

# **PROSPECTUS**

**Academic Session  
2003-2004**

**ALTERNATE HYDRO ENERGY CENTRE  
INDIAN INSTITUTE OF TECHNOLOGY,  
ROORKEE-247 667 (UTTARANCHAL)  
INDIA**

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## PREFACE

*Increased utilisation of renewable energy sources is considered as a key element of sustainable development of the country. In India, the efforts are under way to generate about additional 10% electricity (about 10,000 MW) of the total assessed potential of 1,00,000 MW during the next 10 year. Currently, the renewable energy contributes 3400 MW representing only about 3.5% of the total installed electricity generation capacity (1,04,000 MW) from all sources.*

*The electricity bill 2001 introduced in Indian Parliament calls to prepare a national policy for stand-alone systems for rural & remote areas development and promotion of co-generation & generation of electricity from renewable energy sources. The Energy Conservation Act 2001 calls to enforce efficient use of energy & its conservation. Ministry of Human Resources Development,, Govt. of India, also stressed to review the academic offerings in the context of energy technologies such as new energy technologies and suggested new & emerging areas for new academic programmes. Meeting the minimum additional electricity generation through Renewable Energy Sources has become national policy for several developed and developing countries.*

*Under the clean energy development mechanism (CDM), which is becoming a global character for each country specially developed world, the compensation to the carbon emission is being traded. Renewable energy development, being environmental friendly resource, is the major candidate for trading of CO<sub>2</sub> emission.*

*In view of the above and overall development, expansion, commercialisation of new & renewable energy technologies, it is expected that very large number of trained personnel will be required in future, who can take up the responsibility to plan, design, develop, install, carry O&M, install, repair & manufacture of various renewable energy technologies. This will also open large scale employment opportunities in decentralised, centralised power generation and in large scale industrial applications in organised Govt./Semi Govt./private sectors.*

*For meeting the requirement of trained personnel, AHEC has been offering a two years duration Master of Technology (M.Tech.) course in “Alternate Hydro Energy Systems” since 1997. This prospectus is for the admission of sponsored candidates (national and foreign) for the academic session 2003-2004. The course has the following objectives:*

- To meet the need of trained manpower in the field of renewable energy with particular emphasis on small hydro power development.*
- To train engineers and technologists for the implementation of renewable energy programmes in the country with special reference to rural energy needs.*

*Following academic programmes are available at AHEC:*

- 1. Two year (four-semester) duration Master of Technology (M.Tech.) Degree course in ‘Alternate Hydro Energy Systems’.*
- 2. Research leading to Ph.D. degree in “Alternate Hydro Energy Systems”.*

*This prospectus gives the general information about AHEC, its achievements, facilities available, academic programme, admission eligibility, admission procedure, course details, fees and format of application form.*

*It is requested to the organisations to nominate their officer(s) for the M. Tech. course.*

**(ARUN KUMAR)**  
Head



# FACULTY

Director  
**Prof. Prem Vrat**

Arun Kumar (Head)	M.E.(Civil)	Planning, Investigations and Design of Small Hydro Power, Energy Economics Policy.
S.N. Singh	M.E. (Elect.)	Electrical Machines, Transmission and Distribution of SHP
M.P. Sharma	Ph.D.(Chem.)	Bio energy, Solar Energy, Wind Energy and Environment Pollution
S.K. Singal	M.E. (Civil)	Planning and Design of Civil works for SHP and Refurbishment of SHP
R.P. Saini	Ph.D.(Mech.)	Hydromechanical Equipment, Solar Energy & Environment Auditing
M.K. Singhal	M.E. (Civil)	Planning, Design and Analysis of Civil Works of SHP

## **Others Faculty**

In addition to the above faculty, faculty from various departments of Indian Institute of Technology, Roorkee, experts from Industry/Public/Private Organisations deliver the lectures on specific subject/topics as per the requirement of the programme.

# 1.0 INTRODUCTION

## 1.1 NEED OF THE COURSE

The primary goal of sustainable development is to achieve a reasonable & equitably distributed level of economic well being that can be perpetuated continually for many human generations. This requires depleting non-renewable energy sources at a slow enough rate so as to ensure high probability of an orderly society transition to renewable sources. There is therefore an urgent need to develop and commercialise alternative sources of energy in order to meet the energy demand arising out of sustained development. Though large energy potential is available in wind, solar, biomass, small hydro resources but the pace of exploitation has been slow. The reason for not being able to make any head-way in developing renewable sources of energy has been the total scarcity of trained human resource. To bridge this gap, Alternate Hydro Energy Centre (AHEC) offers a four semesters Master of Technology (M.Tech.) course in “Alternate Hydro Energy Systems” covering renewable energy development with emphasis on Small Hydro power development. It is aimed that personnel working in energy utilities e.g. State Electricity Boards, State Power Corporations, Departments of Power, Energy Development Agencies, National /International Institutions, Consulting firms and Private developers will take advantage of this course for developing their knowledge and know how for development.

## 1.2 ABOUT INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE (IITR)

Roorkee is the oldest seat of technical education in the East. The erstwhile Thomson 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 Indian Institute of Technology, Roorkee (IITR) on

September 21, 2001. During the past 155 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 Engineering, Science & Humanities departments besides a number of centres of higher education and research. Roorkee has the added advantage of availing the facilities of State Irrigation Research Institute, the Bengal Engineering Group & Centre of the Army Corps of Engineers, National Institute of Hydrology and Central Building Research Institute.

## 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 kilometers 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°C 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.

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

## 1.4 ESTABLISHMENT OF AHEC

Alternate Hydro Energy Centre (AHEC) an academic centre, was set up at Indian Institute of Technology, Roorkee (formerly University of Roorkee) by the Ministry of Non-Conventional Energy Sources (MNES) (the then Deptt. of Non-Conventional Energy Sources), Govt. of India, in the Year 1982 to promote power generation through the development of small hydro projects in hilly as well as, plain areas and development of decentralized integrated energy systems in conjunction with other renewable energy sources e.g. biomass, solar, wind etc.

AHEC has been imparting training to the field engineers and technologists through short term training courses to create trained human resource in the field of renewable energy. AHEC offers a four semesters Master of Technology (M.Tech.) course in 'Alternate Hydro Energy Systems' open to engineers, technologists, officers and scientists drawn from India and other developing nations. AHEC also offers two elective subjects on Renewable Energy to engineering bachelor students of the Institute.

The centre offers formal and informal educational programmes, carry out Renovation and Modernisation, formulate national standards, promote SHP development upto 25 MW, provide support for renovation and modernisation of existing SHP projects, the preparation of detailed project reports, engineering designs, techno-economic analysis, field execution of small hydro projects, development of biomass & solar energy systems and Integrated Renewable Energy Systems. The environment and energy auditing of process and allied industries environment impact assessment of small hydro projects and ecorestoration of water bodies are its diversified activities. The centre has laboratories viz., Hydromechanical Systems, Biomass and Eco-systems, Control Systems, GIS, instrumentations, Computer Aided Design and Information Systems to undertake specific research

studies pertaining to the above diverse fields. Data Bank for small hydro projects is the unique facility created at AHEC to cater the speedy development of small hydro power.

Faculty of AHEC drawn from multi disciplinary fields of Civil, mechanical, electrical, chemical, electronics and power engineering have gained excellent expertise in the entire gamut of activities related to renewable energy and the environment. AHEC has been awarded a Citation by Indian Renewable Energy Development Agency Limited (IREDA), a Govt. of India Enterprises (in 1997) and Surya Anand (2nd Prize) by Indian Institute of Rural Development and Social Sciences (in Sept. 2002) in appreciation and recognition of its commendable and outstanding contribution in Renewable Energy sector.

AHEC has signed Memorandum of understood (MOU) to work as expert organisation for SHP development with Uttaranchal State Government and Bihar State Hydroelectric Power Corporation. Recently it has set up instrumentation lab. provide independent performance testing of hydropower plants.

## 1.5 AREAS OF ACTIVITIES

1. Small hydro Power Development
2. Environment Impact Assessment and Ecorestoration of water bodies
3. Performance testing of Hydropower Plants.
4. Human Resource Development
5. GIS/GPS based planning of natural resources
6. Power Systems Planning and Operation
7. Biomass Energy systems
8. Energy Auditing
9. Solar and Wind Energy Systems.
10. Integrated Decentralised Energy Systems.

## 1.6 ACHIEVEMENTS OF AHEC

Some achievements of AHEC:

### 1.6.1 NATIONAL SMALL HYDRO TECHNOLOGY DEMONSTRATION PROJECTS

- Manali Mini Hydro-(Run-of-River) Project (2x100kW) with 40m head in district Kullu (H.P.)
- Jubbal Micro Hydro (Run-of-River) Project (1x100+2x25kW) with 88 m head in district Shimla (H.P.)
- Kakroi Mini Hydro Canal Project (3x100kW) with 1.5m head in district Sonapat (Haryana).

1.6.2 Identified as 'Apex Technical Institution' in the field of Small Hydro by Ministry of Non-Conventional Energy Sources, Govt. of India Under UNDP-GEF assisted Hilly Hydro Project.

