 CUMULATIVE GRADE POINT AVERAGE (CGPA)

Marks Range (Max – 100)	Letter Grade	Level (G)	Grade Point
≥ 90	>90	Outstanding (O)	10
≥80 to <90	90-80	Excellent (S)	9

≥ 70 to < 80	80-70	Very Good (A)	8
≥ 60 to < 70	70-60	Good (B)	7
≥ 50 to < 60	60-50	Fair (C)	6
< 50	< 50	Fail (F)	0
		Absent	0

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA (S_i) = \sum (C_i \times G_i) / \sum C_i$$

Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

Computation of CGPA

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a programme, i.e.

$$CGPA = \sum (C_i \times S_i) / \sum C_i$$

Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester. The SGPA and CGPA shall be rounded off to TWO decimal points and reported in the transcripts.

8.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	From the CGPA secured from 68 Credits.
First Class with Distinction	≥ 7.75 without backlog history	
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	

The secured grade, grade points, status and credits obtained will be shown separately in the memorandum of marks.

Withholding Of Results

If the student has not paid the dues, if any, or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued or detained candidates are eligible for re-admission into same or equivalent subjects at a time as and when offered.

10.0 GENERAL

- 10.1** Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
- 10.2** The academic regulation should be read as a whole for the purpose of any interpretation.
- 10.3** In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.4** The College 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 College.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1. (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.
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 External 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 External 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 part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all External 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.	<p>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.</p> <p>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.</p>
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.	

*Examination Branch Appointment of Subject
Expert for QP Setting*

From

Date: 01.10.2023.

*Dr UV Ratna Kumari
Vice-Principal*

To

I am advised to inform you that you are appointed as subject expert to set the question paper(s) as per the details noted below. You are requested to set the question paper(s) in MS word document format and send a soft copy oiel.ucek@intucek.ac.in. The hard copies of the question paper(s) shall be sent along with the remuneration bill.

You are requested to set the Question Paper(s) by following OBE pattern, as per the revised Bloom's Taxonomy herewith enclosed. Keep this appointment strictly confidential.

1. You are requested to prepare a balanced question paper within the prescribed syllabus covering the entire syllabus. The duration of the examination is **3-hours** and you are requested to prepare the questions in such a way that student must be able to answer each question for about 35-45 minutes time.
2. It is informed that the question paper covering the topics of all FIVE units for 60 marks. Also the question paper shall be set as per the format enclosed, containing ten main questions (two from each unit) over FIVE-units of syllabus with internal choice and **12marks** for each question. The main question shall contain sub questions like 1(a), 1(b) etc.
3. The student has to answer FIVE mandatory questions (One question from one unit).
4. The requirement of data books, codes, graphs etc. may please be indicated on the question paper.
5. You are requested to give the distribution of the marks for each question.
6. **You are requested not to reproduce questions from previous question papers.**
7. Remuneration for setting of one question paper for M.Tech(PG) programme is **Rs. 1,200/-** per set.
8. You are requested to confirm your acceptance through e-mail.

You are requested to reject the offer and intimate the same to the Vice Principal, if any of your relatives are writing the examination or if you are involved in any extra assignment in any tutorial/coaching centers. Please send the question paper in the enclosed model (model is attached for reference).

Question Paper Details		R19 OBE Pattern			
Course	M.Tech (PG)	Question No.	Unit/CO's	Bloom's Taxonomy Level	Marks
Name of the Examination	I-M.Tech, I-Sem (R23) Regular End Exams, Dec-2023	I	U1/CO1	L2/L3/L4	12
Subjects	XXXXXXXX	II	U2/CO2	L2/L3/L4	12
Branch	XXXXXXXXXX	III	U3/CO3	L2/L3/L4	12
No of Question Paper Sets	1 (Ono)	IV	U4/CO4	L2/L3/L4	12
Last Date for submission	14/11/2023	V	U5/CO5	L2/L3/L4	12

Note: U1: Unit 1, CO1: Course Outcome 1

L1: Level 1(Bloom's Cognitive Level) L2: Understanding Level; L3: Apply Level; L4: Analyze Level.

VICE-PRINCIPAL

University College of Engineering Kakinada (Autonomous)

Jawaharlal Nehru Technological University Kakinada

() M. Tech. () Semester (R23) Regular Examinations, ()

Course Code:

COURSE NAME (NAME OF BRACH)

Time: 3 hrs.

Max Marks: 60

Answer all five questions

5X12=60

Q.No	Question	Marks	CO	BL
UNIT-1				
1(a)				
1(b)				
(OR)				
2(a)				
2(b)				
UNIT-2				
3(a)				
3(b)				
(OR)				
4(a)				
4(b)				
UNIT-3				
5(a)				
5(b)				
(OR)				
6(a)				
6(b)				
UNIT-4				
7(a)				
7(b)				

(OR)				
8(a)				
8(b)				
UNIT-5				
9(a)				
9(b)				
(OR)				
10(a)				
10(b)				

Note: CO: Course Outcome, BL: Bloom's Cognitive Level;

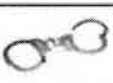


Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- ⇒ Ragging within or outside any educational institution is prohibited.
- ⇒ Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	 6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	 2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	 10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA-533003, Andhra Pradesh (India)
For Constituent Colleges and Affiliated Colleges of JNTUK



Ragging

ABSOLUTELY

NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.



Jawaharlal Nehru Technological University Kakinada
For Constituent Colleges and Affiliated Colleges of JNTUK

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

COURSE STRUCTURE AND SYLLABUS

R-23 Regulations

M.Tech (Water Resources Engineering)

BOS Meeting held on 9-10 September, 2023



DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING
Jawaharlal Nehru Technological University Kakinada

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

Board of Studies (Water Resources Engineering) Meeting: September 2023 (R23).

SEMESTER I

S. No	Course Code	Category	Course Name	P.Os	L	T	P	C
1	MWRI-1	PC -1	Advanced Fluid Mechanics		3	0	3	4.5
2	MWR I-2	PC -1	Advanced Hydrology		3	0	--	3
4	MWRI-3	PE- I	Program Elective-I		3	0	--	3
			a)Hydraulic Structures b) Data analytics in Water Resources c) Free Surface Flows					
5	MWRI-4	PE-II	Program Elective-II		3	0	--	3
			a) Climate change impacts on Water Resources b)Irrigation Water Management c)Hydrological hazards and Risk management d). Water resources Planning and Management					
6	MWRMC	CC	Research Methodology and IPR		2	0	0	2
7	MWRPI-1	Laboratory 1	Experimental Hydraulics Lab		-	-	3	1.5
8	MWRA-1	Audit Course –1	Constitution of India		2	0	0	0
			Total Credits /Marks					17

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

Board of Studies (Water Resources Engineering) Meeting: September 2023 (R23).

