

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-511** Course Title: **SMALL HYDROPOWER PLANNING AND MANAGEMENT**
Code:
2. Contact Hours: **L: 3 T: 1 P: 0**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To provide an overview of planning, development and management of small hydropower (SHP) projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Forms, development and purposes of water resources, types of hydro projects, SHP development and its relevance, Electricity acts, constitutional provisions, development process, allotment of sites, opportunities	8
2.	Small hydropower planning on existing structures and new sites	4
3.	Different methods for stream gauging, rainfall, runoff and its estimation by different methods, peak flood estimation, demonstration of discharge measuring instruments	6
4.	Flow duration studies, assessment of power potential and determination of installed capacity	6
5.	Topographical, geological and power evacuation surveys and investigations, demonstration of surveying instruments, site selection for SHP projects	5
6.	Different types of project reports and their relevance	4
7.	Different methods of project implementation	4
8.	Financing of projects, cost estimation for different components, financial and economic analysis, clean development mechanism, management of SHP plants	5
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Harvey, A., Brown, A. and Hettiarachi, P., "Micro Hydro Design Manual", Intermediate Technology,	1993
2.	Fritz, J.J., "Small and Mini Hydro Power Systems: Resource Assessment and Project Feasibility", McGraw Hills.	1984
3.	Gulliver, J.S. and Arndt, E.A., "Handbook of Hydro Electric Engineering", McGraw Hills.	1993
4.	Kausal, M.L. and Chauhan, G., "Planning and Design of Small Hydroelectric Projects", (Publication No. 305), Central Board of Irrigation and Power.	2006
5.	"Civil Engineering Guidelines for Hydroelectric Projects", (Vol. 4-Small Hydro), ASCE.	1989
6.	Nigam, P.S., "Handbook of Hydroelectric Engineering", Nem Chand and Bros.	2006
7.	"Guidelines to Develop Small Hydropower Plants", ESHA.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-512** Course Title: **DESIGN OF SHP STRUCTURES**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To provide knowledge of the design concepts of various civil structures of small hydro power projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Hydraulics and structural designs of civil works, national and international standards and codes of practice, diversion works and intake structures, site selection, innovative designs.	8
2.	Power house layouts , channel (lined and unlined), under drainage works, tunnels and tail race channel	8
3.	Sediment properties and transport, desilting devices, silt disposal	6
4.	Cross drainage works	4
5.	Balancing reservoir, spillway and forebay tank	5
6.	Penstock, anchor block and saddle, surge tank	5
7.	Power house buildings, material handling, machine foundation	6
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Mosonyi, E., "Water Power Development", Vol. I and II, Nem Chand and Brothers.	2009
2.	Brown, G., "Hydro-electric Engineering Practice", Vol. I, II & III, CBS Publication.	2009
3.	"Civil Engineering Guidelines for Hydroelectric Projects", Vol. II and IV, American Society of Civil Engineers (ASCE).	1989
4.	Nigam, P.S., "Hand book of Hydroelectric Engineering", Nem Chand and Brothers.	2001
5.	Varshney, R.S., "Hydropower Structures", Nem Chand and Brothers.	2001
6.	National and International Standards.	-