1.6.3 Developed Micro Hydro Projects in U.P.Hills (4 Nos.)

### 1.6.4 R&D/MONITORING PROJECTS COMPLETED

- Use of Governorless Turbines
- Development of Electronic output Load Controller
- Use of Pump-as-Turbine
- Development of Hydraulic Air Compressor
- Model Development and Testing of Cross Flow Turbine.
- Development of Cost Effective Emergency Closing Devices for SHP Stations.
- Improved Water Mill for Himalayan Region.
- Micro Turbine for Lift Irrigation
- Development of Velocity Head Turbine
- Pilot Testing and Evaluation of Prototypes in Biomass Gasifier Engine System.
- Studies on evaluating Carrying Capacity of Doon Valley for Developmental Planning.
- Energy and Environment Auditing of Sugar Mills.
- Emission Control System for Cupolas

- Production of Biogas from Agricultural and Forest Residues.
- Setting up of Energy-cum-Rural Technology Complex at village Brahampur near Roorkee.
- **Design & preparation of construction drawings** for over 15 small hydro projects in Arunachal Pradesh.
- **Planning and Project formulation of SHP** for several state agencies e.g. HP-09 nos. J&K-13 nos., Bihar - 67 nos., Ar.P. -27 nos., Mizoram-1 no., Tripura-1 no., UP-5 nos., Gujarat - 1No.
- Pre-investment study on New and Innovative Small Hydro Options for SHP projects - IREDA, Govt. of India.
- **Comprehensive Survey for Master Plan of Sources for Irrigation and Small Hydro Power generation in tea Estates of Darjeeling Hills** for Darjeeling Planter's Association.
- **Post Commissioning monitoring** of cross flow turbine based micro hydro stations in UP hills- sponsored by DST, Govt. of India.
- **Stability Studies of Reinforced Earth Retaining Walls using Geosynthetics in micro hydro power projects** - sponsored by UPCST, Lucknow.
- Setting up of **Renewable Energy Technology Park** at AHEC- sponsored by MNES, Govt. of India.
- **Techno-economic feasibility of Hydrogen Generation from off Peak Electricity** - sponsored by MNES, Govt. of India.
- **Data bank on Small Hydro** sponsored by Ministry of Non-conventional Energy Sources, Govt. of India.
- **Monitoring of execution and performance of light weight portable micro hydel sets (50 nos.)** of Ministry of Non-Conventional Energy Sources (MNES), Govt. of India covering 7 Hilly States.
- GEF assisted Hilly Project - Ministry of Non-Conventional Energy Source, Govt. of India has assigned the following four major activities :
  - **Preparation of Zonal Plan for SHP** including identifying the

demonstration sites and clustering of potential sites.

- **Selection of Technology** for demonstration and other potential sites.
- To provide information (national & international) on **Research, Training & Consultancy work** including conducting short term courses for field engineers for SHP development.
- To assess the potential sites and develop **water mills & multi purpose units** in Himalayan Region.
- To assist in the execution of **6 demonstration projects** located in UP, HP and Sikkim.
- **Design of External Drainage System** for Tronica City (1500 Acres) for U.P. State Industrial Corporation Ltd. (UPSIDC).
- **External Drainage Design of Kosi Kotwan Industrial Area (1200 Acres) near Mathura** in the vicinity of Agra Canal Network and River Yamuna for UPSIDC.
- Checking of Vendor Drawings of Civil & E&M Works for Jalimghag and Nindighag for SHP including PERT Chart of BHPC, Bihar.
- Survey, Investigations & Preparation of DPR for 12 SHP projects in Sikkim.

#### 1.6.5 EIA/ECO-RESTORATION

- **EIA of Rural Roads under Improving Rural Infrastructure** sponsored by Uttaranchal Government.
- Projects sponsored by National River Conservation Development (NRCD), MoEF, Govt. of India :
  - \* Preparation of Detailed Project Report for Conservation and management plan of Dal-Nagin Lake in Srinagar (J&K)
  - \* Preparation of a Vision documents of NRCD's work for 10<sup>th</sup> 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 4 lakes in district Nainital.
- **Preparation of PFR for use of solar, tobacco waste and small hydropower energy sources in ITC factory**, sponsored by ITC, Saharanpur.
- **Emission Control System for Cupolas** sponsored by Sterling Co., Agra.
- **Energy and Environment Auditing of Sugar Mills (Jagraon)**, sponsored by Jagraon Sugar Mills.
- **Intensive Air Quality Monitoring of Doon Valley for Carrying Capacity Evaluation** sponsored by MoEF/NEERI.

#### 1.6.6 Small Hydro Power Projects

- **Vetting of Estimates and Review of Designs of Protection works of Balia Nallah** sponsored by Irrigation Deptt, Nainital, Uttaranchal.
- **Renovation & Modernisation of 3 SHP Stations in Bihar** sponsored by Bihar Hydro Power Corporation, (BHPC), Patna.
- **Preparation of Construction Schedule, Engg. Design and Construction Drawings of Civil Works and Vetting of Equipment Vendor's drawings for Triveni Link Canal Projects"** Sponsored by Bihar State Hydro Electric Power Corporation (BSHPC).
- **Identification of Sources for Irrigation and drinking water** sponsored by Darjeeling Tea Planter's Association (West Bengal).

- **Preparation of Pre-Feasibility reports, survey & Investigation & DPRs of Small Hydro Power Projects (38 nos.) in West Bengal** for West Bengal State Electricity Board.
- **Checking of Engg. Drg. of Arunachal Pradesh** sponsored by DOP, Arunachal Pradesh.
- **Checking of E&M Drawings of Arunachal Pradesh** sponsored by DOP, Arunachal Pradesh.
- **Renovation and Modernization of SHP projects of Ar. Pradesh** sponsored by DOP, Arunachal Pradesh.
- **Preparation of Construction Time Schedule & Review of Vender Design of Civil Structure/E&M Aspects** sponsored by BSHEPC, Patna.
- **DPR of SBC** sponsored by SSNL Ltd.
- **DPR of Miyagam Branch Canal** sponsored by SSNN Ltd.
- **Design & Development of SHP Model Based Self Sustaining Power Projects** sponsored by PFC.
- **Preparation of Pre-feasibility Reports, Survey & Investigation and DPRs of SHP in WB** sponsored by West Bengal State Electricity Board.
- **Vetting of Detailed Engineering Designs and Drawings for SHP in Bihar (Agnoor and Netarhat)** sponsored by BHEPC, Patna.
- **DPR for Walipur Fall Small Hydro Project on Canal Fall in District Bulandshahr.**
- **Drinking Water Supply Project on SSNNL Canal** sponsored by MECON Ltd.
- **Detailed Engineering of Agnoor Hydro Electric Project** sponsored by NIPPON Ltd.
- **DPR including Planning, Engineering and Tender Specifications of SCADA Operation and R&M of 3 micro hydro stations in Darjeeling.**
- **Concurrent Engineer for the 3 x 6 MW Rajwakti SHP in Chamoli District (Uttaranchal)-** financed by IREDA.
- **International Hydrological Programme of UNESCO-Study** sponsored by C.E.H. U.K.
- **International Hydrological Programme of UNESCO-Training** sponsored by C.E.H. U.K.
- **Checking of Vender drawings of Civil & E&M works for Jalimghag and Nindighag for Small Hydro Power** including PERT Chart preparation sponsored by BHPC.
- **Survey & Investigation & Preparation of DPR for SHP in Sikkim.**
- **Detail Investigations and Preparation of DPR for 2 SHP sites in H.P.** Sponsored by Puri Oil Mills.
- **Concurrent Engineer for the 2.4 MW New SHP in Darjeeling Distt. Of W.B.** sponsored by Neora Hydro Ltd.
- **Dissemination of Regional Flow Regimes Estimation for Small Hydro Power** sponsored by CEH, UK
- **RLA/LE- Studies for Dhakrani and Dhalipur Hydro Power Stations in Uttaranchal** sponsored by BHEL.
- **Construction schedule engg. Design & construction drawings of civil works and vetting of equipment vendor's drawings for Triveni Links Canal Projects** sponsored by BSHEPC.
- **Upgradation of 8 shp projects – DPRs,** sponsored by UREDA, Almora
- **Preparation of DPR of Mohammadpur Power Station on Upper Ganges Canal** sponsored by Power Deptt. Govt. of Uttaranchal.
- **Survey, Inspection and testing for R&M of Mohammadpur Power Station at U.G.C.** sponsored by Govt. of Uttaranchal.
- **State Level Master Plan of SHP Potential sites in Chhattisgarh** sponsored by CSREDA- Raipur.
- **Development of Standard Water Mills in Uttaranchal,** sponsored by TIFAC-DST.
- **Design of civil works of Pacha M.H. Project** sponsored by DOP, Ar. Pradesh.