SEMESTER II

S. No	Course No	Category	Course Name	P.O s	L	T	P	C
1	MWRII-1	PC- 3	Remote Sensing and GIS		3	0	0	4.5
2	MWRII-2	PC -4	Ground Water Engineering		3	0	--	3
3	MWRII-3	PE-III	Program Elective III		3	0	--	3
			a) Socio-Economics and Policy in Water Resources b) Urban Hydrology c)Eco – Hydrology					
4	MWRII-4	PE- IV	Program Elective IV		3	0	--	3
			a) Environmental impact assessment of water resources projects b) Contaminant Hydrology c)Coastal and Ocean Engineering					
5	MWRP II-2	Laboratory 2	Hydrologic Stimulation Lab		-	--	4	1.5
6	MWRMP		Mini Project With Seminar		0	0	4	2
7	MWRA-2	Audit Course –2			2	0	0	0
			Total Credits / Marks					17

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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SEMESTER III

S. No.	Course No	Category	Course Name	P.Os	L	T	P	C
1	MWRIII-1	PE-V	Program Elective V* (MOOCs (NPTEL) - 12 Week Course recommended by the department)		3	0	0	3
			a)Hydrogeology and Geophysical Exploration b)Watershed Management and Modeling c)MOOCS/NPTEL Course					
2	MWRIII-2	O E/MOOCs	Open Elective / MOOCs*		3	0	0	3
3	MWRIII-2	Internship	Internship (Performed during summer / I year break)		-	-	-	2
3	DISSERTATION	PJ Core	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)**		--	--	20	10
			Total Credits / Marks					18

* Students Going for Industrial Project / Thesis will complete these courses through MOOCS

** Evaluated and displayed in 4th Semester marks list

SEMESTER IV

S. No	Course No	Category	Course Name	P.Os	L	T	P	C
1	DISSERTATION	PJ.	Phase II (Continued from III Semester)		0	0	32	16
			Total Credits / Marks					16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**Board of Studies (Water Resources Engineering) Meeting: September 2023 (R23).****Program Educational Objectives (PEOs):**

PEO1	Apply knowledge of basic sciences and engineering to analyze water resources systems for socio- economic development
PEO2	To better understand the flow principles and apply to solve the fluid flow problems
PEO3	Able to give design solution to complex water resources engineering problems and manage the available water resources environment
PEO4	Assess the environmental impact of water resources projects

Mapping of PEOs with Mission statements

	PEO1	PEO2	PEO3	PEO4
M1				
M2				
M3				
M4				

Program Outcomes (POs):

PO1	Ability to independently carryout research / investigation & development work to design and manage water resources systems to solve practical problems
PO2	Ability to work and present a substantial technical report / document in hydro meteorological data and components of hydrological cycle to assess surface and groundwater resources
PO3	Students should be able to demonstrate a degree of mastery to plan water resources projects for meeting socio-economical and environmental needs.
PO4	Manage land and water in the changing climate scenario.
PO5	Analyze hydrologic extremes and adopt suitable management practices to minimize impacts
PO6	Work and lead in multi disciplinary environment and demonstrate professional and social ethics.

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SEMESTER-I

MWRI-1	ADVANCED FLUID MECHANICS	PC-1	L	T	P	CREDITS
			3	0	3	

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Basic concepts of mathematical and physical background to analyze real life problems in fluid mechanics	
CO2	Understanding of possess skills to take up research activities involving fluid motions	
CO3	Develop the boundary layer concept on fluid motion	
CO4	Analyze the irregular fluid in motion	
CO5	Explain about the basic concept of Hydraulic Transients	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	1	-	-	
CO2	-	2	2	-	-	
CO3	-	-	2	-	-	
CO4	-	1	3	-	-	
CO5	-	2	3	3	1	

(Please fill the above with Levels of Correlation, viz., L, M, H)

Syllabus:

Unit I:

Kinematics of Flow: Description of fluid motion - Lagrangian and Eulerian approaches, Equations of continuity, energy and linear momentum in Cartesian and polar coordinates, Standard 2D Flow Patterns: Uniform flow, Source, sink, vortex, doublet and their combinations, D'Alembert's paradox

Unit II:

Laminar Flow: Derivation of Navier-Stokes equations – exact solutions for flow between parallel plates, Hagen Poissulle flows, Couette flow, velocity, shear stress and pressure distribution, flow near a suddenly accelerated plate and an oscillating plate.

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Boundary Layers: Boundary layer equations, Boundary layer thickness boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Karman-Pohlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer.

Unit IV:

Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, Prandtl mixing length, velocity profiles for inner, outer and overlap layers, shear stress and pressure distribution, equilibrium boundary layers.

Unit V:

Hydraulic transients : Basic concepts- transient flow equation, transient in pumping systems, transient in hydro electric power plants, cavitation, water hammer, surges and their protection works.

Text Books:

- Foundations of Fluid Mechanics by S W YUAN
- Fluid Mechanics by White
- Fluid Mechanics by Hunter and Rose
- Fluid Mechanics by C S P Ojha
- Boundary layer theory by Schlichting H
- Applied Hydraulics of pumps by Tullis, Hydraulic Transients by Hanif Choudhary

ADVANCED FLUID MECHANICS LAB**List of Experiments:**

Exposure to software's such as ANSYS, FLUENT, creation of Geometry, Mesh, description of boundary condition and solution of flow problems in 1D, 2D and 3D. Typical examples should include Dams and pipes

- Static & Dynamic analysis of concrete gravity dams using ANSYS APDL
- Seepage analysis of concrete gravity dams using ANSYS APDL
- Seismic analysis of concrete gravity dam ANSYS APDL
- Crack analysis of concrete gravity dam ANSYS APDL
- Laminar flow analysis using CFD
- Turbulent flow analysis using CFD

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MWRI-2	ADVANCED HYDROLOGY	PC-2	L	T	P	CREDITS
			3	0	0	

3

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop basic tools for analysis of hydrologic processes
CO2	Apply time series models for hydrologic data generation and forecasting
CO3	Knowledge about the hydrologic design concepts and method including estimation of the design flows
CO4	Assess impact of mathematical modeling, Hydrological routing and Reservoir routing
CO5	Discuss about the flood forecasting, Auto regressive and moving average methods, Extreme value distribution methods

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	-	-
CO2	2	1	-	-	1
CO3	1	1	-	3	2
CO4	-	1	-	2	3
CO5	3	2	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit-I:**

Introduction: Hydrologic system and hydrologic budget, fundamental laws of hydrology; atmospheric water vapour. Hydrologic Inputs: Precipitation and its forms, snowfall and rainfall; measurement techniques and space-time characteristics

Unit-II:

Hydrologic Abstractions: Infiltration – indices, Hortons, Phillips, Green-Ampt methods, depression storage, evaporation, evapotranspiration; measurement techniques and estimation, space time characteristics and their modelling.

