

PROSPECTUS

Master of Technology (M.Tech.) Programme
in
“Environmental Management of Rivers & Lakes” (EMRL)

Academic Session 2012-2013



ALTERNATE HYDRO ENERGY CENTRE
INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

PROSPECTUS
for
Master of Technology (M Tech) Programme
in
“Environmental Management of Rivers & Lakes”
(EMRL)

Academic Session
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Sponsored by

Ministry of Environment & Forests
National River Conservation Directorate
Government of India



INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE
(UTTARAKHAND), INDIA

TABLE OF CONTENTS

	Page No.	
1.0	Introduction	1
1.1	Need for the Programme	1
1.2	About Indian Institute of Technology, Roorkee (IITR)	2
1.3	About Roorkee	2
1.4	About participating departments	2
1.4.1	Alternate Hydro Energy Centre	2
1.4.2	Department of Biotechnology	3
1.4.3	Department of Chemical Engineering	3
1.4.4	Department of Civil Engineering	3
1.4.5	Department of Hydrology	3
1.4.6	Department of Management Studies	4
1.5	Conservation related Industrial Consultancy Projects carried out by AHEC	4
1.6	Projects with International Collaborations	5
1.7	Institutional Facilities	5
1.7.1	Lodging & Boarding	5
1.7.2	Club	5
1.7.3	Mahatma Gandhi Central Library	5
1.7.4	Information Superhighway Centre	5
1.7.5	Other Facilities	5
1.8	About the Programme	6
1.8.1	Admission Procedure	6
1.9	Financial Incentives/Obligations	6
1.9.1	For Indian Nationals Sponsored by Government Agencies	6
1.9.2	Foreign Students and scholarships	6
1.9.3	GATE qualified (with Institute Assistance ship and Self financed)	6
1.10	Academic Programme	6
1.10.1	Medium of Instruction	6
1.10.2	M. Tech. Programme	7
1.10.3	Number of seats in the programme	7
1.10.4	Eligibility for Admission	7
1.10.5	Grading of the Students	8
1.10.6	Course Credits and Evaluation	8
1.10.7	Interpretation of IIT Roorkee Regulations	8
1.10.8	General & Important	8
1.10.9	Procedure for Admission	8
1.11	Suggestive Areas and Topics of Dissertation for M. Tech. Programme on Conservation of Rivers & Lakes	9
2.0	M. Tech. Teaching Scheme	10
3.0	Details of Courses Contents	12
4.0	Fee Structure	20
5.0	Application Form	21

1.0 INTRODUCTION

1.1 NEED FOR THE PROGRAMME

The programme of pollution abatement of rivers was started by the Ministry of Environment & Forests (MoEF), Government of India with the launching of the Ganga Action Plan (GAP) Phase I in June 1985. A Central Ganga Authority under the Chairmanship of Prime Minister was constituted to finalize the policy framework and to oversee the implementation of the Action Plan, a 100% Centrally Sponsored Scheme. Later in April 1993, Yamuna and Gomti Action Plans were approved under a new scheme of GAP Phase II which was followed by the pollution abatement programmes of other polluted rivers of the country in July 1995 under the National River Conservation Plan. The Central Ganga Authority was reconstituted and re-named as the National River Conservation Authority under the Chairmanship of Prime Minister. Both GAP Phase II and NRCP were approved as Centrally Sponsored Schemes with 50:50 cost sharing basis between the Central and the concerned State Governments. Ganga Action Plan Phase-II was later merged with NRCP in December 1996.

National River Conservation Plan (NRCP) at present, extends to towns along polluted stretches of major rivers in States. The various components included under the scheme are laying of sewers, construction of sewage treatment plants, pumping stations, management of solid waste, provision of low cost toilets and crematoria, shifting of dhobi ghats, improvement of bathing ghats, afforestation along rivers, public participation facilitate in improving the environment within the town. The share of the Central Government in the programme is now limited to 70% of the total cost of the new scheme with the remaining 30% cost coming from State Government/local bodies. The Operation & Maintenance of all assets is the responsibility of the State Government/local bodies.

Apart from this, the MoEF is also implementing the National Lake Conservation Plan (NLCP) with a funding pattern of 70:30 between the Central & State Governments. The objective of the scheme is to take up conservation of urban lakes as they are seriously threatened with environmental degradation. The thrust under the plan is to undertake *in situ* remedial measures for the lakes such as interception, diversion and treatment of sewage discharged into the lakes, solid waste management, catchment area treatment

and lake front development (beautification). So far 42 lakes have been taken up for conservation and improvement under NLCP.

Recently under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) launched by Ministry of Urban Development, Government of India, financial support is being provided to State Government and their urban local bodies for efficient urban infrastructure projects related to water supply, sanitation, sewerage, solid waste management, road network, urban transport and service delivery mechanism covering community participation and accountability towards citizens.

In February 20, 2009, the Government of India has given Ganga River the Status of National River and set up a 'National Ganga River Basin Authority' (NGRBA) as an empowered planning, financing, monitoring and coordinating authority for the Ganga River under the Environment (Protection) Act, 1986. The authority has been vested with appropriate powers to carry out its functions to ensure effective abatement of pollution and conservation of river Ganga by adopting a river basin approach as well as to maintain minimum ecological flows in the river Ganga with the aim of ensuring Water Quality and Sustainable Development.

The need to create adequate and properly trained manpower in the various scientific & technical, social, economic, administrative aspects of Environmental Management of rivers and lakes has long been felt. MoEF has the huge responsibility of the National River/Lake Conservation programmes and trained manpower is urgently needed, to:

- Prepare and implement programme/projects /schemes of environmental conservation
- Operate and maintain the assets created under conservation of water bodies
- Monitor the environmental status of rivers and lakes

To create trained manpower in the country, the MoEF has sanctioned the funding of an interdisciplinary Master of Technology (M. Tech.) programme in "Conservation of Rivers and Lakes" in the year 2004 at Indian Institute of Technology, Roorkee (IITR) for the officers from Central, State and local governments and their organisations involved in river and lakes conservation programme.

The programme has been renamed as Environmental Management of Rivers and Lakes from the 2010-11 session.

Departments including Alternate Hydro Energy Centre (AHEC), Biotechnology, Chemical Engineering, Civil Engineering, Hydrology and Management Studies at IITR are offering this programme with the AHEC as the administrative Department.

1.2 ABOUT INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE (IITR)

Roorkee is the oldest seat of technical education in the East. The erstwhile Thomason College of Engineering was founded in 1847 and was raised to the status of the University in 1949 having the distinction of becoming the first technical University in India. University of Roorkee has been converted to IITR on September 21, 2001. During the past 163 years, the Institute has played a leading role in development of the country through technical education, research and extension services. The faculty and alumni of the Institute have distinguished themselves in India and abroad through their contributions & achievements. Delivering the centennial address, Pandit Gobind Ballabh Pant, the first Chief Minister of Uttar Pradesh, described the then University of Roorkee (Now Indian Institute of Technology, Roorkee) as “ the jewel in the Crown of Uttar Pradesh

The Institute has departments of Engineering, Science, Management & Humanities besides a number of centres of higher education and research. Roorkee has the added advantage of interaction with and cooperation of academic institutions such as the State Irrigation Research Institute, the National Institute of Hydrology and the Central Building Research Institute.

IITR is a fully residential Institute. The programme participants are provided accommodation in the bachelor hostels (called Bhawans) of the Institute. However, limited family accommodation, as and when available, may also be provided.

1.3 ABOUT ROORKEE

Roorkee (Latitude 29° 52'00" N and Longitude 77° 53' 52") is a small town in Haridwar district of newly created Uttaranchal State. Its elevation is 261m above mean sea level. On a clear day, it presents a

fine view of snow clad Himalayan peaks. The place is within easy reach from New Delhi, the capital of India, the distance being about 180 km by road. It is also connected by Rail.

The temperature ranges from 5°C to 20°C in winter (October to March) and from 25° to 40°C in summer (April to September). The average annual rainfall is 1100 mm & bulk of it occurs from middle of June to middle of September.

Roorkee also hosts the Bengal Engineering Group and the Centre of Army Corps of Engineers.

1.4 ABOUT PARTICIPATING DEPARTMENTS

1.4.1 Alternate Hydro Energy Centre

AHEC, an academic centre, is engaged in human resource development in the field of Renewable Energy and Small Hydro Energy since 1982. It offers a Master of Technology (M.Tech.) programmes in ‘Alternate Hydro Energy Systems’ which is open to fresh engineering graduates as well as to the practicing engineers, technologists, officers and scientists drawn from India and other developing nations. AHEC also offers two elective subjects on Renewable Energy Resources Development Technology and Small Hydropower development to engineering bachelor students of the Institute. It also organising national and international short term training programmes for field engineers and technologists in the related field. Facilities are also available for carrying out R&D work leading to Ph.D. . Owing to having vast experience in the area of Small Hydro Power (SHP) AHEC also offers consultancy services in and outside the country.