- **DPR for R&M of Mai-II and Tago SHP in Ar. Pradesh** sponsored by DOP, Itanagar
- **R&M of Upper Rongnichu SHP stations in Sikkim.**
- **DPR preparation for Nainital Lake, Nainital** sponsored by Govt. of Uttaranchal.
- **Study on consultancy Capabilities for SHP Dev. In India** sponsored by DSIR, GOI, Tech. Bhawan, New Delhi.
- **Lower Kalab SHP** sponsored by IREDA, New Delhi.
- **Neogal SHP** sponsored by IREDA, New Delhi
- **Evaluation of 32 proposals for Village hydro in Ar. Pradesh** sponsored by MNES, GOI.
- **DSI and preparation of DPR for 3 SHP in Maharashtra** sponsored by MEDA
- **Engg. Services for Dehar SHP in HP** sponsored by ASTHA Project.
- **Performance Review of Yamnua Action Plan (YAP) project works** sponsored by MoEF.
- **Consultancy for Detailed Engg. of Mukerian-II SHP (2x9 MW) in Punjab** sponsored by PSEB.
- **Design of Weirs for Kota and Nanthor** sponsored by Irrigation Deptt. of Govt. of Uttaranchal Nainital.
- **Support for U.P. Irrigation Deptt.** under MIS-TES, Lucknow.
- **Inspection work of Balia Nalla for Nainital Lake** sponsored by SE, UID, Nainital.
- **Engg. Design & Vetting of E&M works for Jainagra SHP in Bihar** sponsored by BSHEPC Patna.
- **Engg. Design & vetting of E&M works for Nasaraganj SHP in Bihar** sponsored by BSHEPC Patna.
- **Engg. Design & Vetting of E&M works for Tejpura SHP in Bihar** sponsored by BSHEPC Patna.
- **Engg. Design & vetting o E&M works for Dhelabagh SHP in Bihar** sponsored by BSHEPC Patna.

- **Detailed Survey & Investigations as well as DPR for Dhakwan SHP Project** sponsored by UPJVN, Lucknow.
- **Preparation of DPR for 10 shp schemes in UP** – sponsored by NEDA.

#### 1.6.7 PROJECT WITH INTERNATIONAL COLLABORATIONS

- \* **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 on “SHP Training”**
- \* **SCP Gestion Conceil, Sherbrook, Quebec, Canada** on “ (a) Demonstration of remote auto-operation of Sobla SHP in U.P. and (b) Modernisation and Privatisation of state owned SHP Stations in U.P. (c) DPR for Galogi SHP
- \* **International Network-Small Hydro Power, Hangzhou, China** on “SHP - Training”
- \* **ITECO, Nepal** for the work on the execution of “SHP Project”
- \* **Canada Natural Resources (CANMET)** for GIS training and technology transfer for decentralised small hydro systems and resource assessment.
- \* **Water and Energy Commission Secretariat, HMG Nepal** for small Hydro Projects.

#### 1.6.8 Members

- \* International Centre for Hydropower, Trondheim, Norway.
- \* **Asian Development Bank**, AHEC has been registered as Institutional consultant

### 1.6.9 SMALL HYDRO PROJECTS

(Covering more than 12 states of the country geographically located in the far flung areas)

- Detailed Project Reports - 143
- Detailed Engineering and Construction drawings - 24
- Technical Specifications - 15
- Pre-feasibility Reports - 196
- Techno-economic appraisal - 57
- Planning, design and execution - 09
- R&D monitoring projects - 31
- Project & International inputs - 08
- Renovation and Modernisation of SHP Stations - 35
- RS & GIS based projects - 07

### 1.6.10 Ministry of Human Resources Development (MHRD), Govt. of India sponsored Projects/Centres within AHEC

- (a) Centre for Hydro Energy
- (b) Alternate Hydro Systems
- (c) Modernisation of AHEC Labs
- (d) Renewable Energy Technology Development
- (e) Design & Development of Micro-processor based control Governing and monitoring system to automise small hydro power station
- (f) Development of improved water mills for Himalayan regions
- (g) Modernisation of Alternate Hydro Energy Centre Labs.
- (h) Development of Improved Water Mills for hilly areas.

### 1.6.11 State Bank of India Chair for Appropriate Energy Technology Development

### 1.6.12 Workshops/Seminars Organised

- National Workshop on “Small Hydropower Development in Uttaranchal”, Roorkee June 26-27, 2001 (60 participants)
- Dissemination Workshop on “RERESHA Hydro HP, Software”, Shimla, June 21-23, 2001 (50 participants).
- International Symposium on “Hydrology of Ungauged Stream in Hilly Regions for Small Hydro Power Development” March 9-10, 1998 at New Delhi.
- Workshop on GIS based identification of Small Hydro Sites for State Govt. Participants Jan. 30-31, 1998 at Roorkee and Feb. 20-21, 1998 at Guwahati.
- National Seminar on Small Scale Hydro Power development in Himalayan Regions - Achievements, Issues & Constraints” at New Delhi, Jan. 20-21, 1995 (117 participants)
- Round Table Meet on “Co-generation in Sugar Mills” on Jan. 6, 1995 (50 participants).
- Round Table Meet on “Small Hydro” on April 22, 1994 at AHEC, Roorkee (60 participants)
- “National Workshop on Small Hydro” during July 17-18, 1993 at Shimla (200 participants)
- “National Workshop on Human Resource Development for Small Hydro” during March 5-6, 1993 at Roorkee (80 participants).
- Regional Workshop on “Eco-Restoration, Environment, Conservation & Management” at Roorkee, March 14, 1990.
- National Seminar on “Potential development of Small/Micro Hydrel Energy Systems in Himalayan Regions, Dec. 19-20, 1987.
- Indo-US Workshop on “Micro Hydro Hybrid Energy System”, New Delhi Jan. 27, 1982.

### 1.6.13 Publications by AHEC

- (a) **Small Hydro Power - Private Sector Participation** 1996, 1999 and 2002
  - (b) **Publication in Hindi and English (4 volumes)**- Manuals for Micro Hydro Power Development (Material provided by ICIMOD) –1998 and reprinted 2002.
  - (c) **Small Hydro Programme in India (for MNES)** – 1999.
  - (d) **URJA BHARATI** Special Issue on ‘Small Hydro’ for Ministry of Non-Conventional Energy Sources - August 1992 & 1999.
  - (e) **INDIAN STANDARD:** 12800 (Part 3)-1991, “Guidelines for Selection of Hydraulic Turbine, Preliminary Design & layout and surface hydro electric power house”, Part III. Small, Mini/Micro Hydel Power Station for Bureau of Indian Standard, New Delhi.
  - (f) Standard Type Designs and Technical Specifications for Low Head Hydro
- Projects proposed under **WORLD BANK funding** on irrigation canals/dams.
- (g) Prepared the “Guidelines for the development of Small Hydro Schemes” brought out by Central electricity Authority in 1982 as member of committee.
  - (h) Providing Guidelines as Member of Technical Advisory Committee to MNES.
  - (i) Prepared the draft of 8th Plan document for Small Hydro Power development and Implementation programme document for MNES.
  - (j) Prepared a National Water Mill Development and Implementation programme document for MNES.
  - (k) Low head small hydro turbine (state-of-Art) for UNESCO-1986.
  - (l) Small/mini hydro power technology research & education (state-of-Art) for UNESCO-1983.

## 2.0 SPECTRUM OF SERVICES PROVIDED BY AHEC

### 2.1 Design, Development and Consultancy Services

- Planning, techno-economic analysis and design of SHP including refurbishments of old power houses.
- Preparation of DPRs on small hydro power projects.
- Engineering designs for construction of Small Hydro projects.
- Development of software packages for computer design and drafting of civil structures of SHP stations.
- Water wheels (Gharats)
- Installation & commissioning of micro hydro power projects.
- Survey, planning and designs of water resources schemes including drainage schemes.
- GIS/GPS based planning and analysis of natural resources.
- Ecorestoration plan of rivers & lakes.
- Environment impact assessment of Small Hydro Projects, renewable energy projects, industries/mills especially sugar, paper, steel etc.
- Energy auditing of sugar mills/other allied industries
- Testing of Fuels

### 2.2 Standardisation and Testing Facilities

- Performance Testing and life assessment of small hydro power plants.
- Meteorological data collection and analysis
- Biomass & Fuel Analysis
- Test rigs for testing pump/turbine upto 50kw rating

### 2.3 Technology Extension Services

- Water wheels (Gharats)
- A portable micro hydel unit of 1.5 kW capacity was exhibited at Nairobi, Kenya in 1981 and in several other

national exhibitions held in 1981, 1982, 1983, 1991, 1992, 1993 1994, 1995, 1996 and 2001 at Pragati Maidan, New Delhi and at Itanagar, Arunachal Pradesh in Jan. 1994 and 1995. The unit has been displayed in India Trade Exhibition, Kathmandu (Nepal) in March. 1997.

- An Energy-cum-rural technology complex at Brahampur village near Roorkee was established under joint sponsorship of UPCST & NEDA, Lucknow to demonstrate the suitability and adaptability of rural renewable energy technologies for the betterment of economically weaker section of the society.
- A **Renewable Energy technology Park** has been established at AHEC with financial support from Ministry of Non-Conventional Energy Sources, Govt. of India for the purpose of demonstration of RET systems to general public and student community and for carrying out studies related to dissertation/thesis work by the students of the above ME course.