Unit III:

Stream flow: Measurement techniques, space-time characteristics, rating curves System Approach: Unit Hydrograph, distribution hydrographs, IUH - Clark and Nash models

Unit IV:

Mathematical Modelling: Linear and Nonlinear models, Physically based models, Hydrological routing – Channel routing – Muskingum, Reservoir routing – Pulse and Goodrich methods

Unit V:

Flood forecasting, Advanced Method of Frequency Analysis Outliers, Time series analysis – Auto regressive and moving average methods, Extreme value distribution methods

References:

- Chow, V.T., Maidment, D.R. and Mays, W.L., "Applied Hydrology", McGraw Hill. 1988
- Model Curriculum of Engineering & Technology PG Courses [Volume -II] [80]
- Ojha, C.S.P., Berndtsson, R. and Bhunya, P., "Engineering Hydrology", Oxford University Press. 2008
- Wanielista, M., Kersten, R. and Eaglin, R., "Hydrology", John Wiley. 1997
- Water Resources Systems by S Vedula and P P Mujumdar
- Vijay.P Singh Hand Book of Hydrology

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MWRI-3	(a) HYDRAULIC STRUCTURES	PE-I	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concept of Hydraulic structures for water resources projects and design of various types of hydraulic structures
CO2	Explain and analysis of types of Dams
CO3	Experimental with the Dam outlet works
CO4	Analyze the various types of terminal structures
CO5	Assess the impacts of Hydraulic Modeling

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	3	2
CO2	-	1	3	3	2
CO3	-	1	3	3	2
CO4	-	1	3	2	2
CO5	-	2	3	2	1

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Introduction: Hydraulic structures for water resources projects, Embankment Dams: Types, design considerations, seepage analysis and control, stability analysis, construction techniques.

Unit II:

Gravity Dams: Forces acting, Stability analysis of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam, Design theories of arch and buttress dams

Unit III:

Dam Outlet Works: Types of outlet structures – Design principles of Ogee spillway, chute spillway, siphon spillway, side channel spillway, Labyrinth and Pianokey weir

Unit IV:

Design principles of Terminal Structures: Hydraulic jump types, stilling basin, roller bucket, ski jump bucket, baffled spillway, drop structure

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Unit V:

Hydraulic Modeling: Basic principles, dimensional analysis – distorted model analysis, design of physical models of hydraulic structures

References:

- Peterka, A.J, “Hydraulic Design of Stilling Basins and Energy Dissipators”, USBR Engineering Monographs No. 25”. 1984
- Design of Small Dams", Third Edition, Water Resources Technical Publication – US Bureau of Reclamation. 1987
- Singh, B., and Varshney, R.S., "Embankment Dam and Engineering", Nem Chand and Brothers. 2004
- Novak, P. and Nalluri, C., “Hydraulic Structures”, Edition 4, Taylor & Francis. 2007
- Creager, Justin and Hinds, “Engineering for Dams”, Vol. I and II, John Wiley
Engineering for Dams by Creeger, Justin, and Hinds Concrete Dams by R S Varshney

MWRI-3	(b)_Data Analytics in Water Resources	PE-I	L	T	P	CREDITS 3
			3	0	0	

It is advised to use any data handling software such as 'MATLAB' or 'R' to demonstrate / illustrate the concepts discussed in each unit.

Unit 1 : Data Representation and Processing

- Data forms and representation methods; Representation of graphical data; Analysis of missing data and data gaps; Qualitative and quantitative methods of data interpretation; Data visualization techniques; Random variables and probability distributions.

Unit 2 : Spatial Data Analysis

- Sampling distributions; Spatial data interpolation – deterministic and probabilistic methods; inverse distance weight (IDW) method; semi-variogram concepts; kriging; Spatial statistics.

Unit 3 : Temporal Data Analysis

- Statistical metrics for evaluation; Data classification with time series; Time series data visualization techniques; Stationarity and non-stationarity in time-series; Autoregression; Moving average; ARMA models, Time series forecasting; nowcasting; hindcasting.

Unit 4 : Hypothesis Testing

- Null and alternative hypothesis; Significance level; Test statistic; Critical value approach; P-value approach; Type 1 and Type 2 errors; Numerical problems in Water resources concerning one- and two-tailed hypothesis testing; Rank-sum test.

Unit 5 : Advanced Techniques for Data Analysis

- Correlation; Simple linear regression; Multiple linear regression; Trend analysis; artificial intelligence (AI) and machine learning (ML) in water resources.

Text Books / References

- 1) Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, *Statistical methods in water resources: U.S. Geological Survey Techniques and Methods*, book 4, chapter A3, 458 p., <https://doi.org/10.3133/tm4a3>
- 2) Statistical hypothesis testing : Theory and Methods by Ning-Zhong Shi and Jian Tao
- 3) Statistical methods in hydrology and Hydrometeorology by Rajib Maity – Springer Transactions in Civil and Environmental Engineering

MWRI-3	(c) FREE SURFACE FLOW	PE-I	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Free surface flows, specific energy and specific force
CO2	Understanding the basic concepts of Non-Uniform flows and also methods
CO3	Knowledge about the Rapidly varied flow
CO4	Analyze the Spatial varied flow
CO5	Explain about the Unsteady flows and dam break analysis

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	-	2
CO2	-	2	3	-	2
CO3	-	2	3	-	3
CO4	-	2	3	-	3
CO5	-	2	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

Introduction: Free surface flows, velocity distribution, resistance relationships, specific energy and specific force, normal and critical depths computations

Unit II:

Non-Uniform flows- gradually varied flow-governing equation –types of flow profiles- computation of gradually varied flow profiles by direct integration, graphical and numerical methods.

Unit III:

Rapidly varied flow -Hydraulic Jump: Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.

Unit IV:

Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.

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Unit V:

Unsteady Flows: St. Venant's equations and their solution using method of characteristics and finite difference schemes; dam break problem, hydraulic flood routing. Channel Transitions.

References:

- Chow, V.T., "Open Channel Hydraulics", McGraw Hill. 1959
- Choudhary, M.H., "Open-Channel Flows", Prentice-Hall. 1994
- Ranga Raju, K.G., "Flow Through Open Channels, Tata McGraw Hill. 2003
- Subramanya K. Open channel flows

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MWRI-4	(a) Climate change impacts on water Resources	PE-II	L	T	P	CREDITS 3
			3	0	0	

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Climate System; Climate, weather and Climate Change; Overview of Earth's Atmosphere; Vertical Structure of Atmosphere; Radiation and Temperature; Laws of Radiation; Heat-Balance of Earth Atmosphere System; Random Temperature Variation; Modelling Vertical Variation in Air Temperature; Temporal Variation of Air temperature; Temperature Change in Soil; Thermal Time and Temperature Extremes.

Unit II:

Hydrologic Cycle: Introduction; Global water balance; Cycling of water on land, a simple water balance model;

Unit III:

Climate Variables affecting Precipitation: Precipitation and Weather, Humidity, Vapor Pressure, Forms of Precipitation, Types of Precipitation; Cloud; Atmospheric Stability; Monsoon; Wind Pattern in India; Global Wind Circulation; Evaporation and Transpiration, Processes of Vadose Zone, Surface Runoff, Streamflow

Unit IV:

Climate Variability: Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes.

Unit V:

Climate Change: Introduction; Causes of Climate Change; Modeling of Climate Change, Global Climate Models, General Circulation Models, Downscaling; IPCC Scenarios

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MWRI-4	(b) Irrigation Water Management	PE-II	I	T	P	CREDITS 3
			3	0	0	

1. Slightly 2. Moderately 3. Detailed

Syllabus:Unit 1 : Irrigation History and Development

- History and development of irrigation in India; Irrigation projects – types, benefits, and challenges; Irrigation methods – drip and sprinkler methods; Irrigation structures – Design principles; Case studies of successful irrigation strategies.