As diversified activities, AHEC is also working in the area of environment and has handled a number of prestigious projects which include Environment Impact Assessment of development projects and eco-restoration of water bodies like preparation of Detailed Project Reports (DPR) for the conservation and management of Dal & Nagin lake in Srinagar (J&K), 5 lakes in Nainital in Uttaranchal, pollution abatement of rivers at Bhubaneshwar, review of proposals of conservation of Husain Sagar (Hyderabad), Lake in Kodaikanal etc. AHEC has done following works for MoEF

- (a) Reviewed the water quality monitoring programme of MoEF.

- (b) Carrying out Cumulative Impact Assessment of hydro-electric projects in Uttarakhand sponsored by MoEF.
- (c) Guidelines for preparing the report for pollution abatement has been recently prepared by AHEC for MoEF.
- (d) Environmental status report of River Ganga

Faculty members of AHEC drawn from multi disciplinary fields of Civil, Mechanical, Electrical, Chemical, Electronics and Computer Engineering Biotechnology and Management have gained excellent expertise in the entire gamut of activities related to renewable energy and Eco-restoration. AHEC has received recognition from IREDA, SESI and others.

AHEC has signed Memorandum of Understanding (MoU) to work as an expert organisation for SHP development with Uttaranchal State Government, Bihar State Hydroelectric Power Corporation Himurja (Govt of Himachal Pradesh) and J & K State Power Development Corporation. It has set up instrumentation laboratory to provide independent performance testing of small hydropower plants as the sole certifying testing organisation for MNRE.

A real time digital simulator for Small Hydropower plants has been established at AHEC to design, simulate and impart training for small hydropower plant personnel. Standards for Small Hydropower plants are being developed.

1.4.2 Department of Biotechnology

A center of Bio-sciences was started in 1980 and was upgraded to a full-fledged academic Department of Bio-sciences and Biotechnology in 1986. It has been renamed as Department of Biotechnology in the year 2002. It has teaching and research programmes, which draw heavily on the basic knowledge of modern biology, biochemistry, biophysics and chemical engineering, particularly at cellular and molecular levels. The Ministry of Human Resource Development (MHRD) has created a strong infrastructure base for advanced research in "Bio-conversions" in the Department.

The Govt. of India has recognized the Department by sponsoring the M. Sc. (Biotechnology) programme. At present, the research focus is on microbial biotechnology, DNA-drug interactions, reproductive endocrinology, genetic engineering of nitrogen fixation and molecular biology.

1.4.3 Department of Chemical Engineering

The Department of Chemical Engineering was establishment in 1963 with the Undergraduate programme in Chemical Engineering. Currently the Department is running a B. Tech. (Chemical Engg.) programme and Integrated Dual Degree (IDD) programme in B.Tech. (Chemical/M.Tech. Hydrocarbon) alongwith three M. Tech. (Chem. Engg.) programmes, namely Computer Aided Process Plant Design Industrial Pollution abatement and Industrial safety and Hazard Management. The department has well qualified faculty to undertake research activities in the traditional and emerging areas of Chemical Engineering-process integration, process intensification, clean technology, modeling and simulation, control, biochemical engineering, hydrocarbon engineering and environmental engineering. Five centers of advanced research in various areas have been established in the department. The Department is actively engaged in providing consultancy to chemical and allied industries.

1.4.4 Department of Civil Engineering

The Department of Civil Engineering, the oldest in the country and perhaps in Asia is a worthy successor of the Thomason College of Civil Engineering of 1847 vintage. Apart from the Bachelor's degree programme, the Department offers Master's degree programme in eight different specializations with a possibility of diversification in three different streams and a strong research programme leading to Ph.D. in various areas of Civil Engineering. Ten centers of advanced research covering various facets of Civil Engineering, viz., Structures, Hydraulics, Transportation, Geotechnical, Environmental Engineering, Computer Aided Design, Wind Engineering and Remote Sensing, have been established in the Department with assistance from various agencies. The Department also provides consultancy to industries and agencies involved in various kinds of civil works.

1.4.5 Department of Hydrology

The Department of Hydrology came into existence with the inception of International PG course in Hydrology in 1972 with the assistance from UNESCO, Govt. of India & IDRC, Canada. The course aims to award M. Tech. degree in hydrology and to impart training to engineers and scientists from Asia, Africa & other developing countries. In the field of floods, ground water and watershed

management, the department has made significant contributions. Some important investigations include hydrological estimates on the failure of Macchu Dam II in Gujarat, design floods of 21 sub-basins of the Sone river, studies on ground water modeling and subsurface drainage studies in command areas of Sardar Sarover and Narmada Sagar projects, respectively.

1.4.6 Department of Management Studies

The MBA programme was launched in 1998 by the Institute to meet the needs of present-day dynamic business and economic scenario. It takes the onus to prepare a breed of managers who have the courage, skills and resilience to excel in the corporate world.

The MBA at IIT Roorkee is designed to help students to develop essential management skills in leadership and working in teams. At IIT Roorkee, education stretches beyond class room sessions. The emphasis is on creating an environment for students to explore, experiment, discover and realize their potential. A number of activities like Marketing Fair (Consol), National Level Students Paper Presentation Contest (Jigyasa), National Seminar and a bi-monthly in-house magazine (@doms.edu) have been evolved for the students of the Department targeted at developing in them the spirit of teamwork, trust and to create in them the ability to synchronize their individual objectives with the group objectives.

Students also assist the academic coordinator in scheduling all academic activities, test, examinations, faculty evaluation, attendance, discipline, faculty coordination, course restructuring and so on. The Institute has a proven track record of placing its students to the best of organizations.

1.5 CONSERVATION RELATED PROJECTS CARRIED OUT BY AHEC

The projects carried out by AHEC are:

- (i) Projects sponsored by National River Conservation Development (NRCD), MoEF, Govt. of India and completed:
 - * Draft Working Group Report on Rivers, Lakes and Aquifers in the Environment and Forest Sector for Planning Commission/ MoEF-XIth plan.
 - * Review of NRCD Xth & XIth Plan proposals from states sponsored by MoEF, GOI.
 - (ii) Conservation of Mansi Ganga Lake (near Govardhan) for UP Jal Nigam.
 - (iii) EIA of Rural Roads under Improving Rural Infrastructure sponsored by Uttaranchal Government.
 - (iv) DPR for Integrated Sewage & Solid Waste Management of Bhubaneswar city for Government of Orissa.
 - (v) Engineering Services for Execution of Special Works-Nainital Lake.
 - (vi) Preparation of PFR for use of solar, tobacco waste and small hydropower energy sources in ITC factory, sponsored by ITC, Saharanpur.
 - (vii) Emission Control System for Cupolas sponsored by Sterling Co., Agra.
 - (viii) Energy and Environment Auditing of Sugar Mills (Jagraon), sponsored by Jagraon Sugar Mills.
- * Preparation of Detailed Project Report for Conservation and management plan of Dal-Nagin Lake in Srinagar (J&K)
 - * Preparation of a Vision document of NRCD's work for 10th Plan and its Restructuring.
 - * Review of Eco-restoration, Conservation and Management Plan of Kodai Kanal Lake in Tamil Nadu.
 - * Review of Eco-restoration, Conservation and Management Plan for Hussain Sagar Lake, Hyderabad.
 - * Preparation of Detailed Guidelines of NRCD for preparing the Proposals.
 - * Evaluation of Works Carried under Yamuna Action Plan (YAP).
 - * Preparation of Detailed Project Report for Conservation and Management of Nainital and 4 lakes in district Nainital.
 - * Review of Water Quality Monitoring Programme Under National River Conservation Programme – NRCD MOEF, New Delhi
 - * Preparing the status paper on Ganga River sponsored by Ministry of Environment and Forests, Govt. of India
 - * Evaluation and appraisal of pollution abatement proposal from state governments for the city of Kanpur, Varanasi, Allahabad, Moradabad, Garhmukteshwar, Begusarai, Buxar, Munger, Hazipur, Gayeshpur, Ramgarh.
 - * Study on Cumulative Impacts of Hydroelectric Projects in Alaknanda and Bhagirathi river upto Deoprayag.