## 3.1 LABORATORIES

The following is the list of facilities available in various laboratories of the Centre:

### Equipment Qty.

#### 3.1.1 Information System & Computer Aided Design Lab (CADIS)

1.	Pentium and PCs	34
2.	Computer Printer	6
3.	Laser Printer (A3 & A4)	6
4.	Photo copying M/c (A3 duplex)-Digital	3
5.	Software Packages	1set
6.	Scanner (A4 Size)	4
7.	Fax Machine	1
8.	Plan Printer	1

#### 3.1.2 GIS Lab

1. GIS Software SPANS & Arc View

2.	Pentium 5.2 MB and 128 MB RAM colour monitor (21")	2
3.	Injet A3 Printer	1
4.	EASI-PACE Software	1
5.	GIS related data on India	1
set.		
6.	R2V software	1
7.	IBM Think Pad 380D	2
8.	Digitizer (A0)	1
9.	Plotter (A0)	1

### 3.1.3 Control Systems Lab

1.	Intel's MDS System	3
set		
2.	Universal PROM Programmer	1
set		
3.	Z-80 based trainee kits	5
sets		
4.	100 MHz 4-channel oscilloscope	
5.	PCB making facility	
6.	Variable Speed DC drive	
7.	Wind data Logger	
8.	Digital Earth tester	
9.	20 MHz Oscilloscope (Dual Trace)	
10.	Frequency Counter	
11.	Digital Multimeters	
12.	X-Y 8-channel recorder	
13.	High voltage power supply	
14.	Portable High Voltage Capacitance meter	
15.	Portable Partial Discharge Detector	
16.	Portable ELCID Tester.	
17.	Non-contact type Vibration Meter	
18.	Portable AC/DC Hipot Tester	
19.	Portable 5.0 kV Megger	
20.	Contact Resistance Tester	
21.	IR non-contact thermometer	
22.	Portable Relay Test set	

### 3.1.4 Hydromechanical Systems Lab

1.	10 kW semi-closed loop pump turbine test rig.
2.	50 kW Semi-closed loop pump test rig.
3.	Cross flow turbine test set up.
4.	Accusonic Flow Measuring equipment
5.	Hydraulic Pressure Test Pump
6.	Closed Loop vertical turbine/pump test rig
7.	Portable Flow-detector

8.	Flow meter for flow measurement in closed pipe.	
9.	Electronic Torque transducer	
10.	Water level indicator	
11.	Workshop facility	
12.	Digital multimeters	4
nos.		
13.	Discharge Measuring Equipment	
14.	Portable Ultrasonic Flow Detector.	
15.	Portable Digital Flow Meter for Pipes	
16.	Portable Digital Transit-Time Flow Meter	

### 3.1.5 Civil Engg. System Lab.

1.	Digital multimeters (3 types)	-9
2.	Current meters (4 types)	-6
3.	Electronic total Station (Leica Make) with LISCAD software	-1
set		
4.	Digital Video CAM Recorder	-1
5.	Digital Curvimeter	
6.	Mobile PC Pentium-IBM	-2
Nos.		
7.	GPS (10 channel)	-4
Nos		
8.	Ultrasonic Concrete Tester	
13.	Concrete Hammer for NDT	
14.	Micro Covermeter	

### 3.1.6 Biomass and Eco System Lab

1.	Portable Flue Gas Analyser
2.	Automatic Hydrologic Station
3.	PC based Spectrophotometer
4.	Automatic Hydrologic Station
5.	Digital Analytical balance
6.	Water Testing Kit
7.	High Volume Samplers.
8.	Bomb and Junker's Calorimeters
9.	Deep Freezer
10.	Digital Temp. Indicators & controllers
11.	Solar meter solar collectors & solar cookers, air heaters etc.
12.	Modified C.I. engine to run on 100% biogas
13.	3.5, 7.5 and 12 kW rating DG sets
14.	Gear Type Deep Well Wind Mill Pump
15.	BOD & COD analysers
16.	Pensky-Martens Flash Point Apparatus
17.	Redwood Viscometer

### **3.1.7 Demonstration facilities available at AHEC:**

1. Portable Small Hydro Power unit.
2. Briquetting Fuel Plant for different biomass residues.
3. Hydraulic Air Compressor Unit.
4. Family size Biogas Plant.
5. Aerogenerator -cum - battery charger.
6. Electronic/Mechanical Controller actuators.
7. Renewable Energy Technology Park.
8. GIS/GPS based technology.
15. Earth pressure studies an retaining walls.
16. Digital video camera
17. Audio-Visual facilities for students.

### **3.2 LIBRARY FACILITIES**

AHEC has well documented library of its own with latest literature on the topics related to small hydro power and other renewable energy sources. The centre subscribes regularly important journals and periodicals in the related fields. The proceedings of a number of conferences and symposia are also available. The Library has more than 4000 volumes of books, reports, monograms, journals, manual standards etc.

### **3.3 MODEL DISPLAY**

The centre has well developed models & charts showing different aspects of some of the important small hydro power projects executed by AHEC including layout of work, structural details, construction details etc. Working model of micro hydro system, test rig of 10kW & 50kW rating for testing pumps/turbine, hydraulic air compressor, biomass gasifier system of 20kg/hr capacity, biogas plant of 6.0 m<sup>3</sup>, briquetted fuel plant (STPD), and improved water mill.

Films & video cassettes showing various aspects of small hydro power projects, solar PV, solar thermal, biomass energy & wind energy systems are available. These facilities will be used to help trainees of the intricacies of planning, design, implementation and management of SHP

projects and other renewable energy resources projects.

### **3.4 DEMONSTRATION PARK**

AHEC has established a Renewable Energy Technology Demonstration Park with financial support from MNES. The park houses solar PV pump, solar domestic lights, street lights, colour TV, vaccine refrigerator, solar hot water system, solar grain dryer, solar desalination units, solar cookers, improved water mill, aerogenerator, battery operated vehicle model, wind mill pump etc. The students are offered dissertation/thesis work on the performance evaluation of these systems as well as for carrying out R&D work.

### **3.5 PUBLICATION SECTION**

The centre has publication section equipped with photocopying and other type of reproductions facilities to undertake preparation of Various reports, Engg. drawings & report preparation work.

### **3.6 LODGING & BOARDING**

The Institute provides bachelor's accommodation to all sponsored students. However, the family accommodation shall be provided as & when available.

### **3.7 CLUB**

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

### **3.8 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, thesises and other kinds of monographs. It has well bound collection

of more than 2.75 lakh volumes to meet the growing and varied requirements of its clientele consisting of undergraduate and postgraduate students, research scholars, faculty members. The library strives to provide physical facilities with calm and cozy atmosphere conducive to study for long hours and subscribes to over 475 current journals in all branches of Engineering, Physical Sciences, Bio-sciences and Humanities & Social Sciences. In addition, 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.

### **3.9 INFORMATION SUPERHIGHWAY CENTRE**

The Institute has acquired INTERNET connectivity through VSAT as

well as by optical fibres. 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.

### **3.10 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.

### **3.0 ACADEMIC PROGRAMME**

#### **4.1 PROGRAMME**

AHEC has, since its inception, been imparting training to in-service persons through short-term training courses in the field of small hydro and other renewable energy sources. AHEC also offers two Pool elective subject (i) Small Hydro Power Development (IAH-01) and (ii) Renewable Energy Technology Development (IAH-02) to UG engineering students. AHEC also offers Ph.D. Programme in the field of renewable energy and two Ph.D. degrees have so far been awarded in AHEC and seven Ph.D. thesis are in progress.

The course is designed to impart long term training in all aspects of “Alternate Hydro Energy Systems” to in-service engineers holding recognised degrees (with atleast 60% marks) in Civil/Electrical/Mechanical, Industrial/Chemical/Electronic/Computer/ Agricultural/Environmental Engineering with at least two years job experience. Study tours to the projects under construction form the important and integral part of the curriculum and the students are required to prepare a comprehensive report on the basis of given data for a project.

The selected candidate will be admitted to four semesters M.Tech. programme subject to rules and regulations of the Institute in force. In the 3<sup>rd</sup> and 4<sup>th</sup> semester the project work and dissertation work will be carried out by the students. There will be mid-term evaluation of dissertation work for evaluating the progress of the work.

The following academic programmes are available in “Alternate Hydro Energy Systems”:

- (i) Master of Technology in “Alternate Hydro Energy Systems”.
- (ii) Ph.D. degree in “Alternate Hydro Energy Systems”.

#### **4.2 MEDIUM OF INSTRUCTION**

The medium of instruction at the Institute is English. The foreign students are therefore, required to have adequate working knowledge of English language.

#### **4.3 TECHNICAL STAFF**

AHEC has on its staff scientists with extensive experience in the planning, design, implementation, operation and maintenance of small hydro power projects as well as the development of other renewable energy sources. Services of the staff of various other Departments of the Institute are also utilised as and when required. In addition, experts are invited from various organisations related to the development of Alternate Hydro Energy Systems as per the requirement of the course.

#### **4.4 FEES AND EXPENSES**

The Institute fees and estimated expenses for the course are given in Appendix-I.

#### **4.5 M.Tech. (AHES) PROGRAMME**

The M.Tech. Programme comprises of:

##### **4.5.1 Courses**

The M.Tech. programme consists of two semester teaching and practical work and another two semester for working for project and dissertation/thesis work on special problems. The teaching includes lectures, and laboratory work. The lectures are supplemented by tutorials and through the writing of concept/review papers and group discussions to illustrate the application of various principles and also to judge the extent to which the ideas have been imbibed by the students. The course has been framed to provide upto date knowledge of basic principles of the subjects. Covering planning, investigations, preliminary design, construction, operation, and maintenance of small hydro power stations, development of other renewable energy resource based on biomass, solar,

wind etc. The thirteen departmental elective subjects are also available and the student can select one/two subject of their choice in second semester depending upon their background & requirements.

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

#### **4.5.2 Field Trips**

The field trips shall be organized to SHP projects under construction and recently completed projects apart from other renewable energy based projects. The projects to be visited may be run-of-the river, dam toe and hilly projects. The students will be given opportunity at the sites to study various aspects of SHP such as planning & design of SHP schemes of both canal based and of hilly regions, river diversion arrangements, penstock arrangement, organisation of construction, degree of mechanisation, installation of hydro-mechanical equipment etc. Lectures may also be delivered at the sites by local officers connected with the project site. Discussion are oriented to solve various problems encountered at the project site. The students are also required to prepare study tour report which is evaluated, during the 3<sup>rd</sup> semester.