Unit 2 : Sustainable Irrigation Methods

- Sustainable irrigation; Smart irrigation; Precision irrigation; Water and energy efficient irrigation methods; Hydroponics; Aeroponics; Vertical farming; Decision support system (DSS) for irrigation and agriculture

Unit 3 : Soil-Water-Crop Interactions

- Soil-water interactions – characteristic curves, field capacity, wilting point; Soil moisture – estimation methods; Evapotranspiration– estimation methods; Irrigation schedules; Irrigation efficiencies; Water-Crop interactions – root water uptake; plant water stress; Water use efficiency.

Unit 4 : Instrumentation in Irrigation

- Instrumentation for: rainfall, soil moisture, evaporation, evapotranspiration, meteorological variables, plant canopy, root water uptake – Design principles, Working methodology, advantages and limitations

Unit 5 : Crop simulation models

- Design philosophy, working methodology, data requirement, and applications of: SimDualKc, Aquacrop, SWAP, DSSAT.

Text Books / References

- 1) Irrigation and Drainage Engineering by Peter Waller and Muluneh Yitayes, Springer
- 2) Irrigation Water Management by Dilp Kumar Majumdar, PHI Learning
- 3) Michael, A.M. 2006. Irrigation: Theory and Practice, Vikas Publishing House Pvt. Ltd., New Delhi.

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MWRI-4	(c) HYDROLOGICAL HAZARD MITIGATION AND MANAGEMENT	PE-II	I	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Floods and applications of GIS and Remote Sensing in flood management
CO2	Understanding the basic concepts of Droughts and applications of GIS and Remote Sensing in Drought management
CO3	Solve the Case studies Crisis and Emergency Management
CO4	Analyze the Case studies Risk Management
CO5	Determine the Advanced warning systems

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	-	2
CO2	-	2	3	-	2
CO3	-	1	3	-	3
CO4	-	1	3	-	3
CO5	-	2	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Flood Hazard Mitigation: Basics of floods, Natural and man-made floods, Flood control structures, Flood management, Applications of geographical information systems and remote sensing in flood management, Case studies

Unit II:

Drought Hazard Mitigation: Basics of droughts, Natural and man-made droughts, Watershed management, Drought management, Applications of geographical information systems and remote sensing in drought management, Drought problems in arid and semi-arid regions

Unit III:

Case studies Crisis and Emergency Management: Nature of extreme events, Cyclone and related flooding, Global problems of catastrophe solution and emergency situations, Mobilisation of communities, Community involvement

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Unit IV:

Case studies Risk Management: Risk assessment, Risk reduction and management, Role of insurance companies

Unit V:

Advanced Warning Systems: Global positioning systems, Applications of remote sensing and GIS, Role of Information Technology in natural hazard mitigation management

References:

- Centre for Science & Environment, Wrath of Nature: Impact of Environmental Destruction on Floods and Droughts, Centre for Science & Environment, New Delhi
- Beven, K. and Carling, P., (eds.), Floods: Hydrological, Sedimentological and Geomorphological Implications, British Geomorphological Research Group Symposia Series, Wiley, Chichester, 1989.
- B.H.R.A., Hydraulic Aspects of Floods & Flood Control, B.H.R.A., England, 1983.
- Brown, J.P., Economic Effects of Floods, Springer-Verlag, Berlin, 1972.
- Prasad, P., Famines and Droughts: Survival Strategies, Rawat, Jaipur, 1998.

Course Outcomes

Programme Objective No.	Objective
CO1	<ul style="list-style-type: none"> * Understand the priorities for allocation of water. * Meeting challenges in management of available water resources. * Appraisal of various strategies for planning of water resources projects. * Steps involved in implementation of water resources projects.
CO2	<ul style="list-style-type: none"> * Appraisal of welfare economics related to water resources projects. * To estimate the cost of a water resources project. * Allocation of cost among various purposes in a multi-purpose project. * Carrying out the cost-benefit analysis for selection of a water resources and alternatives based on incremental cost-benefit analysis.
CO3	<ul style="list-style-type: none"> * Need for an integrated water resources management (IWRM) * Understanding the importance of systems approach in water resources planning and management. * River basin system and various sub-systems. * System decomposition and modelling of water resources systems.
CO4	<ul style="list-style-type: none"> * Understanding the importance of optimization in water resources planning and management. * Different techniques of optimization for water resources system analysis. * Linear programming concepts - Graphical method, Simplex method, Big M method.
CO5	<ul style="list-style-type: none"> * Impart the significance of dynamic programming in water resources systems analysis. * Multi-objective optimization. * Examples of river basin planning and management.

Mapping of Course Outcomes with Programme Out Comes.

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1	2	3	1	-
CO2	-	-	3	1	-
CO3	1	-	2	2	2
CO4	1	1	2	3	2
CO5	2	-	2	2	2

Water Resources Systems Planning and Management

L	T	P	C
4	0	0	4

UNIT I: General Introduction to Water Resources Planning & Management.

Introduction: Water Resource Potential & Future Demand. Water Resources Development - Purposes Served. Planning & Management Approaches - National Water Policy - Water Allocation Priorities. Water Resources Project Planning Process - Planning of Water Resources Projects for various purposes - Meeting Challenges - Water Resources Planning Strategies. Project Planning for Domestic Water Supply, Irrigation Water Supply, Hydropower generation, flood control. Miscellaneous other projects - Ecology restoration, Industrial Water supply, Navigation. Implementation of Water Resources Projects - Steps Involved

UNIT II: Economics of Water Resources Projects

Basic Concepts of Engineering Economics - Welfare Economics. Definition of Terms Related to Costs - Various costs of a project - Project Costs, Associated Costs and Working Costs. Cost Allocation and Cost Benefit Analysis - Allocation of Costs among components of Multipurpose projects: (i) Remaining Benefits Method, (ii) Alternative Justifiable Expenditure Method and (iii) Facilities Used Method. Total Economic Value of Projects. Project Analysis. Study of Alternatives - Steps involved in decision making - Cost Estimates of Project - Parameters influencing - Capital Recovery Factor (CRF) - Project Life. Cost comparison of alternatives - Various Cost-Benefit Ratios (CB Ratios) Incremental Cost Benefit Analysis - Project selection.

UNIT III: Integrated Water Resources Management (IWRM) & Systems Approach.

Introduction to Integrated Water Resources Management (IWRM): Integrative Nature of River Basins - Challenges and Actions to be taken - Planning and Management Approaches - Technical, Economic and Institutional aspects in planning and management. System Approach - Definition of System - System Concept - Need, Advantages and Disadvantages of Systems Approach. - Examples of problems - Techniques in WRS Analysis - System Components - Types of Systems. River Basin System: Typical Water Resources System - Sub-system (i) Reservoir Design and Operation, (ii) Real Time Operation for Flood Control, (iii) Optimal Groundwater Development, (iv) Multi-reservoir Systems, (v) Interlinking of Basins, (vi) Conjunctive use of surface and Groundwater, (viii) Water quality in streams (ix) Hydropower Systems. Systems Analysis - Water Resources System Analysis - System Representation in Water Resources Planning and Management - System Decomposition. Modelling of Water Resources Systems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**Board of Studies (Water Resources Engineering) Meeting: September 2023 (R23).****UNIT IV: Optimization Techniques in Water Resources Management.**

Introduction to Optimization: Engineering Applications of Optimization – Basic Concepts of Optimization - Types of Optimization Techniques. Basic Components of Optimization Problem - Objective function - Variables and Constraints – Optimization by Method of Calculus – Stationary Points, Functions of Single and Two Variables – Sufficient and Necessary Conditions - Convex and concave functions. Constrained and Unconstrained Optimization – Optimization through Linear Programming –Standard form of LP - Canonical Form - Elemental and Pivotal Operations - Transformation to Canonical Form - Graphical and Simplex Methods of LP. - Big M Method - Duality of LP problems. Sensitivity.