- (ix) National River Conservation Development Intensive Air Quality Monitoring of Doon Valley for Carrying Capacity Evaluation sponsored by MoEF/NEERI.
- (x) Conservation and management of River Kshipra sponsored by Ujjain Municipality Madhya Pradesh
- (xi) Evaluation of Process Designs of 3 offers for 30 MLD STP at Loni, Ghaziabad Based on MBBR Technology sponsored by Yamuna Pollution Control Unit UP Jal Nigam Ghaziabad
- (xii) Evaluation of Treatment technology for Talwara Colony sponsored by Bhakra Beas Management Board, Talwara Township, District - Hosiarpur
- (xiii) Development for sustainable basin planning and DSS for MPWSRP For two river basins (Sindh & Tons) sponsored by MP Water restructuring project

1.6 PROJECTS WITH INTERNATIONAL COLLABORATIONS

- * EU Funded Research project on “Development of an Assessment System to Evaluate the Ecological Status of Rivers in Hindu-Kush Himalayan Region” with 9 countries co-ordinated by University of Natural Resources & Applied Life Sciences Viena, Australia.
- * Centre for Ecology & Hydrology (CEH) (U.K.) Regime Estimation for Regional Small Hydro Power Assessment
 - Estimation of Low Flows and Verification.
 - International Hydrological Training Programme of UNESCO.
 - Dissemination workshop on REFRESHA.
- * International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
- * Assessment of River Quality using Biological Indicators of Rivers of Hindu Kush Himalayan Regions- EC funded project.
- * Water and Energy Commission Secretariat, HMG Nepal for small Hydro Projects.

1.7 INSTITUTIONAL FACILITIES

1.7.1 Lodging & Boarding

The Institute provides bachelor’s accommodation to all the students. However, the family

accommodation may be provided as & when available.

1.7.2 Club

The students are entitled to become members of the staff/student club of the Institute on payment of membership fee and can avail the facilities of card room & lounge, tennis, squash and badminton court available at the hostel. The facilities like Swimming Pool and Cinema of the Institute can also be used by the members of the club.

1.7.3 Mahatma Gandhi Central Library

The library provides necessary infrastructure facilities in the form of books, advanced treatises, works of reference and bibliographical nature, current and back volumes of journals, thesis’s and other kinds of monographs. It has more than 3.20 lakh volumes to meet the growing and varied requirements of undergraduate and postgraduate students, research scholars, faculty members. The library subscribes to over 8000 electronic journals in all branches of Engineering, Physical Sciences, Bio-sciences and Humanities & Social Sciences available to all computers in the institute. The Library is currently in the process of digitizing its archival collection, thesis and dissertation. The library has also adopted new technologies like VIS, E-mail, CD-ROM workstation and is commissioning a VSAT link for global communication and information through internet.

1.7.4 Information Superhighway Centre

The institute has a star topology Gigabit Ethernet Switch based, state-of-the-art Enterprise network with data, voice and video communication capabilities. The network covers 365 acres of area through 25 km of OFC and 45 km of E CAT 5 UTP, connecting all Departments/Centres, and Hostels with 24 hours Wi-Fi facility. The Intranet has 2500+ nodes. This facility is being used extensively by the faculty and the students for their educational and research needs and provides an avenue for the exchange of information with other libraries and the centres of research and education.

1.7.5 Other Facilities

Well-equipped hospital, dairy and bakery are available in the campus. A post office as well as branches of the State Bank of India and Punjab National Bank, with foreign exchange facility, are

also located in the campus. An Indian Railway Reservation Counter is also located in the Institute Campus.

1.8 ABOUT THE PROGRAMME

A multi disciplinary M. Tech. programme in “Environmental Management of Rivers & Lakes”, with AHEC as the coordinating centre with Deptt. of Hydrology, Deptt. of Management, Civil Engg. Deptt., Chemical Engg. Deptt. & Biotechnology Deptt. as participating departments, is sponsored by MoEF for capacity building of the state, local, central government officers for conservation of water bodies and maintaining their ecological health systems.

1.8.1 Admission Procedure

There are two ways in which a person can get admitted to this M.Tech. programme.

- a) As a sponsored candidate
- b) As a ‘GATE’ qualified candidate

1.9 FINANCIAL INCENTIVES/ OBLIGATIONS

1.9.1 For Indian Nationals Sponsored by Government Agencies

1.9.1.1 The following expenditure would be met by the IITR out of the sponsorship amount of the National River Conservation Development (NRCD)/ MoEF, among other items:

- A monthly allowance of Rs. 2,500/- shall be paid to each candidate. This will be in addition to the salary and allowances that the candidate’s parent organization will be paying to the candidate.
- A one time book expenditure (on approval from faculty supervisor) upto Rs. 5,000/- will be reimbursed to each candidate.
- Tuition fee, statutory deposits and hostel fee.

1.9.1.2 Other items

- Mess and other dues will be borne by the candidates directly. (about Rs. 18,000/- annually).

- Hostel/Mess and other facilities will be available as for other candidates of the Institute.
- Married accommodation will be provided only, if available, for which additional charges may be levied.
- The candidates will be entitled to medical facilities as admissible to other M. Tech. students of IITR.

1.9.2 Foreign Students and scholarships

The procedure is described below for each type of sponsored candidates:

Foreign candidates seeking admission to postgraduate course should apply through the Govt. of India, if they wish to come through any Govt. supported programmes such as International Technical and Economical Cooperation (ITEC) and Cultural Exchange Programmes or through Educational Consultants (India) Ltd., New Delhi or any such government/government approved schemes. They may seek necessary help from the Indian Embassy in their country or their Embassy in India. Interested persons may visit their web sites www.itec.nic.in and <http://www.iccrindia.net/students.html>

1.9.2.1 At the cost of Sponsoring Governments

Applications of candidates sponsored by foreign governments at their own cost may be made in the prescribed form and forwarded through the Embassies/ Missions of India to the Head, Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee - 247 667 India.

1.9.3 GATE qualified (with Institute Assistance ship and Self financed)

The fee and other financial obligations are to be paid/met directly by the candidates as given separately under 4.0.

1.10 ACADEMIC PROGRAMME

1.10.1 Medium of Instruction

The medium of instruction at the Institute is English.

1.10.2 M. Tech. Programme

The M. Tech. Programme comprises of:

1.10.2.1 Courses

The M.Tech programme consists of two semester teaching and practical work and another two semester for working for seminar, project and dissertation/thesis on special problems. The teaching includes lectures, and laboratory work. The lectures are supplemented by tutorials and through the writing of concept/review papers. The course has been framed to provide upto date knowledge of basic principles of the subjects. The student can select one/ subject in each semester (I and II) of their choice depending upon their background & requirements as minor elective course from other departments.

The academic session starts from **July/August** each year.

1.10.2.2 Field Trips

The field trips are organized to conservation facilities for Rivers & Lakes. Visits are oriented to identify, understand and find the solution to various problems encountered at the project site. The students are required to prepare study tour reports which will be evaluated during the 3rd semester.

1.10.2.3 Seminar

Every student is required to give presentations in seminar/s on topic/s of his own interest selected in consultation with the faculty. The students collect field data and prepare drawings etc. for proper presentation at the seminar.

1.10.2.4 Project

Each student shall be required to prepare a project report based on the field data gathered by and/or supplied to him/her for rivers/lakes projects.

1.10.2.5 Dissertation work

Each student is arranged dissertation work to on the subject of practical and theoretical importance to be carried out under the supervision of faculty member (s).

While deciding the Seminar/Project / Dissertation of a candidate, the views, if any, of the NRC D/parent

organization, are also be taken into consideration. A list of project work/dissertation topics will normally be announced by the concerned faculty in consultation with NRC D (Suggestive topics are given at 1.10).

The existing provisions of the IITR enable a candidate to do part time his/her dissertation work (during II year) outside the institute subject to conditions prescribed in this regard. (Entirely or in part at the NRC D or the State project sites)

1.10.3 Number of Seats in the Programme

Total number of seats under this programme are.

a)	Candidates sponsored by Indian/State Govt. agencies	05 Nos.
b)	Foreign participants and self financed (GATE qualified)	upto 05 Nos.
c)	Regular GATE qualified	15 Nos.

1.10.4 Eligibility for Admission:

These essential eligibility requirements are applicable to all categories of candidates, viz; regular, sponsored and foreign candidates.

1.10.4.1 For sponsored Indian Nationals:

The candidate seeking admission must possess:

A recognized degree in Civil / Electrical / Mechanical / Industrial / Chemical / Agricultural / Environmental Engineering / Architecture / planning / Biotechnology or equivalent with at least 60% marks or a CGPA of 6.00 on a 10 point scale at the Bachelor's level including AMIE examinations of the Institution of Engineers.

Master in Science with Mathematics at graduation level with at least 60% marks or a CGPA of 6.00 on a 10 point scale (limited to 30% of total seats).

1.10.4.2 For direct admission of foreign national and Non-Resident Indians

For **M. Tech. Programme**, the candidates should have (i) A Bachelor's degree in the above disciplines with a minimum grade point average of 6.00 on a 10 point scale or 60% marks in aggregate

(ii) GRE/GMAT scores (iii) Proof of proficiency in English and (iv) Three reference letters.