#### **4.5.3 Seminar**

Every students is required to give a talk in a seminar on some topic of his own interest related to Alternate Hydro Energy Systems, of which he has special knowledge. For this purpose, the students are required to collect field data and prepare drawings etc. for preparation and proper presentation at the seminar.

#### **4.5.4 Project**

Each student shall be required to prepare a project report based on the field data supplied to him for river/canal based project as well as for designing SHP in hilly regions, design of solar thermal/solar photovoltaic system based on solar insulation data of given area and evaluation

of energy from available wind and solar data. Based upon these data, the performance evaluation of solar thermal, SPV system, wind mill pump, wind battery charger etc. installed at the park may be carried out by the student. Given the data on biomass availability, the task of designing a bio-energy system to meet the energy demand of a given area may also be offered as project work.

#### **4.5.5 Dissertation work**

Each student will take up dissertation work to fulfil the requirement of M.Tech. degree. The work of dissertation will be on the subject of practical and theoretical importance and will be carried out under the supervision of faculty member (s).

#### **4.6 Ph.D. Programme**

Facilities for undertaking doctoral studies in “**Alternate Hydro Energy Systems**” and other renewable energy technology are also available at the centre. Full-time and part-time, candidates are accepted for this programme as per the rules of the Institute. The details of fee, admission procedure etc. are available at Institute **website : <http://www.iitr.ernet.in>**

#### **4.6.1 Areas of Research**

Small Hydropower Planning, investigations, designs, development, optimisation of generation, development of softwares for shp planning and designs, life assessment and life extension of existing shp equipment, planning of natural resources, Biomass gasification; Biogas generation from agricultural wastes; Biomass Energy System development, Modelling of Integrated Energy systems, Conservation of Energy in Electrical Network; Environment Impact Assessment; Environment & Energy Auditing; Power System Planning & Operation; Control system development; Solar & wind Energy System Development; Solar Air heaters development; Integrated Renewable Energy System Development; Human Resource Development.

#### 4.7 Short Term Training Programmes

AHEC also offers special short term training courses in Alternate Hydro Energy System and other renewable energy technologies to in-service engineers. The following are some of the short-term (one week to 4-week duration) courses conducted by AHEC for the training of field engineers:

1. Design of Sub Stations - 1986
2. Design of Small Hydro Power Station - 1987
3. Turbines & Governors of Mini Micro Hydro - 1987
4. Design of Micro Hydro Electric Projects - 1990
5. Small Hydro Power Development on Canal Falls & Irrigation Dams - 1990
6. Gates and Trash Racks for SHP Stations - 1990
7. Run-off-River Small Hydro Development-1990 & 1991
8. Planning, Implementation & Operation of SHP Projects - 1991
9. Construction, Planning & Management of SHP Projects-1991
10. Economic & Financial Analysis of SHP Projects 1991
11. Small Hydro Power Development - 1991 (10)
12. Design Operation & Maintenance of SHP Projects- 1991
13. Renewable Energy Source Development Technology - 1991
14. SHP Development on Canal falls & Irrigation dams - 1992
15. Small Hydro Power Development - 1992
16. Electro-Mechanical Equipment for small Hydro Power - 1992
17. Planning & Design of Hydro Electric Stations- 1993
18. Design of Small Hydro Power Projects - 1993
19. Small Hydro Development (For HIMURJA) - 1994
20. Planning of SHP Stations - 1995
21. Renovation & Refurbishment of Hydro Power Projects - 1995
22. Orientation course on SHP MeSEB, Shillong - 1995
23. Hydro Power Projects siting, Licensing & Safety Management - 1996
24. Refresher Course on SHP, Nainital - 1991
25. International Course on SHP - Nov. 1996
26. Short Term Training Course on "Investigation and Preparation of DPR for SHP" at NERIST, Itanagar Feb. 27-Mar 2'97
27. Short Term Course on small Hydro Power for NGO, Oct. 1997
28. Orientation Course for J.Es from NEDA-Nov. 1997.
29. Training course for Water Mill - Jan '98
30. Training for Managers and Operators of Micro hydro projects (April 1998).
31. Training for designers and Surveyors of micro hydro projects, June 1998
32. GIS based Identification of SHP sites - at Roorkee and Guwahati - Jan & Feb. 1998
33. International Course on "Planning Design & Implementation of SHP Projects - March 15-25, 1999
34. International course on SHP at Dhaka, Bangladesh, May 6-9, 1999.
35. International Course on "Planing of Small Hydro Power Projects" March 7-16, 2000.
36. International course on Small Hydro Power Development at Kathmandu, Nepal, April 17-22, 2000.
37. Renewable Energy Training Programme on "Small Hydro Power Development" August 8-14, 2000 and August 7-11,2001.
38. International course on "Planning, Technology Selection and Implementation of Small Hydro Power Projects" February 13-22, 2001.
39. Training-cum-Workshop on Low Flow Estimation, Oct. 9-13, 2001.
40. Training for ANERT engineers and public representatives, Oct. 16-20,2001, Thiruanathapuram.
41. Training on "Identification and Ground Verification of SHP Potential sites including Water Mills in Uttaranchal", November 2-4, 2001.

42. International course on “Cost Effective Planning & Designs for Small Hydro Projects” Feb. 5-14, 2002.
43. Short term training course on “Small Hydropower Development including O&M Aspects” September 10-14, 2002.
44. Short Term Training Course on “Identification, Planning and Selection of Technology for SHP Projects” for North-Eastern region, September 24-28, 2002.
45. Short Term Training on “SHP in Chhattisgarh” Dec. 19-24, 2002.
46. International Course on “Technology Selection for Small Hydro Power” Feb. 18-28, 2003 (Planned).

#### 4.8 NUMBER OF SEATS IN THE COURSE

**Seats :** Total number of seats are 18 Regular (Gate Score Holder) & 5 Indian sponsored candidates. The number of seats for foreign nationals are not specified but are available over and above the number of seats mentioned above.

#### 4.9 ELIGIBILITY FOR ADMISSION

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

##### a) For sponsored Indian Nationals

Minimum qualifications for admissions are :

A recognised Bachelor degree in **Civil /Electrical /Mechanical /Industrial /Chemical/ Electronics/Computer/Agricultural/Environmental Engineering** or its equivalent qualification with minimum two years of full time work experience in responsible capacity in relevant field.

Candidates of General Category seeking admission to the PG programmes must have at least 60% marks or 6.75 CGPA on a 10-point scale at the qualifying degree level and SC/ST category candidates must have 55%

marks or 6.25 CGPA on a 10-point scale. The percentage of marks will be considered as aggregate awarded in the qualifying degree examination. The SC/ST category candidates must submit, at the time of admission, the requisite certificate from the competent authority.

OR

**Civil/Electrical/Mechanical/Industrial/Chemical/Electronics/Computer/Agricultural/Environmental Engineering** after passing examination to section ‘A’ and ‘B’ of the Institution of Engineers (India) and possessing a B.Sc. degree or a 3-years Diploma in Engineering and having at least 3-years of Research or professional experience in responsible position in renewable sources of energy or allied fields.

Candidates having AMIE/AMIS/AMIChe/AMMIM/Grad IETE, who possess B.Sc. or Diploma in Engineering and have at least three years research, teaching or other professional experience in relevant field, are also eligible to apply for admission to M.Tech. Engineering Courses. Such candidates will have to produce a proof of their having been elected as AMIE/MIE before they fill in forms for I Semester Examinations.

The full time sponsored candidates must have a minimum of two years of full-time work experience in responsible capacity in a Registered

Firm / Company / Industry / Educational and Research institution / Govt. / Quasi govt. Autonomous Organisation in the relevant field in which admission is being sought. The Firm/Company/Industry shall either be a public sector undertaking or a public limited undertaking registered in a stock exchange or a private concern whose annual turn-over during the past two years exceeds Rs. 5 crores. The educational institutions should be recognized by AICTE.

Candidates must submit the sponsorship certificate duly signed by the Head of the Institution/Organisation on the prescribed proforma at the time of counseling. A few candidates may also be admitted under QIP,

Early Faculty Induction programme (EFIP) of **AICTE** and Defence Research & Development Organisation (**DRDO**) **Schemes**, for which admission procedure is **separate** and for further details, Assistant Registrar (Academic), Indian Institute of Technology, Roorkee - 247 667 may be contacted.

#### **b) For foreign national & Non-Resident Indians**

For **M. Tech. Course**, the candidates should have (i) A Bachelor's degree in the above disciplines with a minimum grade point average of 6.75 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

For **Ph.D. programme**, the candidates should have (i) Master's degree in Science/Engineering/technology in the relevant field with a minimum grade point average of 6.75 on a 10 point scale or 60% marks in aggregate (ii) Proof of Proficiency in English and (iii) Three reference letters

Three National Renewable Energy Fellowships sanctioned By Ministry of Non-Conventional Energy Sources (MNES), Government of India are available for the award to Ph. D. students who will be registered in Ph.D. in the area of Renewable Energy.

#### **c) Regular-For 'GATE' Qualified Candidates**

The admission for such candidates is dealt separately by the Institute.