Unit V: Applications Dynamic Programming, Simulation and Water Resources Systems Modelling.

Introduction and preliminaries: Dynamic Programming Models - Classical Optimisation Techniques - Non-linear Programming, Gradient Techniques, Genetic Algorithm, Stochastic Programming, Simulation, Search Techniques, Multi Objective Optimisation. Water Allocation - Capacity Expansion - Reservoir Operation. Multi-objective Optimization - Multipurpose Reservoir Operation. Simulation & Modelling - River Basin Simulation - Reservoir Operation Simulation. Water Resources Systems Modelling - River Basin Planning and Management - Some Examples: (i) Water Distribution System, (ii) Groundwater System, (iii) Water Quality Modelling, (iv) Flood Plain Management and (v) Urban Storm Water Management.

Text Books:

1. Water Resources Systems - Modelling Techniques and Analysis by S. Vedula and P. P. Mujumdar
2. Water Resources Systems Planning and Management – An Introduction to Methods, Models and Applications by Daniel P. Loucks and EELCO VAN BEEK
3. Economics of Water Resources Planning by L. Douglas James and Robert R. Lee
4. Economic Analysis of Water Resources by Mc Kinney
5. Water Resources Systems Planning - Some Case Studies for India by Mahesh C. Chaturvedi and Peter Rogers.

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MWRMC	Research Methodology and IPR	CC	L	T	P	CREDITS
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand research problem formulation.
CO2	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO3	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO4	Analyze research related information
CO5	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.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO8
CO1	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	-	-	1
CO3	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	1
CO5	-	-	-	-	-	-	-	3

1. Slightly

2. Moderately

3. Detailed

Syllabus:**UNIT-I:**

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.

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UNIT-II:

Effective literature studies approaches, analysis Plagiarism, Researchethics.

UNIT-III:

Effective technical writing, how to write report, Paper Developing aResearch Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-IV:

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-V:

Patent Rights- Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications, **New Developments in IPR-** Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Research methodology: an introduction for science & engineering students, 1st Edition, Stuart Melville, Wayne Goddard, 1996
2. "Research Methodology: An Introduction", Wayne Goddard and Stuart Melville
3. "Research Methodology: A Step by Step Guide for beginners", 2nd Edition, Ranjit Kumar

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MWRPI-I	Hydraulics LAB	LB-I	L	T	P	CREDITS 1.5
			0	0	3	

List of Experiments:

- To calculate the Discharge of the Pump
- To Perform the Yield test on a single confined aquifer well using cooper-Jacob drawdown method.
- To Perform Recuperation test on a single confined aquifer well using cooper-Jacob drawdown method.
- To determine the relationship between Hydrograph and intensity duration Curve
- To determine the relationship between the intensity and duration frequency Curve
- To Plot Depth-Area- Duration Curve

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MWRAC-1	CONSTITUTION OF INDIA	AC-1	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes:

After the completion of the course, student 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 of 1956.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO8
CO1	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	-	-	1
CO3	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	1

1. Slightly

2. Moderately

3. Detailed

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Syllabus:

UNIT – I:

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble, Salient Features.

UNIT – II:

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT – III:

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

UNIT – IV:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive:** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT – V:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

TEXT BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication
2. Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, 2015.

REFERENCES:

1. Indian Constitution Law, 7th Edn. M. P. Jain, Lexis Nexis, 2014.
2. Introduction to the Constitution of India, Lexis Nexis, D.D. Basu, 2015.

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II SEMSTER

MWRII-1	REMOTE SENSING AND GIS	PC-3	L 3	T 0	P 3	CREDITS 4.5
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Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concept of introduce the technology and principles of Remote Sensing
CO2	Understanding the theoretical explanations on Image processing and information extraction from Satellite Data Products
CO3	Knowledge about GIS mapping, editing and modeling
CO4	Analyze the spatial data analysis
CO5	Explain about remote sensing and GIS is solving problems in water resources through case studies.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	-	2
CO2	3	2	3	-	1
CO3	3	2	3	-	3
CO4	3	2	2	-	1
CO5	3	3	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Remote Sensing: Definition, Elements involved in Remote Sensing, Nature of Electromagnetic radiation, Electromagnetic spectrum, Energy interaction with earth features-vegetation, soils and water bodies, energy interaction in the atmosphere, Spatial resolution, Spectral resolution and Radiometric resolution, characteristics of various sensors and satellites: LANDSAT, IRS, SENTINEL

Unit II:

Image analysis: Introduction; Elements of visual Image Interpretation, Digital image processing - radiometric and geometric corrections, image enhancement, image classification, supervised classification, unsupervised classification.

Unit III:

Geographic Information System: Introduction to GIS, Key Components of GIS, Overview of GIS, Map projections, GIS editing, GIS modeling.

Unit IV:

Spatial Data input and analysis: Introduction, spatial data input, raster data models, vector data models, raster versus vector, overlay functions-vector overlay operations, raster overlay operations, network analysis

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Unit V:

RS&GIS Applications in Water Resources: land cover and land use, land use and land cover classifications, role of satellite remote sensing in water resources management, surface water monitoring and mapping, Ground water prospects, reservoir management and flood management

Text Books:

- Fundamentals of GIS by MICHEAL N DEMERS in MC GRAHILL PUBLICATIONS
- Introduction To Geographic Information Systems – Kang Tsung Chang, TataMc.G.H. Publications, New Delhi.
- Fundamentals of Remote Sensing 2nd Ed – George Joseph, University Press, New Delhi
- Lillesand, T.M. And Kieffer, Remote Sensing And Image Interpretation, Joh Wiley And Sons, New York, 1987.

Reference Books:

- Remote Sensing of The Environment – An Earth Resource Prespective – John R. Jensen, Pearson Education, New Delhi.
- Aronoff, S. 1989. Geographic Information Systems: A Management Perspective. Ottawa: Wdl Publications.
- Bonham – Carter, G.F. 1994. Geographic Information Systems For Geoscientists: Modeling With Gis. New York: Pergamon Press.
- Burrough, P.A And R.A. McDonnell. 1998. Principles Of Geographical Information Systems. Oxford: Oxford University Press.
- Lo, C.P., And Albert K.W. Young Concepts And Technologies Of Geographic Information Systems, Prentice Hall Of India (Pvt) Ltd, New Delhi.