1.10.4.3 GATE Qualified (Institute Fellowship and Self Financed)

The admission for such candidates is dealt separately by the Institute for which candidate may visit the IITR website www.iitr.ac.in.

1.10.5 Grading of the Students

The students shall be graded for their academic performance on a 10 point grade system as per Regulation in force.

1.10.6 Course Credits and Evaluation

1.10.6.1 Credit (Cr) and Weekly contact Hours

Each course has a number of credits which depend on the academic load and weekly contact hours for Lecture (L), Tutorial (T), Practical (P) and/ or Drawing (D). One Credit is normally assigned to one hour of lecture or two hours of tutorial or practical per week.

1.10.6.2 Performance Evaluation

As per regulations in vogue, the evaluation of academic performance of students is done on continual basis throughout the semester. In the credit and grading system of evaluation, passing and failing is subject wise. Promotion of a student to the next semester is linked to his obtaining a certain minimum grade point average and his earning of certain minimum number of credits in a semester. The award of degree is also linked with the earning of total number of credits along with other requirements, as specified for each programme.

A student is evaluated for his academic performance through tutorials, practicals, class work, home work assignments, term papers, field work, viva-voce examination, etc. in each semester as per regulations. Evaluation of each subject is based on the weightage of marks/grades assigned to various components as per curriculum structure. The components for evaluation of academic performance are CWS (Class Work Sessional), MTE (Mid Term Examination), ETE (End Term Examination), PRS (Practical Sessional) and PRE (Practical Examination). The marks earned by a student in a subject are converted into letter grades on a 10 point scale.

1.10.7 INTERPRETATION OF IIT REGULATIONS

- (i) Dispute if any, arising out of or relating to any matter whatsoever concerning the admission and/or academic programme of M.Tech, shall be subject to the exclusive jurisdiction of courts at Roorkee/Uttarakhand State.
- (ii) In case of any dispute or difference of opinion in interpretation of IITR regulations or any other matter not covered in this brochure, the decision of the Chairman, Senate IITR shall be final and binding.
- (iii) Notwithstanding anything contained in the regulations, the Chairman of the Senate IITR may, in emergent situation, take such action on behalf of the Senate, as he deems appropriate and report it to the next meeting of the Senate for its approval.

1.10.8 GENERAL & IMPORTANT

The admission, studentship fee and related matters are subject to ordinances / regulation of the institute in vogue from time to time. Continuation of registration and award of Degree etc. are governed by certain minimum academic performance & other regulations of the institute in vogue from time to time. All students shall be governed by ordinances/regulations in force.

1.10.9 PROCEDURE FOR ADMISSION

Application should be submitted in the prescribed form (available in this brochure) completed in all respects and duly endorsed by the employing organization/government. The application may be sent to :

Assistant Registrar (PGS & R), Indian Institute of Technology, Roorkee - 247 667, Uttarakhand.
E-mail: adap@iitr.ernet.in,
Tel. +91 1332-285200, 285098,
Fax : +91 1332-285200, 273560

For any details/information, the following may also be contacted:

Head, Alternate Hydro Energy Centre,
Indian Institute of Technology, Roorkee-247 667,
Uttarakhand.

E-mail : ahec@iitr.ernet.in, aheciitr@gmail.com,
rajsafah@iitr.ernet.in

Tel. : +91 1332 - 274254, 285213, 285841

Fax : +91 1332 - 273517, 273560

1.11 SUGGESTIVE AREAS AND TOPICS OF DISSERTATION FOR M.TECH. PROGRAMME IN “ENVIRONMENTAL MANAGEMENT OF RIVERS AND LAKES”

1. Performance study of STPs designed on different treatment technologies such as, ASP, WSP, UASB, Oxidation ditch.
2. Suitability and usefulness of advanced sewage treatment technologies such as FAB, MMBR etc. in Indian conditions.
3. Performance evaluation of in use septic tanks and suggesting improvements to make them more effective.
4. Evaluating/Exploring the usefulness of Imhoff's tank technology.
5. Suggesting sewage treatment techniques for hilly towns with population spread over in isolated pockets.
6. Suggesting Decentralized sewage treatment system for a community.
7. Suggesting sewage treatment system for a Group Housing Society having 200 flats.
8. Cost-Benefit analysis of various type of pipes available for laying Gravity sewers.
9. Decentralized Wastewater Treatment Systems (DTS)- it's cost benefit analysis with conventional treatment system, options for reuse of treated sewage, guidelines for incorporation/promotion of DTS in Cist Master Plan/town planning, study of demonstrated DTS units.
10. Low cost sanitation programmes for rural settlements, urban slums.
11. Resource recovery from STPs to reduce O&M costs-utilization of treated sewage, manure sludge & biogas recovery for power generation/domestic use etc.
12. Nutrient cycle (Nitrogen & Phosphorous) in lakes.
13. Oxygen transfer (DO profile) of lakes and its variation corresponding to organic pollution load.
14. Pollution profile of river for a particular stretch (parameters BOD, COD, TSS, DO, FC, Alkalinity).
15. Environmental Flow: Minimum flow of rivers Ganga/Yamuna pollution abatement.
16. Techno economic comparison of the existing technology vis-vis new technologies for waste water treatment to find out most cost effective treatment technology.
17. Non-point pollution source modeling identifying a particular area.
18. Water Quality modeling for forecasting POPs status in some identified river.
19. Review of status of Lake Conservation Projects in other countries.
20. Approach to Lake Conservation w.r.t. Lakes in urban areas.
21. Evaluation of bioremediation technology used in lake conservation.
22. Evaluation of River Action Plans vis-à-vis the impact as Water Quality.
23. Review of technologies for coliform reduction.
24. Review of indicators of pathogens in water.
25. Technologies for reduction of pathogens vis-à-vis coliform in water.
26. Magnitude of pollution contribution by open defecation.
27. Correlation between application rate of pesticides & fertilizers with their residue in run-off water.
28. Apportionment of capital and O&M cost of sewage & effluent treatment plants.

2.0 M. TECH. IN “ENVIRONMENTAL MANAGEMENT OF RIVERS AND LAKES”

I Semester (Autumn)

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. No.	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	MA-501F	Numerical Analysis, Probability and statistics	ICC	4	3	1	0	3	-	25	-	25	50	-
2.	AH-521B	Modeling, Simulation and Computer Application	PCC	4	3	1	2/2	3	-	15	15	30	40	-
3.	AH-525	Aquatic Ecology [#]	PCC	4	3	1	2/2	3	-	15	15	30	40	-
4.	AH-523	Integrated Management of water bodies [#]	PCC	5	3	1	2	3	-	15	15	30	40	-
5.		Open Elective-I	MEC	3/4	-	-	-	-	-	-	-	-	-	-
6.		Technical Communication (Optional)	-	2	1	0	2	2	-	15	15	30	40	-
Subtotal				20/23										

L= Lecture, T= Tutorial, P= Practical, CWS= Class Work Sessional, PRS = Practical Sessional, MTE= Mid Term Examination, ETE= End Term Examination, PRE = Practical Examination, ICC= Institute Core Course, PCC= Programme Core Course, OEC= Open Elective Course, PEC= Programme Elective Course

[#]See next page

II Semester (Spring)

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. NO.	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	-	Major Elective-I ⁺	PEC	4	-	-	-	-	-	-	-	-	-	-
2.	-	Major Elective-II ⁺	PEC	4	-	-	-	-	-	-	-	-	-	-
3.	-	Major Elective-III ⁺	PEC	4	-	-	-	-	-	-	-	-	-	-
4.	-	Major Elective-IV ⁺	PEC	4	-	-	-	-	-	-	-	-	-	-
5.	-	Open Elective-II [#]	MEC	3/4	3	1	0	3	-	-	-	-	-	-
6.	AH-527	Laboratory Course	PEC	2	-	-	3	-	3	-	50	-	50	-
Subtotal				21/22										

⁺See next page

III Semester (Autumn)

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. NO.	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	AH-601	Seminar	SEM	2	-	-	-	-	-	-	-	100	-	-
2.	AH-602	Project and Site Visits	RP	4	-	-	-	-	-	-	-	100	-	-
3.	AH-603	Dissertation [†]	DIS	0	-	-	-	-	-	-	-	-	25	-
Subtotal				6										

[†]To be continued and grades to be awarded in the next Semester

IV Semester (Spring)

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. NO.	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	AH-603	Dissertation	DIS	20	-	-	-	-	-	-	-	-	75	-
Subtotal				20										
Total				67/70										