However, depending upon the Institute requirement, the admission to the course would be based on a merit list prepared on the basis of GATE percentile. The GATE score would be valid only once for admission. Minimum GATE score will be 75% for unreserved and 50% for SC/ST candidates.

In addition to the above, MNES, Government of India, has also sanctioned 5

National Renewable Energy Fellowships for students registered for M.Tech in the area of Renewable Energy. The interested candidates may visit the **website** : **<http://www.mnes.mic.in/fellow.htm>** for information & downloading the application form for the same.

#### **4.10 PROECEDURE FOR ADMISSION AND FELLOWSHIP**

##### **4.10.1 For Sponsored Candidates**

###### **4.10.1.1 Indian students**

Application should be made in the prescribed form completed in all respects and duly sponsored by the employing government and semi- government and autonomous organisations or government departments. The applications should be sent to **Head, Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee-247667 (Uttaranchal) India.** The applications should normally reach in the office by **15th May each year** so that suitability for selection is notified at the earliest.

###### **4.10.1.2 Foreign Students**

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 or under 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. In addition to these avenues, a provision of direct admission for Non-Resident Indians (NRI's) and Self Financing Foreign National candidates exists for Postgraduate and Research degree programmes in Engineering and other fields.

#### **4.10.1.2.1 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**, with a copy to the **Ministry of External Affairs, (Students Cell room No. 1009), Government of India, Akbar Bhawan, Chanakyapuri, New Delhi - 110021, India Tel. : 91-11-26876133 and 34, Fax : 91-11-26876134 and Educational Consultants (I) Ltd., Plot No. 18A, Sector 16A, NOIDA - 201 301 (U.P.) India, Tel. : 91-120-251001 to 6, Fax : 91-12-2515372, email : postmaster@edcil.ernet.in/helpdesk@edcil.ernet.in, website : <http://www.edcil.co.in>. More details can be seen on <http://www.meadev.nic.in/culture/iicr/chap-5.htm>.**

#### **4.10.1.2.2 Government of India-ICCR Scholarships**

Some Scholarships may be available from ICCR and one needs to apply through Indian missions in host country. Applications in form A2 and A3 (obtainable from Embassies/missions of India in the countries of the candidates) should be sent through Embassies/Missions to **Ministry of Finance, Department of Economic Affairs, Government of India, New Delhi - 110 001 and Indian Council for Cultural Relations, Azad Bhawan, Indraprastha Estate, New Delhi - 110 002, (Tel. : 91-11-23319309 & 23319310, Fax : 91-11-23370732, 23378647, 23319056, email : iccr@vsnl.com)**. More details can be seen on <http://www.meadev.nic.in/culture/iicr/chap-6.htm>.

#### **4.10.2 For Non Sponsored and GATE Qualified Candidates**

The GATE qualified candidates may see the admission notice of the Institute in

Employment news/National news paper (Normally appears in March/April every year) and apply on application forms obtainable from the Institute separately.

#### **Reservation :**

The reservation of seats in respect of GATE qualified candidates will be applicable as per the rules of the Institute.

#### **Institute Assistantship For GATE Qualified Candidates**

Institute Assistantships shall be provided only to the GATE qualified candidates admitted to the course as per Ministry of Human Resource Development (MHRD), Govt. of India norms.

#### **4.11 LAST DATE OF SUBMISSIONS OF APPLICATIONS FOR SPONSORED CANDIDATES 15th May, 2003**

#### **4.12 VISA REGULATION AND AID TEST**

Foreign candidates should fulfill the following requirements :

- Foreign candidates will be admitted only after obtaining the clearance from the Govt. of India. Foreign candidates having student's provisional student's visa only are eligible for admission. All foreign students on self-financing basis are requested to obtain regular students visa from Indian Missions abroad by producing confirmed acceptance/admission letter from the Institute.
- Foreign candidates are required to undergo medical examination as per medical rules prescribed by the Central Government for foreign students and have to undergo test for HIV at National Institute of Communicable Diseases (NICD), Delhi within one month of their admission. The admission of foreign candidates would be confirmed only after medical examination and the test report regarding HIV.

#### 4.13 GRADING OF THE STUDENTS

The students shall be graded for their academic performance in a 10 point grade system in the following manner:

Academic Performance	Grade	Grade Points
Outstanding	A+	10
Excellent	A	9
Very Good	B+	8
Good	B	7
Average	C+	6
Below Average	C	5
Marginal	D	4
Poor	E	2
Very poor	F	0
Audit Pass	AP	-
Audit Fail	AF	-
Incomplete Course	I	-
Incomplete Project/ Dissertation	X	-
Satisfactory Completion of Dissertation	S	-
Unsatisfactory Dissertation	U	-
Withdrawal	W	-
Non-Completion of Course Requirement and /or training	Z	-

The grades S and Z are for requirements (if any) as are to be fulfilled but are not to be counted for credits. Pass grade is Grade D and high grades. Grades E & F are Fail grades.

A student detained for not fulfilling the attendance requirements shall be given F grade.

#### 4.14 COURSE CREDITS AND EVALUATION

##### Credit (Cr) and Weekly contact Hours

Each course (Subject) has a number of credits which depends 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.

##### 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 coursewise (Subjectwise). 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 and upto that 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, terms papers, field work, quizzes, tests, examination, viva-voce etc. in each semester, as per regulations. Evaluation in every course (subject) is based on weightage of marks/grades assigned to various course as per curricular 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 course (subject) are converted into letter grades, the value of which is on a 10 point scale.

##### Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

The grades awarded to a student in all the courses of a Semester, shall be converted to Semester Grade Point Average (SGPA). The SGPA shall be calculated as follows :

$$SGPA = \frac{\sum_{i=1}^m C_i \times P_i}{\sum_{i=1}^m C_i}$$

Where,

$C_i$  = Number of credits earned in the  $i^{\text{th}}$  course

of a semester for which SGPA is to be calculated.

$P_i$  = Grade point earned in  $i^{\text{th}}$  course.

$i = 1 \dots n$ , represents the number of courses in which a student is registered in concerned semester.

The overall grade of a student in the programme of study upto the end of a particular semester shall be called **Cumulative Grade Point Average (CGPA)**. The (CGPA) shall be calculated as follows :

$$CGPA = \frac{\sum_{j=1}^m C_j \times P_j}{\sum_{j=1}^m C_j}$$

Where,

$C_j$  = Number of credits earned in the  $j^{\text{th}}$  course upto the end of the semester for which CGPA is to be calculated.

$P_j$  = Grade point earned in  $j^{\text{th}}$  course.

$j = 1 \dots m$ , represent the number of courses in

which a student was registered upto the end of the semester, for which CGPA is to be calculated.

Note : E & F grades shall not be considered for calculation of CGPA but shall be considered for calculation of SGPA.

#### 4.15 GENERAL

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

## 5.0 M.TECH COURSE SCHEME

### SCHEME OF TEACHING AND EXAMINATION OF TWO YEARS DURATION M.TECH. COURSE IN “ALTERNATE HYDRO ENERGY SYSTEMS”

#### I Semester (Autumn)

Teaching Scheme					Teaching Scheme Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S.No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	Pre
1.	MA-501B	Advanced Mathematics	PG-11	4	3	1	-	3	-	25	-	25	50	-
2.	AH-511	Small Hydro Power System Planning and Management	PG-13	4	3	1	-	3	-	20	-	30	50	-
3.	AH-513	Renewable Energy Resources Development Technology	PG-13	4	3	2/2	2/2	3	-	15	5	20	50	10
4.	AH-515	Fluid Mechanics	PG-13	2	2	-	-	2	-	15	-	35	50	-
5.	AH-517	Modelling, Simulation & Computer Applications	PG-12	4	3	-	2	3	-	-	15	20	50	15
6.	AH-519	AHES-Bridge Course	PG-13	-	3	1	-	3	-	25	-	25	50	-
7.		Minor Elective	PG-15	4	-	-	-	-	-	-	-	-	-	-
<b>Sub Total</b>				<b>22</b>										

#### II Semester (Spring)

Teaching Scheme					Teaching Scheme Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S.No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	Pre
1.	AH-512	Design of SHP Structures	PG-13	4	3	1	-	3	-	25	-	25	50	-
2.	AH-514	Small Hydro Generator Protection and Control Equipment	PG-13	4	3	2/2	2/2	3	-	20	10	30	50	10
3.	AH-516	Hydromechanical Equipment	PG-13	4	3	2/2	2/2	3	-	10	10	20	50	10
4.		Major Elective	PG-14	4	-	-	-	-	-	-	-	-	-	-
5.		Major Elective	PG-14	4	-	-	-	-	-	-	-	-	-	-
6.		Minor Elective	PG-14	4	-	-	-	-	-	-	-	-	-	-
7.		Minor Elective	PG-15	4	-	-	-	-	-	-	-	-	-	-
<b>Sub Total</b>				<b>24</b>										

L= Lecture; T = Tutorial; P = Practical

### III Semester (Autumn)

Teaching Scheme					Teaching Scheme Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S.No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	Pre
<b>2<sup>nd</sup> Year</b>					<b>III Semester (Autumn)</b>									
1.	AH-601	Project & Visit to Sites	PG-19	4	-	-	-	-	-	-	-	-	-	-
2.	AH-603	Seminar	PG-20	4	-	-	-	-	-	-	-	-	-	-
3.	AH-604	Dissertation (To be continued in IV Semester)	PG-20	14	-	-	-	-	-	-	-	-	-	-
<b>Sub Total</b>				<b>22</b>										

### IV Semester (Spring)

Teaching Scheme					Teaching Scheme Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S.No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	Pre
<b>2<sup>nd</sup> Year</b>					<b>IV Semester (Spring)</b>									
1.	AH-604	Dissertation	PG-20	22	-	-	-	-	-	-	-	-	-	-
<b>Sub Total</b>				<b>22</b>										
<b>Total</b>				<b>90</b>										

\* The courses for Minor elective (I&II) are to be selected by the students from other departments such as Department of Mechanical and Industrial Engineering, Department of Hydrology, Water Resources Development Training Centre, Department of Electrical Engineering, Department of Earth Sciences, Civil Engineering Department, Chemical Engineering Department and Biosciences & Bio-Technology Department.