MWRPII-1 REMOTE SENSING & GIS LAB

List of Experiments:

1. Collecting ground control points (GCPs)
2. Digitization- Point, Line, Polygon and Surface Data
3. Building topology-measuring distance and area
4. Adding attribute data- querying on attribute data
5. On screen digitization-Data Conversion-Vector to Raster, Raster to Vector
6. Generation of DEM: from contours, spot heights, Arc Hydro
7. Vector Analysis-Buffering, Overlay and Network analysis
8. Raster Analysis-Measurement-Arithmetic overlaying, Logical overlaying

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MWRII-2	GROUND WATER ENGINEERING	PC-4	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Role of ground water in hydrological cycle and aquifer properties
CO2	Understanding the governing equations of Ground water flows
CO3	Knowledge about the impacts exposure towards well design and practical problems of ground water aquifers
CO4	Analyze the Ground water conservation and Ground water quality
CO5	Explain about Ground water flow modeling

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	1	1
CO2	3	3	3	-	2
CO3	3	3	3	-	3
CO4	3	3	3	-	2
CO5	2	2	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

Introduction: Role of groundwater in hydrological cycle, groundwater bearing formations, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity.

Unit II:

Governing Equations for Groundwater Flow: Dupuit- Forchheimer assumptions, general differential equations governing groundwater flows, analytical solutions.

Unit III:

Wells and Well Hydraulics: Types of wells, construction of wells, steady and unsteady state solutions for confined, unconfined and leaky aquifers, effect of boundaries, image well theory, interference of wells, well losses, pumping and recovery test analysis.

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Unit IV:

Groundwater Conservation: Regional groundwater budget; resource assessment; estimation of recharge, Indian practice for artificial recharge,

Groundwater Quality: Contamination of groundwater, sources, remedial and preventive measures, seawater intrusion in coastal aquifers.

Unit V:

Groundwater Flow Modeling: Role of groundwater flow models, Hele-Shaw and analog models, introduction to numerical modeling – boundary conditions, Planning of Groundwater Development: constraints, optimal groundwater development.

Text Books:

- Groundwater Hydrology by Todd and Mays
- Groundwater Hydrology by H M Raghunath
- Introduction to Groundwater by Schwartz and Hubao Zhang
- Hand book of Groundwater by Jacques Delluer
- Groundwater Assessment, Development and Management by K R Karant

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MWRII-3	(a) Socio-Economics and Policy in Water Resources	PE-III	L	T	P	CREDITS 3
			3	0	0	

UNIT-I: Introduction: General outlines; Water availability and uses: national and international scenario; Challenges in water management. Water Rights: Need of water rights; Water and sanitation in international law; Right to Water; Entitlements and criteria. Water Sustainability: Concept of sustainable water uses; The Dublin statement; Sustainable water management with economical, engineering, ecological and social viewpoints; Stakeholders' participation.

UNIT-II: Valuing Water: The use and non-use values of water; Valuation methods; Non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments. Water Pricing - Approach and Models: Significance of water pricing; Average and marginal cost pricing; Short run marginal cost pricing; Water pricing models - flat rate, uniform rate, increasing block tariff and seasonal rate models. Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, efficiency verses fairness in supply, development decisions verses capacity restrictions; Water pricing practices in India and abroad; relevant case studies.

UNIT-III: Economics of Water Projects: Economics of sectoral water allocation; Capital budgeting in water projects; Costs concepts of capital budgeting; Financial evaluation of water projects. Economic Evaluation Methods: Methods of project evaluation; Payback Period; Discounted Payback Period; Net Present Value; Internal Rate of Return; Average Rate of Return; Benefit-Cost Ratio.

UNIT-IV: Water Governance: Elements and dimensions of water governance; Building blocks; Effective water governance schemes; Benchmarking water governance; Indicators of good governance. Water Governance in India: National water policies and water acts; Water regulatory authorities; Power and roles of central and state regulatory authorities; Legal and regulatory framework for hydro projects; Institutional arrangement and administrative controls of water service; Interstate water management initiatives; Stakeholders' participation; NGOs and social movements

UNIT-V: Water Disputes Management: Interstate and intrastate water disputes resolutions practices; Judiciary involvements; Tribunals for water disputes resolutions; Treaties and bilateral agreements; Environmental issues and disputes related to water resources projects; relevant case studies. Global Water Diplomacy: International freshwater agreements; Global water treaties and transboundary water agreements between the countries on international water resources; Multi-national water disputes and their resolution mechanisms; relevant case studies.

Books and references

1. Handbook of Water Economics : Principles and Practice (2003) by Colin H. Green; Publisher - Willy
2. Handbook of Water Economics (2015) by Ariel Dinar and Kurt Schwabe (editors); Publisher - Edward Elgar

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3. Water and the Laws in India (2009) by Ramaswamy R. Iyer; Publisher - SAGE Publications
4. Water Law Poverty and Development, Water Sector Reforms in India by Philippe Cullet; Publisher - Oxford (2009)
5. Water Resource Economics: Towards a Sustainable Use of Water for Irrigation in India (2015) by M.G. Chandrakanth; Publisher - Springer
6. Water Governance: An Evaluation of Alternative Architectures (2013), by A. Gunawansa and L. Bhullar (editors) Publisher - Edward Elgar (2013)
7. Water Resources and Economics: A journal from Elsevier

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MWRII-3	(a) URBAN HYDROLOGY	PE-III	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Urban Hydrological cycle and effect of urbanization on hydrology
CO2	Understanding the basic concepts of precipitation analysis
CO3	Knowledge about the methods of quantity estimation of storm water
CO4	Analyze the Infrastructure for storm water management
CO5	Explain about the Study the process of urbanization and its influence on urban hydrological processes and urban water supply system including, storm water modeling.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	-	2
CO2	3	3	3	-	2
CO3	-	3	3	1	2
CO4	-	1	3	-	2
CO5	3	3	3	-	2

1. Slightly 2. Moderately 3. Detailed

Unit I:

Introduction: Urbanisation and its effect on water cycle – urban hydrologic cycle – trends in urbanisation – Effect of urbanisation on hydrology, need for urban drainage system, population forecasting.

Unit II:

Precipitation Analysis: Importance of short duration of rainfall and runoff data, methods of estimation techniques for urban drainage systems, Intensity-Duration -Frequency (IDF) curves, design storms for urban drainage systems.

Unit III:

Quantity Estimation of Storm Water: Factors Affecting the Quantity of Storm water, Methods for Estimation of Quantity of Storm Water, Time of Concentration, zoning and runoff coefficient, peak flow estimation approaches -Rational method, NRCS curve number approach, Empirical formulae.

Unit IV:

Infrastructure for Storm Water Management: conventional drainage systems, underground drains, sustainable drainage systems, Requirements for Urban Drainage Design, Operation and Maintenance, source control.