Programme Elective Courses

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. NO.	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	AH-544	Project Formulation and Implementation	PEC	4	3	1	-	3	-	25	-	25	50	-
2.	AH-550	Application of RS and GIS in Environment Management	PEC	4	3	1	-	3	-	25	-	25	50	-
3.	AH-552	Hydrology and Modeling of water bodies	PEC	4	3	1	-	3	-	25	-	25	50	-
4.	AH-554	Waste Water Collection, Treatment and Disposal	PEC	4	3	1	-	3	-	25	-	25	50	-
5.	AH-556	Environmental Laws, Public Participation and Institutional Development	PEC	4	3	1	-	3	-	25	-	25	50	-
6.	AH-558	Coastal Pollution Monitoring and Impact Assessment	PEC	4	3	1	-	3	-	25	-	25	50	-
7.	AH-576	Planning and Management of Environmental Facility	PEC	4	3	1	-	3	-	25	-	25	50	-
8.	AH-580	Climate Change and water body	PEC	4	3	1	-	3	-	25	-	25	50	-
9.	HY-527	Ground Water Hydrology	PEC	4	3	1	-	3	-	25	-	25	50	-
10.	HY-531	Water Shed Behavior & Conservation Practices	PEC	4	3	1	-	3	-	25	-	25	50	-
11.	HY-542	Urban Hydrology	PEC	4	3	1	-	3	-	25	-	25	50	-
12.	CE-624	Environmental Impact and Risk Assessment	PEC	4	3	1	-	3	-	25	-	25	50	-
13.	CE-625	Industrial and Hazardous Waste Management	PEC	4	3	1	-	3	-	25	-	25	50	-

Some Suggestive Open Electives

Teaching Scheme					Teaching Load Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S. NO	SUBJECT CODE	COURSE TITLE	SUBJECT AREA	CREDITS	L	T	P	T	P	CWS	PRS	MTE	ETE	PRE
1.	AH-536	Biomass Production & Utilization	MEC	4	3	1	-	3	-	25	-	25	50	-
2.	AH-542	Energy conservation and Management	MEC	4	3	1	-	3	-	25	-	25	50	-
3.	CE-536	Remote sensing for land use analysis and urban planning	MEC	4	3	-	2	3	-	15	15	30	40	-
4.	HY-538	Hydrology Data Collection Processing and Analysis	MEC	4	3	1	2/2	3	-	15	15	30	40	-

The courses for Open Elective (I&II) are to be selected in consultation with the faculty by the students from other departments such as Department of Mechanical and Industrial Engineering, Department of Hydrology, Water Resources Development and Management Department, Department of Electrical Engineering, Department of Earth Sciences, Civil Engineering Department, Chemical Engineering Department and Biosciences & Bio-Technology Department.

3.0 DETAILS OF COURSE CONTENTS

MA-501F: Numerical Analysis, Probability and statistics

Solution of non-linear equation: Newton-Raphson and a fixed point iteration methods to find roots of non-linear equation(s) in one and two variables; Solution of linear simultaneous equation: LU-decomposition, Crouts method, Jacobi's and Gauss-Scidel interactive methods; Numerical differentiation: Revision of various interpolation formulae, Numerical differentiation using Newton's forward, backward and Stirling's formulae and divided difference; Numerical Integration: Revision of Trapezoidal and Simpson's formulae and Gauss-Legendre Quadrature formulae; Solution of first and second order differential equation: Euler, modified Euler and 4th order Range-Kutta methods for initial value problems and finite difference approximation methods for two point boundary value problems; Numerical Solution of parabolic and elliptic partial differential equation (i) finite difference methods (ii) and methods of weighted residuals such as collocation, least square and Galerkins methods; Revision of Concept of probability, Random variable and distribution function: discrete and continuous, moments and moments generating functions; Special distributions (discrete): Binomial, Poisson, Negative binomial, Geometric, Hypergeometric (continuous): Uniform, Exponential, Gamma, Beta, Weibull, Normal, Lognormal, Pearsons; Sampling and sampling distributions; Bivariate distributions, statistical independence, Correlation and regression; Point and interval estimation; Testing of hypothesis; Analysis of variance; Concept of design of experiments

AH-517A: Modelling, Simulation & Computer Application

Introduction to Review of C++, Principles of modeling, physical, mathematical, static and dynamic models, transport phenomena based model, Modeling of empirical data, estimation of model parameter, goodness of fit, confidence level, Experimental and mathematical simulation; numerical methods used for simulation and exposure to available computer softwares; parameter estimation for models and sensitivity analysis/ANN based model development., Design of experiment and optimization, Uniform and non

uniform continuous distribution random numbers, computer generation of random numbers, Monte-Carlo simulation, spread sheet simulation, numerical computation techniques for continuous and discrete models, Water quality modelling, assimilation capacity, dispersion of pollutants in water bodies, Case studies; modelling of waste treatment and other pollution mitigation system; Monte-Carlo simulation for risk analysis of conservation of rivers and lakes, lake water balance and simulation, modelling for dependable yields from a lake.

List of Practicals:

Software development for planning and designing of sewage and effluent treatment plant based C++ programming, development of model with empirical data, software development for simulation technique.

AH-523: Integrated Management of Water Bodies

Hydrology, types, hydrological processes and water balance of water bodies, estimation of present and projected demands, human impacts, inventory of human activities in a basin, land use and impact of anthropogenic activities on water quality, domestic water demand, wastewater generation, collection and treatment and disposal, urban storm water, industrial waste generation, open defecation, municipal solid wastes collection, transport and disposal, impacts of dumping in drains or sewer lines, Point and non point sources, types of water pollution, water quality criteria and standards, designated best uses of water; equilibrium, acid base, oxidation – reduction, precipitation and complex reactions, Physical methods (turbidimetry, nephelometry, optical methods of measurement, potentiometry, chromatography, spectroscopy); measurement of sulphates, Na, DO, BOD, TOC, all forms of N, fluorides exposure to analytical techniques of IIC like ICP, AAS, GC, biological components (periphyton, phytoplankton, zoobenthos, nekton, biodiversity indices, trophic status, P/R ratio microbiological MPN, coliform and streptococcus, bioindicators, biomonitoring of water bodies), sampling, schedule and water quality monitoring program of national rivers and lakes; sampling protocol of NRCD, standards, water quality

indices, strategy for water quality management, case histories of ongoing projects., Principles of environmental management, EIA, water and sustainable development, involvement of stakeholders, water governance, environmental education, public participation; Legal, constitutional provisions, national policies, legal and institutional arrangement for the management of water quality and quantity., Application of remote sensing and GIS for water management, modeling (forecasting and growth modeling), eco-mapping, inter river basin transfer, cost-benefit analysis, environmental taxes, economics of natural resources;

List of Practicals:

- i. Measurement of the total dissolved solids (TDS), total suspended solids (TSS) and total solids (TS) in water sample
- ii. Determination of total hardness, calcium, sodium, potassium, magnesium hardness of the water sample
- iii. Determination of bi-carbonate carbonate, chloride, sulphate and acidity of water sample
- iv. Determination of total phosphorus
- v. Bacteriological examination for total coliform, faecal coliform of sewage and water
- vi. Estimation of oil and grease, fluorides, volatile acids
- vii. Exercise:
 - a. To prepare a water budget for a watershed/sub-watershed either from a provided case study or one where the student can obtain information of on their own
 - b. To carry out a water demand analysis and future projection.
 - c. To perform case study on IWRM for a basin

AH-525: Aquatic Ecology

Definition, relevance, principles and scope of ecology, sub-divisions, Structure and functions, biotic and abiotic components and productivity of ecosystem and energy flow, materials cycling, energetics, limiting factors, development and evolution; Trophic levels, food chain and food webs, ecological pyramids, competition, population ecology., Lakes, wetlands and rivers, reservoirs and springs, structure and functions, usefulness, natural and manmade ecosystems;

concept, importance and conservation of aquatic biodiversity role of invasive species and its importance, System analysis, ecosystem models, Stressed ecosystems, homeostasis, ecological succession, ecosystem resilience, Pollution of lakes and rivers, causes, impacts and control of eutrophication; principles and application of restoration methods, ecotechnologies, National/international perspectives, policies, Ramsar convention, NLCP, NRC, case studies of Dal lake, Nainital lake, Chilka, Loktak and Asan wetlands, Tehri dam reservoir, river Ganges and Yamuna., Elementary biochemistry, salient features of biomolecules, enzymes and other tools of biotechnology, discovery and diversity, prokaryotic cell, microbial energetics, biosynthesis and nutrition, autotrophic way of life, growth, macromolecular synthesis., Microorganism in environment, microbiology of water, bacteria and viruses, bacteriophages, animal and plant viruses, structure, replication and quantification, structure and diversity of algae, protozoa and rotifers.