**AHEC, Departmental Major Electives**

Teaching Scheme					Teaching Scheme Hrs/Week			Exam. Duration (Hrs.)		Relative Weightage (%)				
S.No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	Pre
1.	AH-518	Environmental Planning and Management	PG-14	4	3	1	-	3	-	20	-	30	50	-
2.	AH-520	Energy System Economics, Policies and Laws	PG-14	2	2	-	-	2	-	20	-	30	50	-
3.	AH-522	Wind Energy Application Technology	PG-14	4	3	1	-	3	-	20	-	30	50	-
4.	AH-524	Design & Testing of Hydro Mechanical Equipment	PG-14	4	3	2/2	2/2	3	-	10	10	20	50	10
5.	AH-526	Instrumentation for Small Hydro Power Station	PG-14	4	3	-	2	3	-	-	15	20	50	15
6.	AH-528	Rural Electrical Energy System Planning and Design	PG-14	4	3	1	-	3	-	20	-	30	50	-
7.	AH-530	Remote Sensing and GIS for SHP Planning	PG-14	4	2	1	2	3	-	10	10	20	50	10
8.	AH-532	Electrical Design of SHP Stations	PG-14	4	3	1	-	3	-	20	-	30	50	-
9.	AH-534	Construction Planning & Management	PG-14	2	2	-	-	2	-	20	-	30	50	-
10.	AH-536	Biomass Production & Utilisation	PG-14	2	2	-	-	2	-	20	-	30	50	-
11.	AH-538	Operation & Maintenance of Small Hydro Plants	PG-14	2	2	-	-	2	-	20	-	30	50	-
12.	AH-540	Solar Photo-Voltaic Design & Applications	PG-14	2	2	-	-	2	-	20	-	30	50	-
13.	AH-542	Energy Conservation & Management	PG-14	4	3	1	-	3	-	20	-	30	50	-

## **6.0 DETAILS OF SUBJECTS CONTACTS**

### **AH-511 Small hydro Power System Planning and Management**

Water Resources Development purposes, Justification of SHP development, Types of hydro projects, Hydrological analysis and design, forecasting and prediction; Simulation for ungauged small streams, stream gauging and stage discharge curve; Runoff and its estimation by different methods; Estimation of power potential, Reconnaissance and feasibility studies; Small hydro power planning in overall energy development economics; Site selection; Evaluation, allocation of cost and financing of projects, management of SHP.

### **AH-512 Design of SHP Structures**

Hydraulics and structural designs of civil works; national and international standards & codes of practice; Small hydro power related civil structures; Diversion and intake structures; Power channel, desilting tank and tail race channel ; Balancing reservoir, spillway and forebay tank; Penstock anchor blocks and saddles; Power house building, machine foundations; Cross drainage works.

### **AH-513 Renewable Energy Resources Development Technology**

Energy reserves and estimates, global energy scenario, renewable energy vis-a-vis environment implications; solar Energy application, availability of solar radiation energy; Collection & concentration for photo-thermal application, thermal storage,

photovoltaic & thermo/electric conversions; Wind energy : Wind energy application-types of wind mills, characteristics, elementary design principles; Biomass Energy : Biomass as a source of energy - Energy Plantation, production of fuel wood; Bio-conversion of agricultural & animal wastes, Biogas-its generation & utilisation; Ocean and geothermal energy, hydrogen energy, alternate fuels for surface transportation.

### **AH-514 Small Hydro Generator, Protection & Control Equipment**

Introduction of electrical works and controls, sizing of single phase and three phase generators; Power factor and power factor correction methodologies; Characteristics, specification and testing of generators & excitation systems; Transformers, circuit breakers; Electro-mechanical/Electronic governors, Protection and control of generation stations, Design of auxiliary and grounding system; Supervisory control and data acquisition (SCADA) and integrated computer control system for SHP station; Switch yard equipments.

### **AH-515 Fluid Mechanics**

Viscosity, streamlines, laminar & turbulent flow, boundary layers; Pressure in a liquid at rest and in motion; Continuity equation, Bernoulli equation, momentum equation and their applications to turbines; Potential flow, superposition and vorticity, circulation and kutta condition. The Reynolds number, scaling & cavitation.

### **AH-516 Hydro-mechanical Equipment**

Types of turbines-Conventional impulse, reaction, axial flow. Non-conventional propeller ( tubular and bulb) and cross flow type turbines, use of pumps-as-turbines, Power transmission system and mechanical governors for turbines; Characteristics of turbines w.r.t. head. discharge and power, Selection of gates and valves for small hydro plants; Turbines-installation, operation and maintenance.

#### **AH-517 Modelling, simulation & Computer Application**

Introduction to C++, Control structure functions ; Classes and data abstraction; Pointer and strings inheritance; Virtual function and polymorphism, C++ stream input/output models; Models classifications, Mathematical models, Physical models, analog models and others, Estimation of model parameters; simulation methodology : Experimental nature of simulation, steps involved in simulation studies, simulation application; Computer technique for simulation : Random numbers, computer generation of Pseudo random; Application : Modelling of Civil, Electrical and Mechanical components of small hydro and Renewable Energy Projects.

#### **AH-518 Environmental Planning and Management**

Basic ecological Principles : Introduction to ecosystem ecology, components of ecosystem: Energy flow, nutrient cycling, cybernetics, ecological diversity, Interactions of various components of environment, ecological disorders; Environment Impact Assessment

(EIA) of water resources projects with emphasis on renewable energy projects e.g. SHP, biomass, solar energy etc.; Conservation of resources, environmental policies, laws & acts; significance of EIA of renewable energy projects, case studies of large & small hydro projects and socio-cultural system; environmental compatible growth.

#### **AH-519 AHES – Bridge Course**

Hydraulic Design : Flow through Open Channels : Basic Concepts – Classification of flow (3). Resistance Equation, Uniform flow in Mobile Boundary Channels (3). Sediment Transport-Bed load & suspended load, specific Energy & Critical depth, Hydraulic Jump, channels of efficient Cross Section, Channel Transitions, Preliminary Idea of Gradually varied Flow, Backwater curves (5)

Flow Through Pipes : Smooth & Rough boundaries, Resistance of Smooth & Artificially roughened pipes, Commercial Pipes – Moody's Diagram (4). Energy Losses in Sudden expansion, sudden contraction, transitions, bends and fittings & valves (5).

Structural Design : Materials for reinforced cement concrete, Properties of concrete, Design loads, Stressed and bending moment, Design of reinforced concrete beams, columns, slabs and foundation (5).

Hydraulic Machines : Pumps and turbines, their working principles, Selection of machine, components like Greases bearings and bolts (5).

Electrical Systems : Generator; Synchronous and Induction Generator rating and characteristics (4). Transformer ; Types; Rating and Characteristics; Electrical protection; Generation, Transformer Principles (5). Control System; Switch Gear; Types and Characteristics (5).

#### **AH-520 Energy System Economics, Policies and Laws**

Introductory concepts, Basic concepts of costs and output; Demand and supply of energy. types and patterns, estimating the demand, price and income, elasticity, inflation, taxes, subsidy etc.; Renewable Energy Projects : Projects costs and benefits, Economic-financial and social feasibility; Discounting technique-NPV, BC ratio and IRR : Irreversibilities and role of uncertainty decisions; Production function, estimation of MVP's influencing parameters and computation and optimum use of resources ; Pricing of energy and policies, Acts, Marginal analysis technique, cost of energy generation, energy tariff.

#### **AH-522 Wind Energy Application Technology**

Properties of wind, wind velocity, power from wind roses, site selection; types of wind turbines, characteristics, construction, aerodynamic, considerations of wind mill design, choice of plant type; regulating system.

#### **AH-524 Design & Testing of Hydro-mechanical Equipment**

Design concepts of turbines-impulse, reaction and axial type; Design of turbine components runner shaft, guide mechanism, casing, bearing, control gates &

tubes; Design of intake, spillway, draft tubes and valves; Recent trends in the turbines; Specific problems of hydro turbines; Geometric similarity, hill curves and model testing of turbines; Specific problems of hydro turbines - viz., cavitation, vibration etc.; Testing of prototypes of turbines, valves etc.

#### **AH-526 Instrumentation for Small Hydro Power Stations**

Industrial instrumentation; transducers and their applications; Instrumentation for power system : Analog instruments and measurements; Instruments for measuring voltage and current; average, peak and peak to peak responding voltmeter; Electronic voltmeters for non- sinusoidal voltage, d.c. voltmeters, mechanical & electrical tachometer, altimeter; Instrument transformers; Current transformers and potential transformer; Digital instrumentation, technology of regulators, sensors and actuators, recorders, signal processing circuits, data acquisition system; A.C. Bridges; General equation for bridge balance; General form of A.C. Bridge, measurement of self inductances, capacitance and mutual inductance with the help of AC. bridges; Case study of the instrumentation schemes used in small hydro power development.