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Unit V:

Analysis and Management: Storm water drainage structures, Sewer appurtenances, design of storm water network- Best Management Practices–detention and retention facilities, constructed wetlands, models available for storm water management, Water conservation systems

References:

- Urban Drainage, David Butler and John W. Davies, Spon press an imprint of Tylor & Francis, London and new york.
- Report on Storm water Management, Adrián Morales Torres IIAMA - Universitat Politècnica de València, Sara PeralesMomparderGreen Blue Management
- National Disaster Management Guidelines, Management of Urban flooding , National Disaster Management Authority of India
- Design guidelines for storm water drainage system (Ministry of Housing and Urban Affairs Manual : Part A – Engineering, Part B – O&M, Part C – Management)

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MWRH-3	(c) ECO HYDROLOGY	PE-III	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Eco Hydrological process and characterize variability in ecohydrologic systems
CO2	Demonstrate knowledge of problems facing current ecohydrologic systems
CO3	Identifying the techniques in ecohydrologic measurements and mass and energy balances to estimate ecohydrologic fluxes
CO4	Explain about the wet lands and its applications in ecosystem
CO5	Explain the impact of ecohydrologic changes on system functionality

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	-	2
CO2	3	3	3	-	2
CO3	3	3	3	-	3
CO4	-	2	3	-	2
CO5	-	2	3	-	3

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

Introduction, Origin and scope – eco hydrological processes : interaction between physical, chemical and biological processes at basin scale – scales of interactions

Unit II:

Soil-water dynamics, land surface energy budgets, eco hydrological optimality theory, eco hydrological controls on nutrient cycle, morphological, ecological, and hydrological controls

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Unit III:

Techniques in eco hydrological measurements, measuring energy and water fluxes in atmosphere, soil moisture, respiration, soil heat flux, stomatal conductance, and transpiration, soil and vegetation, atmospheric latent, sensible, and CO₂ fluxes, distribution of wind, temperature and humidity, wind rose diagram

Unit IV:

Wet land ecosystems, ecological significance, natural purifying potential, constructed wet lands and their design, structure, functioning, and applications

Unit V:

Restoration of degraded ecosystem using ecological approach, mined areas and waste lands, building resilience of ecosystems, soil fertility management

Text Books:

- Mitsch W J and Jorgensen S E “Ecological Engineering and Introduction to eco technology”
- Kadlec R H and Knight R L Treatment Wetlands” Lewis publishers

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MWRRII-4	(a) ENVIRONMENTAL IMPACT ASSESSMENT OF WATER RESOURCES PROJECTS	PE-IV	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Environment Impact Assessment
CO2	Explain about the EIA notification by Ministry of Environment and Forest (Govt. Of India)
CO3	Knowledge related to prediction and assessment of impact for soil and water environment
CO4	Analyze the Impact knowledge related to cultural and socio-economic impacts on environment
CO5	Assess the Prediction and assessment of impact for Water Resources Projects

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	3	3	-	3
CO2	-	-	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	1	3	3	-	3

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

Introduction to EIA: Definition-Concepts, Types-Limitations-components of EIA process-settings-public participation-public hearing-methodologies: background information, interaction matrix methodologies, network methodologies, environmental setting various factors, documentation and selection process, environmental indices and indicators for describing affected environment.

Unit II:

EIA notification by Ministry of Environment and Forest (Govt. Of India):

Provisions in the EIA notification, Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for

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conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring. Case studies in EIA.

Unit III:

Prediction and assessment of impact for water and soil environment: Basic information of water quality (Surface water and groundwater), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and groundwater standards, prediction and assessment of impact for groundwater and soil, mitigations.

Unit IV:

Prediction and assessment of impact on cultural and socioeconomic environment: Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

Unit V:

Prediction and assessment of impact for Water Resources Projects: Basic information on water resources projects, Types of impacts on dams and reservoirs, procedure for environmental clearance, steps involved in preparation of EIA Report for Water Resources Projects.

References:

- Environmental Impact Assessment Methodologies by Y Anjaneyulu, Valli Manickam, B S Publications.
- Canter R.L., Environmental Impact Assessment, McGraw Hill International Edition, 1997.
- John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book
- Peter Watten (Eds.) 'Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988)

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MWRH-4	(b) CONTAMINANT HYDROLOGY	PE-IV	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic key concepts of contaminant and contaminant transport
CO2	Understanding the basic concepts by interpreting data from laboratory experiments
CO3	Knowledge about the transformation and retardation
CO4	Analyze the sea water intrusion and organic and inorganic chemicals in ground water
CO5	Implement solution techniques to solve common problems in contaminant hydrology

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	-	2
CO2	-	2	3	-	2
CO3	-	3	1	-	2
CO4	-	3	3	-	3
CO5	-	2	3	-	3

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

Types of contaminants, point and nonpoint sources, physical, chemical and biological process models, basics of contaminant transport phenomena in natural systems, Chemistry of natural waters, Water quality parameters

Unit II:

Theories of Mass Transport --Advection, Dispersion, Diffusion, Governing equations for flow and transport in surface and subsurface waters - Analytical solutions

Unit III:

Transformation and Retardation --Chemical reactions, equilibrium surface reactions, Sorption, Homogeneous reactions, Radio active decay, Bio degradation

Unit IV:

Multi-phase flow, non-aqueous phase liquids, water-NAPL-air, wettability, capillary pressure-saturation relationships, volatilization of NAPL. hysteresis, relative permeability, residual saturation,

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fluid entrapment; Groundwater chemistry; Organic and inorganic chemicals in groundwater; Sea water Intrusion;

Unit V:

Introduction to remediation technologies, principles of remediation, site characterization, soil vapor extraction, electrokinetic remediation, thermal desorption, vitrification, bioremediation, Phytoremediation, remedy selection and risk assessment

Text Books:

- Contaminant Hydrogeology by Fetter, Boving, and Kreamer
- Ground Water Contamination, Transport and Remediation, Philip B. Bedient, Hanadi S. Rifai and Charles J. Newell

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MWRII-4	(c) COASTAL AND OCEAN ENGINEERING	PE-IV	L 3	T 0	P 0	CREDITS 3
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Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concept of sediment transport and its principles of movement
CO2	Demonstrate the role of coastal sediment process and sediment transport models
CO3	Identify the Beach nourishment and its features
CO4	Identification of the problems of coastal protection and also its prevention measures
CO5	Design principles of Coastal and Harbour structures

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	3	3	-	2
CO2	-	3	3	-	2
CO3	-	2	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit I:

COASTAL ZONE PROCESS: General, Sediment properties; measurement and sampling techniques - fundamental principles of movement - bed load and suspended load transport.

Unit II:

Role of coastal sedimentation process - Long shore drift - Beach Evaluation Models – General sediment transport models - On-shore and off-shore sediment transport.

Unit III:

Beach nourishment - Coast and Bed Morphology - Regime of the Coast and Sea Beach – Sand features - Features of Estuaries - Coastal and Beach features.

Unit IV:

COASTAL PROTECTION: Identification of the problem - Restoration of the Beach - Groynes and Rivetments - Off-shore Breakwaters, Bays and Artificial Headlands - Beach replenishment.

Unit V:

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DESIGN PRINCIPLES OF COASTAL AND HARBOUR STRUCTURES:

Break water - types - Waves, Jetties and Piers; Docks - different types.

References:

- “Coastal Hydraulics” (2nd Edn) By A.M. Muir Wood and CA Fleming, John Wiley and Sons (Newyork).
- “Coastal Engineering” (Vol. 1 & 2) by Richard L. Silvester, Elsevier Scientific Publishing Company.