List of Practicals:

- i. To determine the pH, electrical conductivity and turbidity.
- ii. To determine the Phosphorous (Total P and Orthophosphate), Nitrogen (Total N, nitrate, ammonia), Fe and Total Iron.
- iii. To determine dissolved oxygen, BOD and COD.
- iv. To identify Plankton, common phytoplankton, common zooplankton, common periphyton and macroinvertebrates.
- v. To estimate chlorophyll.
- vi. To identify common aquatic macrophytes.

AH-554: Waste Water Collection, Treatment and Disposal

Overview, sources-domestic and industrial, waste water, its quality, effluent standards, waste water load and its evaluation, flow rates, water supply data, actual measurement and analysis of flow data, Waste water collection, sewerage systems and sewage pumping, natural drainage system and waste water disposal, Typical sewage quality, its composition and health hazards of handling and disposal, Software for sewer design and estimation of waste water, objectives, methods and implementation strategy of treatment processes, physical operations like screening, grit removal, flow equalisation, sedimentation; aerobic, anaerobic, attached and suspended growth

processes; pond system, combination and/or alternatives, design of treatment units, life cycle cost, Operation and maintenance of waste water treatment plants, polishing of treated waste water, disinfection, nutrient removal, natural treatment systems, Treatment of sludge, disposal of treated effluent and sludge, Resource generation by way of biogas generation, sale of treated water and sludge, tertiary treatment, reuse of treated water in agriculture / horticulture / construction work, CDM of conservation facilities like STPs, toilets, crematoria to generate additional revenues

AH-556: Environmental Laws, Public Participation and Institutional Development

Genesis of environmental acts and main national laws, water (prevention and control of pollution) act rules, constitution of central and state boards, Environment (protection) act rules, prevention, control and abatement of environmental pollution, hazardous wastes management and handling rules, pollution abatement policy, municipal and solid waste (management and handling rules), biomedical waste rules and chemical accidents rules, National environmental policy, water policy, EIA guidelines of MoEF and successive amendments, biodiversity act, latest laws and amendments, industrial and MSW rules, health, safety and environment management system, water resources management through community participation, Notification of MoEF for construction projects, National environmental tribunal act and appellate authority, Environment audit, international protocol, treaties and conventions, Latest International global environmental concepts like global warming and its impact on water resources, Stock-holm and Basal convention, Copenhagen conference, Rio-Earth summit, maintenance of biodiversity, awareness, Modes of awareness generation, information, education, communication, costing of awareness generation, Sustainability and impact assessment, role of civil society in awareness generation, stages and forms of public participation, forms of public participation, concept and role of institutions, evaluation of existing institutions, design of institutions, Case studies, Laws related to the institutions.

AH-527: Laboratory Course

Solid waste characterization, soil characteristics: permeability, porosity, LL, PL, grain size

distribution, soil classification and resistivity., Performance evaluation: sewage and effluent treatment plants, disposal of treated solid waste and treated water, possibilities of resource generation on account of biogas and manure production., Performance evaluation of toilets, crematoria and river fronts. , Flow measurement techniques: 'V' notch and area-velocity method., Sediment analysis, Trace element analysis, Performance evaluation of various waste water treatment systems: lagoons, oxidation pond, ASP, UASB and other treatment plants, Students to work at least for two weeks time at any STP set-up under GAP/NRCD to carry out the comprehensive evaluation of STPs or ETPs, Demonstration of latest equipment of Institute Instrumentation Centre.

AH-544: Project Formulation & Implementation

Project objectives and formulation, preparation of pre-feasibility and detailed project reports, Project implementation methods and management, project management agencies, public hearing process, Project planning, background of network charts, network elements, drawing the network, PERT and CPM comparison and application, monitoring and control, management concepts., Tendering procedures, tender documents of central and different state governments, standard tender documents from international bodies like world bank, ADB and other funding agencies, on-line tendering procedure, procurement, Cost estimates, economic and financial analysis, internal rate of return, cost benefit analysis, Financial management, resource mobilization and sustainability of the project, use of application softwares in project management, equipment development of lab, identification of appropriate equipment, Specific regulations/ statutory acts of other countries not practiced in India, problems of project implementation,

AH-558: Coastal Pollution Monitoring and Impact Assessment

Brief history, importance, fields of application and fundamental concepts of coastal pollution, collection, processing, analysis and quality control of data., Fundamentals of acoustic wave propagation in ocean waters, sound velocity computation, attenuation, refraction and reflection, frequency band width, multibeam echosounders, sea floor classification., Water levels and flow

measurements, principles of tides and water levels, astronomical tide producing forces, tidal characteristics, non-tidal water level variations, tide and water level datum, harmonic analysis and tide prediction, principles of tidal currents, measurements and prediction., Biological/chemical indicators of coastal pollution, methods for the assessment of coastal and marine pollution, biological productivity and pollution monitoring, physical/chemical/biological water quality, sampling techniques and problems, nutrients, anoxia, impacts of heavy metals, pathways of radioactivity, data storage and processing, water quality standards., Coastal pollution, types, causes and impact, concept and guidelines of sewage or sludge disposal into the sea., Notification of coastal regulation zone (CRZ) and environment clearance with practical case studies, desalination units for drinking water., Case studies of EIA of developmental projects on coastal areas.

AH-550: Application of RS & GIS in Environment Management

Definition of remote sensing, ideal remote sensing system, sensors and their characteristics., Image processing software, image registration, image enhancement, image classification., Definition and components of GIS, sources of data, coordinates and projection system, global Positioning System., Spatial and non spatial data, raster and vector data, data errors and editing creation of data base, special data operations and analysis., Applications of RS and GIS in optimal routing of solid wastes collection system of an urban area, environmental siting of industries, zoning atlas development and impact of land use and land cover change on environment., Re-modelling of water distribution and sewer network systems using GIS., GIS for sustainable land use urban development planning, rivers, lakes and coastal areas., Groundwater vulnerability modelling using GIS, environmental degradation and soil erosion of catchment, reservoir capacity and sedimentation.

List of Practicals:

- i. Geo referencing of toposheet and satellite image
- ii. Image enhancement and classification – supervised and unsupervised
- iii. Digitization of lake boundary, river network and other features
- iv. Data collection from GPS

- v. Development of environment database on GIS package
- vi. Queries and analysis from GIS database

AH-552: Hydrology and Modelling of Water Bodies

Definition, importance, practical applications of hydrology; global water availability, India's water availability, hydrologic cycles; definition, forms and types of precipitation, measurement of rain fall using rain gauges, selection of rain gauge stations, consistency of rainfall data, computation of mean rainfall, estimation of missing rainfall data, presentation of precipitation data., Losses from evaporation, definition, process, factors and measurement, estimation using empirical formulae; infiltration, factors affecting infiltration capacity, measurement, Harton's infiltration equation, infiltration indices, runoffs, concept of catchments, water budget, components, factors affecting runoff, rainfall-runoff relationship using simple regression analysis, agricultural practices to minimize impacts of runoffs carrying chemicals and pesticides on river ecology., Hydrographs, definition, components and its derivation from simple storm hydrographs, base flow separation, S-curve and its uses, stream flow and its stages, discharge measurement by area-velocity and slope area methods, simple stage discharge relation., Sediment yield and its determination in reservoir/lake, reservoir sediment control, water wealth, river basins and their potential, importance of water resources projects in India, need of minimum ecological flow in rivers, its regulations in India and other countries, small scale and small tank harvesting, urban rainwater harvesting, methods of ground water recharge., Types of pollutants, modeling approach, molecular diffusion in a stagnant fluid, molecular diffusion equation and its classical solutions advection-diffusion equation, its classical solutions and its depth and cross-section averaging, shear flow dispersion, Taylor's analysis of turbulent shear flow., Mechanisms of vertical mixing from steady transverse line, steady and unsteady point sources, statistical analysis of water quality, mechanisms of transverse mixing, constant-coefficient and two-dimensional numerical mixing models, cumulative discharge method for transverse dispersion, transverse mixing from a diffuser of finite length., Mechanism of longitudinal dispersion, Fickian and alternative models, estimation of mixing length, analytical and numerical solutions of longitudinal dispersion equation, estimation of longitudinal

dispersion coefficients, non-Fickian behavior of dispersion process, field measurements of mixing in river and lakes,

AH-576: Planning and management of Environmental Facility

Estimation of earthwork volume by cross-section, spot levels and contour, construction of mass diagram, calculation of haul, over haul and economic haul lead and lift., Procedure for working out quantities and rates for lime and cement mortars, lime and cement concrete, brick and stone masonry, flooring, plastering, RCC works, centering and works for different RCC items, doors, windows and ventilators., Drawing up specifications for construction materials such as coarse aggregate lime, cement, mortars, plain and reinforce concrete, brick masonry, stone masonry, flooring, roofing, plastering, wood work, earthwork and surfacing, water supply distribution lines, surface and sub-surface drainage line (including stone-ware pipes)., Methods for estimating the quantities, preparation of detailed and abstract estimates for the environmental engineering works like septic tank, manhole, pump house, store room, calculation for procuring steel for reinforcement for the basic components such as small slabs, chejja and lintels. , Financial aspects, cost price and its different forms, gross and net income, outgoings and its types, obsolescence, annuity, year's purchase., Capital cost, operating cost, capitalized value, time value of money, sinking fund, depreciation and methods of its calculation, cost fixation on the produced commodity., Fiscal incentives for environmental protection: exemption from it, investment and depreciation allowance, exemption from tax to capital gains, rebate in cess levied on consumption of water., Measures for sustainability, operation and maintenance of the assets and facilities.