#### **AH-528 Rural Electrical Energy system, Planning & Design**

Load forecasting, Rural load management; Survey and profiling of Transmission and Distribution (T&D) lines; Design of L.T. distribution lines and substations for rural electrical systems; Load flow and short circuit analysis, co-ordination

between power and telecommunication lines, maintenance of T&D lines; Case study of a typical system

#### **AH-530 Remote Sensing & GIS for SHP Planning**

Remote sensing : Introduction, Satellite System, Geometric and radiometric properties; Basic computer - based operations, Geometric correction, Geometric and radiometric properties; Basic computed - based operations, geometric correction ; Image processing, Image classification, fundamental of image. Interpretation : Geographic information system and its components; Basic concepts, Data representations; Query and analysis; Application of GIS in SHP.

#### **AH-532 Electrical Designs of SHP Stations**

Planning and layout of Electrical Equipment, estimating unit size, number and type; Power and control system : Generator protection, transformer protection, Busbar protection and feeder protection, Single line schematic and detailed wiring diagram Cable selection, scheduling and routing, Insulating coordination; Digital Integrated Control and Protection System for SHP ; Switchyard : Selection of equipment, Layout of switchyard equipment ; Auxiliary system, auxiliary power, grounding system, D.C. System and D.C. batteries; Lighting system, ventilation system, fire protection.

#### **AH-534 Construction Planning & Management**

Construction planning, Construction facilities, schedules;

Construction method; Construction plants and machinery - functional classification, Selection sizing and matching; Control and management - CPM/PERT; Coordination between different organisations; construction planning for river diversion, foundation construction and treatment, Contracts Operation.

#### **AH-536 Biomass Production & Utilisation**

Biomass production - biomass production from various sources including energy plantation, biomass harvest, handling & pre-conversion processes; Biomass conversion process; Biological & thermal processes - Anaerobic digestion, Fluidised bed gasification & utilisation and waste mitigation system; Utilisation of biomass for the generation of solid, liquid/gaseous fuels for meeting heat & power needs.

#### **AH-538 Operation & Maintenance of Small Hydro Plants**

Operation and maintenance of weir intake, settling tanks, regulating gates, trash racks, tank, channels, forebay and penstocks; Maintenance of turbines governors, generator and excitation system; control panels-relays, circuit breaks, transformers, switchyard and interconnecting transmission lines; monitoring of fiscal condition of power plant.

#### **AH-540 Solar Photo - voltaic Design & Applications**

Photo Voltaic principles, Solar cell characteristics and types of solar cells; PV system components - modules, batteries,

battery charge regulators, block diodes, inverters, load distribution unit; monitoring equipment, circuit breakers; Types of PV system, application and sizing of PV systems; Installation and maintenance, grid interfacing.

#### **AH-542 Energy Conservation and Management**

Introduction : Organisation of an energy Conservation Program, General principles of Energy Auditing and Survey Instrument, Assessment of the technical merits of energy conservation methods and techniques in specific applications, estimation of cost and potential of fuel and electricity savings as technical options. Energy and power supply technology and systems in residential and tertiary sector, transport sector, industrial sector, electrical utilities – technology and operation, total energy systems – CHP, Energy conservation technologies : transport, fuel efficient engines for transport, industry, heat recovery, process monitoring and control, materials conservation and recycling, buildings heat loss, effect of fabric, ventilation and solar gains, heat recovery, lighting, ventilation and cooling, thermal storage and heat pumps and cogeneration : topping Cycles and Bottoming Cycles.

Elective subjects offered by AHEC to Undergraduate students :

#### **IAH-01 Small Hydro Power Development**

General : Necessity and Importance of harnessing small

hydro power, potential assessment, national policies, laws and related economics & financial viability; Civil : Site selection, environmental aspect, run-of-the-river and storage schemes; diversion structures, power channels, desilting arrangements, forebay tank and balancing reservoir, penstock and power house; Mechanical : Type of turbines and their selection, gates and valves, governing system (mechanical & electrical); Electrical : Types of generators - synchronous and induction, transformers, protection & control, transmission and distribution system.

#### **IAH-02 Renewable Energy Sources Development Technology**

General : Energy sources & demand in different sectors, conventional & non-conventional energy sources, Importance of new and renewable energy sources in the present energy scenario; Small Hydro: Basic components of small and mini hydro energy system; Biomass : Biomass conversion process : Thermal and biological, thermal and electricity generation, application of bio-fuels; Solar Energy: Solar insolation; solar collectors; solar energy conversion processes : Thermal & photovoltaic; wind energy ; Types of wind mills, their basic characteristics and applications; Ocean and Geothermal energies, New technologies, Integrated renewable energy system.

## 7.0 FEE STRUCTURE

S. No.	Items	M. Tech. Programme		Ph.D. Programme	
		Indian National	Foreign National	Indian National	Foreign National
1.	Tuition fees/semester (As approved by IIT Council)	Rs. 5900/-	US\$ 6000/- (Per semester) total US\$24000/- =for 4 semester	Rs. 5900/-	US\$ 6000/- (Total US\$ 36000/- = for 6 semeste
2.	Institute fees/semester	Rs. 1850/-		Rs. 2000/-	—
3.	Hostle fees/semester	Rs. 1100/-		Rs. 1100/-	
	<b>One Time Payment</b> ❖ At the time of admission ❖ Refundable fees a) Institute caution report b) Library report Fee payable at the time of admission	Rs. 1500/-  Rs. 1000/- Rs. 2000/- Rs. 13,350/-	US \$ 6,500/-	Rs. 1750/-  Rs. 2000/- Rs. 2000/- Rs. 13,100/-	US\$ 500/-   US\$ 6500/-

- ❖ Rs. 250/- to be paid extra at the time of submission of M.Tech dissertation /thesis.
- ❖ Rs. 3000/- are to be paid at the time of submission of Ph.D. thesis.

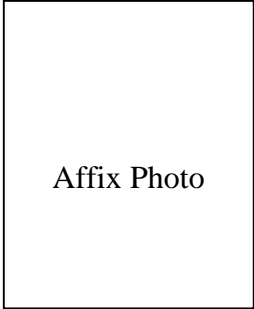
- Note :**
1. In case of having mess facility, an additional amount of Rs. 2000/- as mess security (Refundable) & Rs. 6000/- as mess advance (per semester) shall charged from the students.
  2. The fee may be revised as per MHRD, Govt. of India norms & shall be charged as per actuals.
  3. The candidates are to bear the travel expenses during the field trips in addition to above.

(ONLY FOR SPONSORED INDIAN & FOREIGN NATIONALS)

**ALTERNATE HYDRO ENERGY CENTRE,  
INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE (INDIA)**

Application Form for Admission to Master of Technology  
(M.Tech.) Degree Course in “Alternate Hydro Energy Systems”.  
(Photocopy may also be used)

1. Name.....  
(in Block letters)                      (Surname              (Middle name)              (First name)
2. Father’s Name .....
3. Present address.....  
.....  
.....  
  
Tele. : .....Fax No.....  
E-mail : .....
4. Permanent address.....  
.....  
.....  
  
Tele.: ..... Fax No. : .....  
  
E-mail.....
5. Place/country of birth .....
6. Date of birth .....
7. Nationality .....
8. Details of Passport : .....  
  
Date of Issue : .....  
  
Place of Issue : .....  
  
Valid upto : .....  
(Applicable for foreign nationals only)
9. Capability to read, write, speak & .....  
understand English Language



10. Qualification

A. Academic qualifications (beginning from High School/Metric)

Name of College University	Degree or Exam. passed	Year	Division with percentage of marks/CGPA	Position /distinction	Main Subjects

**Note** \* If the applicant does not hold a professional degree, he should attach a certificate from a responsible officer to the effect that qualifications held by him are considered equal to such degree in his state.

\* Please send transcripts of all certificates/degree/diploma examination passed.

11. Employment record and Experience:

Name of Department firm	Position held	Period	Details of work	Remarks

12. **Membership of Professional societies.**

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

**Declaration**

(a) I shall bring along with me a medical fitness report (including AIDS test) from my country. Also I convey my acceptance to undergo a medical test for myself as well as for accompanying family members as per the instructions of Govt. of India. (Applicable for foreign nationals only)

(b) The information furnished above is true to the best of my knowledge.

Date : .....

**Full Signature of the Applicant**

Place : .....

Recommendations of Sponsoring/Nominating authority (Please specify  
sponsoring/Nominating Authority with Designation)

**Sponsoring/Nominating Authority**  
**With seal**

# SPONSORSHIP CERTIFICATE

(Required from Sponsored Candidates)

The undersigned is pleased to sponsor Mr./Ms..... who is working in this organization for the last ..... years and is presently holding the rank/position of .....for pursuing M.Tech. in the Alternate Hydro Energy Centre with specialization in the area of **ALTERNATE HYDRO ENERGY SYSTEMS**

His/her conduct and character is good.

The Institution/Organization would relieve him/her immediately for joining the above course, if selected for admission. The Institution/Organization also agrees to pay the contingent/all expenses stipulated by the Institute. This is further certified that the sponsorship for admission will not be withdrawn midway till the completion of the course.

Place : ..... Signature of Head of the Institution/Organization with seal

Date : ..... Name .....

Designation .....