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MWRPII-2	HYDROLOGIC SIMULATION LAB	LB-2	L	T	P	CREDITS 1.5
			0	0	3	

List of Experiments:

1. Rainfall and Runoff Modeling
2. Runoff Sedimentation Modeling
3. Reservoir Routing
4. Construction of IUH
5. Pipe Network Design
6. Infiltration Characteristics
7. Water Balance Studies

The above experiments to be carried out using one of the following **SOFTWARE**

1. SWAT
2. HECRAS
3. HEC HMS
4. MOD FLOW
5. SWMM
6. EPANET

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MWRAC-2	Value Education	AC-2	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes:

After the completion of the course, student will be able to

CO1	Understand the importance of value based living and value judgments
CO2	Learn the importance of Human values and Discipline
CO3	Developing the overall personality and behavior
CO4	Imbibe good values in student and emerge as responsible citizens with clear conviction to practice values and ethics in life.
CO5	Developing tolerance towards and understanding of different religious faiths, knowing the importance of character, self-management and contribute in building a healthy nation

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	-	-	-	2
CO2	-	1	-	1	-	1
CO3	1	1	-	-	2	1
CO4	1	-	-	-	1	2
CO5	-	-	-	-	-	1

1. Slightly

2. Moderately

3. Detailed

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Syllabus:

UNIT – 1:

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 – 2:

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 – 3:

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness. Avoid fault Thinking.

UNIT – 4:

Free from anger, Dignity of labour, Universal brotherhood and religious tolerance. True friendship, Happiness Vs suffering, love for truth.

Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT – 5:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

Text Books:

1. “Values and Ethics for organizations Theory and practice”, Chakroborty, S.K, Oxford University Press, New Delhi.

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MWRMP	MINI PROJECT WITH SEMINAR	PR-1	L	T	P	CREDITS
			0	0	4	

OBSERVATIONS:**Article :: 5.2**

For Mini Project with seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For Mini Project with seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 40% marks and remaining 60% marks are awarded by the project review committee.

SEMESTER-III

MWRIII-1	(a) HYDROGEOLOGY AND GEOPHYSICAL EXPLORATION OF GROUNDWATER	PE-V	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of Hydrogeology and exploration of ground water
CO2	Understanding the basic key of ground water in different rock formations
CO3	Identify the methods of exploration-I in ground water
CO4	Categorize the methods of exploration-II
CO5	Explain about the applications of Remote sensing techniques in exploration of ground water

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	-	3
CO2	-	3	3	-	2
CO3	-	1	2	-	2
CO4	-	1	2	-	2
CO5	-	3	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Introduction: Definitions of Hydrogeology - Exploration of ground water - Porosity, permeability and classification, hydraulic head- Direction and speed of movement of groundwater.

Unit II:

Groundwater in different rock formations -Rock types – Yield of groundwater from Igneous, sedimentary, metamorphic rocks, coastal deposits and glacial deposits - Groundwater indicators – Reservoir indicators, Surface indicators – Boundary indicators.

Unit III:

Methods of Exploration- 1 Theory of electrical resistivity - Sounding and profiling - Four electrode system – Wenner, Schlumberger, Dipole configuration-Cumulative resistivity method

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Unit IV:

Methods of Exploration - 2 Types of waves- elastic constants – Refraction method of measurement – its interpretation - Reflection method of measurement with interpretation. Soil temperature survey – Magnetic survey – Gravity survey.

Unit V:

Methods of Exploration- 3 Application of Remote sensing techniques to delineate groundwater potential zones- thematic maps, Assessment of status of groundwater development. Tagg's master curves. Electrical logging - Spontaneous potential logging - Interpretation from logs. Radioactive logging , Induction logging, sonic logging- interpretation from logs. Drilling time, factors influencing and use of drilling time, applications of drill stem test data, wire line formation test.

References:

- Raghunath H M (1998) "Groundwater" New Age International Publishers
- Davis S.N. and Dewiest R.I.M. (1967) "Hydrogeology" – John Wiley sons.
- Griffith,D.H and King R.F (1966) "Applied geophysics for Engineers and geologists" Pergamen Press. 4. Todd,D.K. (1980) "Groundwater Hydrology" John Wiley and sons, New York.
- R.Kirsch (edited by) " Groundwater Geophysics- A tool for hydrogeology" 2nd edition, Springer Publications

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MWRIII-1	(b) WATERSHED MANAGEMENT AND MODELING	PE-V	L	T	P	CREDITS 3
			3	0	0	

Course Outcomes: At the end of the course, the student will be able to

CO1	Basic concepts of watershed management and water resources region of India
CO2	Understanding the basic key points of watershed management
CO3	Knowledge about the wasteland and land drainage management
CO4	Analyze the flood mitigation measures and techniques of water harvesting
CO5	Explain about applications of watershed modeling

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	-	3	3	3	2
CO2	-	3	3	3	2
CO3	-	3	3	-	3
CO4	-	3	3	2	3
CO5	-	2	3	-	2

1. Slightly 2. Moderately 3. Detailed

Syllabus:**Unit I:**

Watershed management concept: introduction, concept of watershed management, history of watershed management and its relevance to India, watershed characteristics; climatic characteristics, physiographic characteristics, causes of watershed deterioration, effect of watershed on the community, water resources region of India

Unit II:

Principles of watershed management: integrated watershed management approach (IWMA); objectives of IWMA, envisaged results, success criteria, selection of watershed village, equity issues for watershed policies, factors causing the inequality, benchmark survey, remote sensing survey in watershed management, land capability classification. Soil erosion: introduction, soil erosion, factors affecting soil erosion, different types and causes of erosion- geologic erosion, accelerated erosion, estimation of loss of soil from erosion, soil loss models, sediment models, bed load models, control of soil erosion. Management of natural drainages: introduction, check dam, structures for gully stabilization and storage of water, rivers or stream bank management measures in watershed, river training works, methods of river training works

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Unit III:

Wasteland and land drainage management: introduction, causes of wasteland – water logging, salinity, soil erosion, overgrazing, mining operation, industrial effluent, brickfields, inadequate surface and subsurface drainages, remedial measures in wasteland management, land drainage management- surface or overland drains, subsurface or underground drains, discharge and spacing of tile drain.

Unit IV:

Flood damage mitigation management: introduction, mitigation measures, structural mitigation measures, non-structural mitigation measures, flood plain zoning, flood forecasting. Water harvesting: introduction, techniques of water harvesting, indigenous water harvesting methods in India, engineering methods of water harvesting.

Unit V:

Watershed modelling: introduction, data of watershed for modeling, application of watershed models, model calibration and validation

Text Books:

- Madan mohan das, Mimi das Saikia, “watershed management”, PHI learning pvt. Ltd.,

References:

- Murty, J.V.S., Watershed Management, New Age Intl., New Delhi 1998.
- Allam, G.I.Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
- Vir Singh, R., Watershed Planning and Management, Yash Publishing House, Bikaner, American Society of Civil Engineers, Watershed Management, American Soc. of Civil Engineers, New York, 1975.

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SEMINAR

Course Outcomes: At the end of the course, the student will be able to

CO1	Collect Research Material on some topic and to summarise it report and give to present the same
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Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	1	1	2	2	2

2. Slightly 2. Moderately 3. Substantially

DESIGN PROJECT

Course Outcomes: At the end of the course, the student will be able to

CO1	Analyse, design and prepare a report on Special Design topic related to Water Resources Engineering
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Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1		1	2	3	1	3

1. Slightly 2. Moderately 3. Substantially

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DISSERTATION /THESIS

Course Outcomes: At the end of the course, the student will be able to

CO1	Identifying the topic after thorough review of literature on chosen topic and Can able to do the Project either Experimental Work or analytical Work
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Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1		2	2	3	3	3

1. Slightly 2. Moderately 3. Substantially