AH-580: Climate Change and Water Resources

Natural eco-systems, autotrophs, heterotrophs, energy flows, pre-industrial humanity; efficiency of photosynthesis and ecosystems like forests, crops, respiration, combustion and other oxidation processes, biomethanation., History of climate change, greenhouse gas effect, anthropogenic climate change, role of different gases, global climatic problems, integrated assessment model, impacts and adaptation, uncertainties precautionary principle., Biological and physico-chemical

methods for carbon sequestration, CO₂ capture from large point sources, pre-, post- and oxy-combustion technology, transport, storage and monitoring, feasibility, economics and public perceptions., Water resources and green house gas emissions, mitigation measures and adaptation to climate change., Kyoto protocol, UNFCCC, IPCC, geopolitics of GHG control, CDM and other emission trading mechanisms, non-CO₂ GHGs, relevance for India, procedure for registration for CDM projects and its benefit., Case studies.

HY-527: Ground Water Hydrology

Scope of groundwater hydrology and its historical development. Darcy's law of groundwater flow in porous media and its validity; Review of aquifer properties and well hydraulics, methods of estimation of hydraulic conductivity, Groundwater flow in ditches and galleries tapping confined, leaky confined and unconfined aquifers, Analysis of pumping test data of confined, semi confined and unconfined aquifers, groundwater flow in partially penetrated aquifers, aquifers having finite boundaries; Anisotropic aquifers tapped by large diameter wells; Multiple well systems, Evaluation of well loss parameters by step drawdown tests, Jacob and Rorabavgh method; Estimation of specific capacity of wells, Development of drilled wells and well design; Artificial gravel pack and natural gravel pack wells, evaluation of entrance velocity and its significance in well design, Groundwater budgeting and assessment, Groundwater Estimation Committee methodology, evaluation of stages of groundwater development, Methods of artificial groundwater recharge, induced recharge and rain water harvesting, Groundwater management in conjunctive use, alternate basin yields, Seawater intrusion in coastal aquifers and its abatement, Groundwater legislation in India and case histories

List of Practicals:

- i. Lab Verification of Darcy Law
- ii. Lab Demo of groundwater flow in unconfined aquifers
- iii. Unsteady state flow in ditches

HY-531: Watershed Behaviour and Conservation Practices

Physical elements of a watershed, effects of land use changes on hydrological cycle component-precipitation, interception, evaporation, transpiration and quality and quantity of runoff,

Concept of vegetative management of water yield and quality, Watershed experiments, extrapolation of results from representative and experimental basins, regional studies, Inventory techniques for precipitation, runoff, soil, timber, range-land and wild life, Water harvesting techniques, elements, development of modern harvesting techniques, Estimation of peak rate of runoff, Land capability classification, Water erosion process, factors affecting erosion, types of erosion, assessment of erosion, universal soil loss equation, control measures for erosion, temporary and permanent measures, Wind erosion and its assessment, vegetative and mechanical control measures, Objective and general soil and water conservation practices, land and soil classification, identification of critical areas.

HY-542: Urban Hydrology

Urbanization, planning, land use, consequences for rainfall-runoff and groundwater Urban water 'cycle', process, flooding, infiltration, groundwater, urban streams and rivers, Rainfall analysis, IDF curves, profiles/ hyetographs, Chicago, antecedent conditions Urban runoff, source control, lag time, empirical methods, SCS method, time-area diagram, linear reservoir, GIS, remote sensing and data management, Water supply and distribution, demand, supply from surface and ground water, treatment, quality control, leakage, groundwater, Surface channel and pipe network drainage, waste and storm water, infiltration, Rational method for design, time of concentration, return period of rainfall and design, return period of flooding (from rainfall), Simulation of drainage network performance, brief hydraulic concepts, related simulation softwares, levels of service, rehabilitation, damage costs, Urban flood management, runoff from adjacent catchments and overflows from rivers, flood flows through urban areas, flash flooding, flood forecasting, warning, sociological issues, 2D flow modeling (simple with easy to use software), Use of storage for flood control, ponds/basins, use of public open spaces for flood storage, over ground flow paths, flood resilience of public/private buildings, roads and railways, Rain water harvesting, codes of practice.

CE-624: Environmental Impact and Risk Assessment

Introduction to environmental impact assessment, definitions, need in decision making, Elements of

environmental impact assessment, guidelines of Ministry of Environment and Forest, GOI, Environmental impact assessment techniques and methodologies, checklists, matrices, network, geographic information system and computer applications, Environmental indices and standards, Assessment of impact on bio-geo-physico-chemical environment-flora and fauna, air, water and land, Assessment of impact on aesthetics, cultural and socio-economic environment, Decision methods, public participation in environmental decision making, Environmental impact statement and its review, Environmental impact assessment-case studies, Environmental audits, Environmental risk assessment – hazard identification, exposure, dose response, risk characterization and risk evaluation, Environmental risk management – cost benefit analysis, utility theory and decision making, mitigation measures, Environmental risk assessment – case studies

CE-625: Industrial and Hazardous Waste Management

Introduction, industrial waste surveys, sampling and characterization, Waste management strategies and programs, waste minimization, end-of-pipe treatment and disposal, waste management options hierarchy, Green technologies, zero waste discharge units, environmentally balanced industrial complex, ISO 9000 AND 14000 series of standards for environmental management, Waste treatment technologies, common effluent treatment plants, co-disposal with municipal waste, Case studies of distilleries, pulp and paper, tannery, sugar, textile, steel, oil refineries, chemicals and industrial complexes, Introduction and classification of hazardous wastes, storage and handling requirements, onsite and offsite emergency preparedness planning, hazardous waste management rules, Hazardous wastes stabilization and solidification, Hazardous waste disposal practices, incineration, land-filling, underground disposal, Site remediation

AH-536: Biomass Production and Utilization

Biomass Resources – biomass production from Agro-forestry, short Rotation Intensive Culture (SRIC) and other practices; Biomass harvesting processing and pre-conversion processes, biomass residues, biomass wastes, biomass from forests, biomass characteristics; Biomass conversion

processes : Biological & thermal processes – Anaerobic digestion: Process, biogas plants and their sizing, thermal and electricity from biogas; Biomass briquetting, types of processes, types of machine and applications; Biomass gasification: types of reactors, design parameters, gas purification, thermal and electricity generation applications, fluidised bed gasification; Biodiesel: sources of oil, characteristics, transesterification process for biodiesel production, use as diesel engine fuels; Fermentation: Process, purification of ethyl alcohol, use as gasoline extender in otto engines; Collection, segregation and disposal of MSW for energy production and its overall management; Environmental aspects of biomass energy production & utilization.

AH-542: Energy Conservation and Management

Energy Conservation: Energy use pattern and scope of energy conservation, organization of energy conservation programme, Energy monitoring, energy accounting and analysis, energy audit and bench marking, monitoring and targeting; Method for estimation of energy saving potential of fuel and electricity in energy consuming sectors; Energy conservation in boilers, diesel engines. Total Energy System: CHP/ co-generation systems including topping and bottoming cycles. Energy efficient house keepings, waste heat recovery technologies; Illumination; light sources, compact florescent lamp (CFL), light emitting diode (LED), Energy Efficient lighting design, impact of lighting efficiency; Electrical power circuit, energy efficient electrical machines, tariffs and power factor improvements in power system, Energy efficient electric heating system; Thermal energy audit in heating, ventilation and air conditioning (HVAC); energy conservation in pump, compressors, fans, blowers and mechanical drives; Energy savings due to friction, lubrication and thermal insulation; Passing energy conservation: Need and importance of building energy conservation, energy management of buildings, concept of solar architecture and day light design;

CE-656: Remote sensing for land use analysis and urban planning

Introduction, land use land cover - definition and its significance in engineering projects, history, modern surveys and classification systems, utility of remote sensing data at various scales, Land use land

cover analysis based on spectral characteristics of remote sensing data-visible, near infrared and shortwave infrared wavelength regions, thermal infrared regions and active microwave region, high resolution images, utility of various indices, Land use land cover analysis based on spatial characteristics of remote sensing data, utility of IFOV, land parcel sizes, minimum mapping unit, map scale, land use land cover analysis based on temporal characteristics of remote sensing data, temporal resolution of remote sensing data, application based temporal requirements, land use land cover change detection, visual and digital change detection algorithms, principles of land use land cover mapping, visual image interpretation techniques, Digital image classification for land use land cover map preparation, per pixel classification, statistical, artificial neural network and other machine learning approaches, object based image classification: Concept of mixed pixel and sub pixel classification, linear mixture modeling, fuzzy set based classification, artificial neural network and other machine learning approaches, Classification accuracy assessment, accuracy of per pixel and sub-pixel classification, sampling design issues, design of error matrix and fuzzy error matrix, statistical testing, Urban and regional planning - objectives and issues, planning processes, data requirements, physical planning and statistical methods, mapping of parcels and individual buildings, utility of land use land cover maps in urban planning, Role of remote sensing and GIS for urban planning, management and growth assessment, study of cropping pattern and resources, utility/service planning, transportation planning and management, infrastructure planning,

List of Practicals:

- i) Familiarization with various photographic and digital remote sensing data products used for land use land cover mapping.
- ii) Study of spectral reflectance characteristics of various land use land cover features using Spectro-Radiometer.
- iii) Preparation of land use land cover classification scheme for an area.
- iv) Study of image interpretation elements through image interpretation keys for visual analysis of land use land cover. Preparation of a land cover map from the given FCC.
- v) Training on image classification. Practice for selection of training areas and their quality

assessment using histogram and separability analyses,

- vi) Comparative assessment of various statistical image classifiers for land use land cover mapping. Practice for selection of testing areas based on different sampling schemes for classification accuracy assessment.
- vii) Preparation of a land use land cover map using back propagation neural network algorithm,
- viii) Preparation of land use land cover map at sub-pixel level using soft classification techniques,
- ix) Preparation of land parcel and building map from high resolution satellite image,
- x) Development of a computer program to implement an advanced image classification algorithm (e.g., decision tree classifier, evidential reasoning or any other),
- xi) Preparation of a land use land cover change detection map using various image change detection algorithms.

HY-538: Hydrological Data Collection, Processing and Analysis

Types of hydrometeorological data and their importance, time oriented, space oriented and relational data, Observation of hydrometeorological data-rainfall, temperature, evaporation, discharge and other parameters, observational and instrumental errors and quality control, Storage, transmission and retrieval of data,

different formats adopted by IMD, CWC and WMO, Design and optimizations monitoring systems for rainfall, evaporation, gauge and discharge networks and groundwater data monitoring stations, Estimation of missing data in rainfall, runoff and other parameters, record extension for rainfall and runoff data, interpolation and kriging techniques, statistical rainfall-runoff models, Development of stage discharge curves using graphical, physical and analytical methods for various types of streams, Automatic weather stations - types, data storage and retrieval; Automatic water level recorders - types, data storage and retrieval, Analysis of randomness and trends in hydrometeorological data; Computation of statistical parameters and standards errors, components of time series, concepts of short and long term dependence in hydro-meteorological data, Estimation of extremes using frequency analysis; Graphical and analytical methods for normal, lognormal and Gumbel distributions,

List of Practicals:

- Observation of rainfall, temperature and evaporation.
- Observation of groundwater levels in observatory.
- Observation of gauge and discharge in lab/field.
- Demonstration of hydrological processes using Total Hydrologic Station.
- Measurement of infiltration rates.

4.0 FEE STRUCTURE

S. No.	Items	M.Tech. Programme			Ph.D. Programmes	
		Indian National	Total Cost	Foreign	Indian	Foreign
		Cost per Semester	Total Fees for 4 semester	Cost per Year (US\$)	Cost per Semester	Cost per year (US\$)
1.	Institute fees (As approved by IIT Council)	₹ 27350/-	₹ 109400/-	<ul style="list-style-type: none"> • 2000 for students from SAARC countries • 4000 for students from other countries + 500 one time per programme. 	₹ 10880/-	<ul style="list-style-type: none"> • 2000 for students from SAARC countries • 4000 for students from other countries + 500 one time per programme.
2.	Hostel Fees	₹ 5500/-	₹ 22000/-		₹ 7500/-	
3.	Mess Advance	₹ 7500/-	₹ 30000/-			
4.	Mess Security (refundable)	₹ 2000/-	-			
	Total	₹ 42350/-	₹ 161400/-			
	One Time Payment					
	-At the time of admission	₹ 2790/-	₹ 2790/-		₹ 2790/-	
	-Refundable fees Deposit	₹ 3000/-	₹ 3000/-		₹ 3000/-	
	-Medical Insurance/Bhawan Fund	₹ 380/-	₹ 380/-		₹ 380/-	
	Fee payable at the time of admission	₹ 48500/-	₹ 167570/-			

- ₹ 250/- to be paid extra at the time of submission of M.Tech dissertation /thesis.
- The charges for mess and married accommodation shall be payable separately.
- ₹ 3000/- are to be paid at the time of submission of Ph.D. thesis.

- Note :
1. In case of having mess facility, an additional amount of ₹ 2000/- as mess security (Refundable) & ₹ 6000/- as mess advance (per semester) shall be charged from the students.
 2. The fee may be revised as per MHRD, Govt. of India norms & shall be charged as applicable from time to time.

9. Employment record and Experience:

Name of Employing Department / firm	Position held	Period	Details of work	Remarks

10. Membership of Professional societies.

11. Research work & any other special attainments (Attach additional sheets, if required)

Declaration

I hereby declare that the information furnished above by me is true to the best of my knowledge and belief.

Date :

Full Signature of the Applicant

Place :

Recommended and forwarded:

Approval for nominating the candidate has been obtained from the competent authority.

The officer, if selected to the programme, will be paid salaries and allowances as may be admissible during the period, he pursues his Master's programme at the IIT, Roorkee.

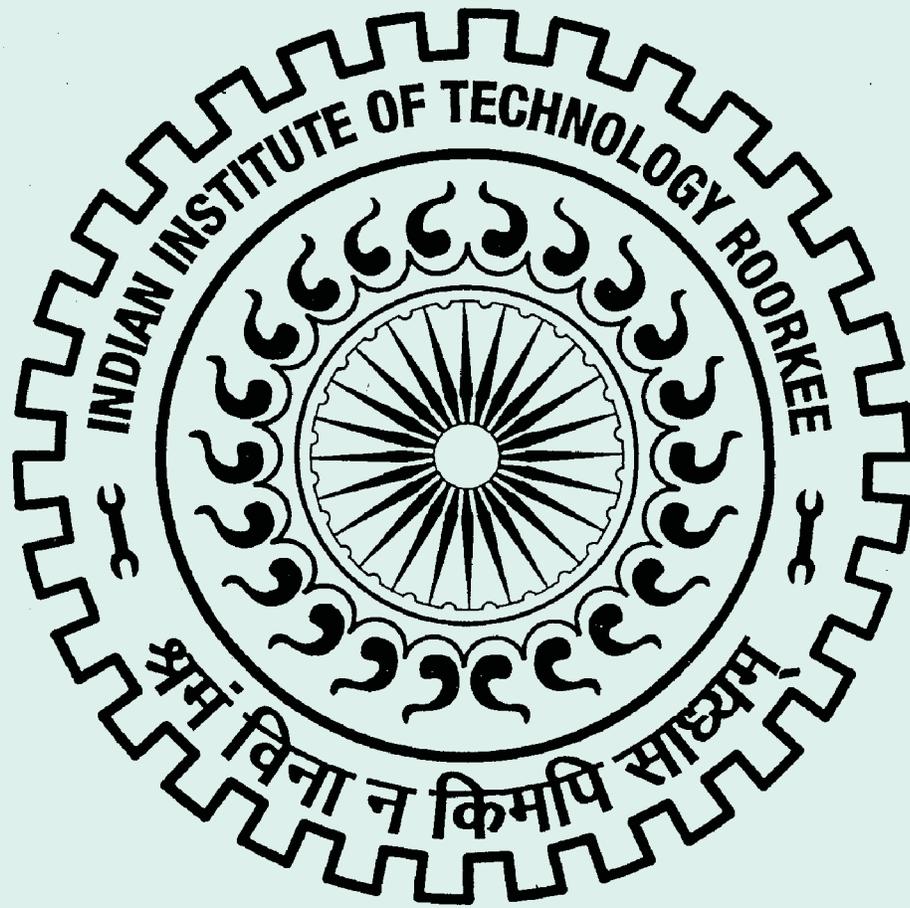
After the candidate has completed the M. Tech. programme, he will be posted on assignments where the skills acquired as a result of his undergoing this programme will be directly used.

Signature, name and designation of the officer forwarding the application

Date :

Name of the employing Organisation
with seal

Place :



For further details, please contact

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