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-513** Course Title: **RENEWABLE ENERGY RESOURCES DEVELOPMENT TECHNOLOGY**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration (Hrs.): **Theory : 3** **Practical: 0**
4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40** **PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To provide knowledge about various renewable energy technologies, their potential and applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to energy sources, reserves and estimates, global energy scenario, renewable energy vis-à-vis environment implications, global warming and climate change.	4
2.	Solar energy and its application, availability of solar radiation energy, collection and solar thermal storage, photovoltaic and thermal power generation.	8
3.	Wind energy and its application, types of wind mills and their characteristics, elementary design principles.	8
4.	Biomass and its sources, energy plantation, production of fuel wood.	8
5.	Bio-conversion processes, bio-gas, bio-diesel and ethanol production and utilization.	4
6.	Thermo-chemical processes, biomass gasification, process, types of reactors, utilization of producer gas for thermal and electricity generation.	4
7.	New energy technology, ocean and geothermal energy, hydrogen energy, alternate fuels for surface transportation.	6
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Duffie, J.A. and Beckman, W.A., "Solar Engineering of Thermal Process", 3 rd Edition, John Wiley,.	2006
2.	Charles, Y. W.-B. and Essel, B. H., "Biomass Conversion and Technology", John Wiley.	1996
3.	Lysen, E.H.A., "Introduction to Wind Energy", Franklin Institute Press.	1988
4.	Clare, R., "Tidal Power: Trends and Development", Thomas Telford.	1992
5.	"World Energy Outlook 2009", International Energy Agency Publication.	2008
6.	Ledjeff, K. et al., "Hydrogen: A Clean Permanent Source of Future Energy", Pergamon Press.	1981
7.	Kemp, W.H., "The Renewable Energy Handbook: A Guide to Rural Energy Independence, Off-Grid and Sustainable Energy", Aztext Press.	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-514** Course Title: **HYDRO ELECTRIC EQUIPMENT**
2. Contact Hours: **L: 3 T: 1 P: 2/2**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weight: **CWS: 20 PRS: 20 MTE: 20 ETE: 40 PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about electrical power generation, protection and control of small hydropower stations.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Types, characteristics and testing of ac generators	5
2.	Sizing and specification of single and three phase generators	5
3.	Power factor and its correction methodologies, excitation systems	6
4.	Electro-mechanical and digital governor, electronic load controller	4
5.	Types of relays, contactors and control schemes for SHP stations	5
6.	Supervisory control and data acquisition (SCADA), integrated computer control system for SHP station	5
7.	Switchyard equipments, power and instrument transformers, circuit breakers, bus-bar	6
8.	Protection schemes for generator, transformer and bus-bar, design of circuit diagram for auxiliary and grounding systems	6
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Reimert, D., "Protective Relaying for Power Generation Systems", Taylor and Francis.	2006
2.	Clemen, D.M., "Hydro Plant Electrical Systems", HCI Publication.	1999
3.	Kundur, P., "Power System Stability and Control", McGraw Hill Inc.	2008
4.	Harker, K., "Power System Commissioning and Maintenance Practice", The Institution of Electrical Engineers.	1998
5.	"Manual on Layout of Substations", Central Board of Irrigation and Power.	1989
6.	"Manual on Sub-station, Design of Earthing-Mat for High-Voltage Substation", Central Board of Irrigation and Power.	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-516** Course Title: **HYDRO MECHANICAL EQUIPMENT**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40** **PRE: 0**
5. Credits: **4** 6. Semester: **Spring** 7. Subject Area : **PCC**
8. Pre-requisite : **PCC**
9. Objective: To provide knowledge about hydro mechanical equipments for small hydropower plants.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Classification and working principles of hydro turbines, different components of impulse and reaction turbines	5
2.	Design concepts of hydro turbines, pump-as-turbine and other non conventional hydro turbines	4
3.	Characteristics of hydro turbines, geometric similarity, main characteristic and operating characteristic curves, hill curves	5
4.	Governing of hydro turbines, mechanical and electro-mechanical governors, electronic load controller, mechanical drives, gear box, pulleys	4
5.	Selection of hydro turbines based on specific speed and their optimal selection	5
6.	Classification, components and selection of gates and valves	4
7.	Model testing of hydro turbines, performance testing of turbines at site	5
8.	Causes and impact of cavitation, silt erosion and their combined effect on operation of hydro turbines	6
9.	Erection, commissioning, operation and maintenance of turbines	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Mosonyi, E., "Water Power Development", Vol. I and II, Nem Chand and Brothers.	2009
2.	Nigam, P.S., "Handbook of Hydroelectric Engineering", Nem Chand and Brothers.	2001
3.	Lal, J., "Hydraulic Mechines", 3 rd edition (reprint), Metropolitan Book Co. Private Limited.	2002
4.	National and International Standards.	-
5.	Brown, G., "Hydro-electric Engineering Practice", Vol. II, CBS Publication	1984

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-517** Course Title: **MODELLING, SIMULATION AND COMPUTER APPLICATIONS**
A

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** Subject Area: **PEC**

7. Pre-requisite: **Nil**

8. Objective: To provide basic knowledge about modeling and simulation techniques and their application small hydropower plants.

9. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of C++	8
2.	Principles of modeling, physical, mathematical, static and dynamic models	5
3.	Model development, parameter estimation, validation of model	3
4.	Nature of simulation, techniques of simulation, discrete and continuous system simulation, parallel and distributed simulation, simulation of queuing and inventory system.	5
5.	Methods of random number generation, Monto-Carlo simulation, spread sheet simulation, numerical computation techniques for continuous and discrete models.	5
6.	Modeling of intake, channel, desilting tank, forebay tank, penstock	6
7.	Modeling of electro mechanical equipment	6
8.	Introduction of simulation language and package	4
TOTAL		42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Kundur, P., "Power System Stability and Control", McGraw-Hill Inc.	2008
2.	Laffore, R., "Turbo C++", Galgotia Publication.	1996
3.	Hubbard, J.R., "Programming with C++", Tata McGraw-Hill Publishing Company.	2000
4.	Deo, N., "System Simulation with Digital Computer", Prentice Hall	1998
5.	Severance, F.L., "System Modelling and Simulation-An introduction", John Wiley and Sons.	2001
6.	Law, A.M., "Simulation Modelling and Analysis", Tata McGraw-Hill Publishing Company.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-517 B** Course Title: **MODELING, SIMULATION AND COMPUTER APPLICATIONS**
Code:

2. Contact Hours: **L: 3 T: 1 P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 20 PRS: 20 MTE: 20 ETE: 40 PRE: 0**

5. Credits: **4** 6. Semester: **Both** Subject Area: **PEC**

7. Pre-requisite: **Nil**

8. Objective: To give knowledge of modelling and simulation techniques and their application to hydrological and environmental management of water bodies.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of C++	8
2.	Principles of modeling, physical, mathematical, static and dynamic models, transport phenomena based model	6
3.	Modeling of empirical data, estimation of model parameter, goodness of fit, confidence level	3
4.	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.	7
5.	Design of experiment and optimization.	4
6.	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 systems.	5
7.	Water quality modelling, assimilation capacity, dispersion of pollutants in water bodies	4
8.	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	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Law, A.M., "Simulation, Modelling and Analysis", Tata McGraw-Hill Publishing Company.	2008
2.	Laffore, Robert, "Turbo C++", Galgotia Publication.	1996
3.	Gordon, G., "System Simulation-The Art and the Science", Prentice Hall	1979
4.	Deo, N., "System Simulation with Digital Computer", Prentice Hall	1998
5.	Ramaswami, A., Milford, J.B. and Small, M.J., "Integrated Environmental Modelling: Pollutant Transport, Fate and Risk in the Environment", John Wiley and Sons Inc.	2005
6.	Wainwright, J. and Mulligan, M., "Environment Modelling: Finding Simplicity in Complexity", John Wiley and Sons Inc.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-518** Course Title: **ENVIRONMENTAL PLANNING AND MANAGEMENT**
Code:

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**

5. Credits: **4** 6. Semester: **Both** Subject Area: **PEC**

7. Pre-requisite: **Nil**

8. Objective: To impart knowledge about basic ecological principles and environmental impact assessment of renewable energy projects.

9. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic ecological principles, concept and components of ecosystem, energy flow, nutrient cycling, cybernetics, ecological regulation, ecological diversity	10
2.	Interaction of various components of environment, ecological disorders	6
3.	Environmental impact assessment (EIA) of water resources projects with emphasis on renewable energy projects e.g. SHP, biomass, solar energy	6
4.	Conservation of resources, environmental policies, laws and acts	8
5.	Significance of EIA of renewable energy projects, case studies of large and small hydro projects	8
6.	Environmental compatible growth.	4
	TOTAL	42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Naidu, B.S.K., "Planning and Management of Hydropower Resources in India", CBIP.	1992
2.	Sengupta, B. and Guha, H., "Construction Management and Planning", Tata McGraw-Hill Publishing Company Ltd.	1995
3.	Chaturvedi, M.C., Jain, S.K. and Singh, V.P., "Water Resource System Planning and Management", Tata McGraw Hill.	2001
4.	Saxena, K.D., "Environmental Planning, Policies and Programmes in India", Sipra Publications.	1993
5.	Jain, S.K., "Water Resource System Planning and Management", Elsevier publication.	2003
6.	Khan, M.A., "Environment Biodiversity and Conservation", APH publication.	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-522** Course Title: **WIND ENERGY APPLICATION TECHNOLOGY**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS 25** **PRS 0** **MTE 25** **ETE 50** **PRE 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about wind energy resources and application technologies.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Wind energy scenario in India, properties of wind, wind velocity and wind rose diagram, estimation of power in wind.	7
2.	Types of wind turbines, characteristics, construction of wind mills.	7
3.	Aerodynamic considerations of wind mill design, wind stream profile, rotor blade profile and cross section.	7
4.	Drive system-gears, wind electric generators, regulating and control systems for wind mills.	7
5.	Performance evaluation and recent technologies of wind energy conversion system	7
6.	Wind energy potential estimation and site selection; wind farms, cost estimation of the energy from wind energy conversion system.	7
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Pillai, G.M., "Wind Power Development in India", Part-II, Shailesh Art Print.	2006
2.	Sorensen, B., "Renewable Energy", Academic Press.	2004
3.	Burton, T. et al, "Wind Energy Handbook", John Wiley and Sons Ltd.	2001
4.	Lysen, E.H.A., "Introduction to Wind Energy", Franklin Institute Press.	1988
5.	Boyle, G., "Renewable Energy Power for a Sustainable Future", Oxford University Press.	1996
6.	Bansal, N.K., Kleemann, M. and Heliss, M., "Renewable Energy Sources and Conversion Technology", Tata McGraw-Hill Publishing Company.	1990

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-523** Course Title: **INTEGRATED MANAGEMENT OF WATER BODIES**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about the hydrology, causes and impact of water pollution on water bodies.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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	7
2.	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	8
3.	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.	10
4.	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.	7
5.	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;	10
	TOTAL	42

Cont.....

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/Reprint
1.	Lenton, R. and Muller, M. and Carriger, S., "Integrated Water Resources Management in Practice", Earthscan Publishers.	2009
2.	Mollinga, P.P., Dixit, A. and Athukorala, K., "Integrated Water Resources Management Global Theory Emerging Practice and Local Needs", SAGE publication.	2006
3.	Timmerman, J. G., Pahl-Wostl, C. and Moltgen, J., "The Adaptiveness of IWRM, Analysing European IWRM Research", IWA Publisher.	2008
4.	Liu, D. H. and Liptak, B.G., "Environmental Engineers Handbook", 2 nd edition CRC Press.	1999
5.	"Standard Methods for the Examination of Water and Waste Water", 21 st edition, American Public Health Association.	2005
6.	Clair, S., McCarty, P.L. and Parkin, G.F., "Chemistry for Environmental Engineering", McGraw Hill Publication.	1994
7.	Kulkarni, V. and Ramachandra, T.V., "Environment Management", TERI Press.	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-525** Course Title: **AQUATIC ECOLOGY**
2. Contact Hours: **L: 3 T: 1 P: 2/2**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weight: **CWS: 20 PRS: 20 MTE: 20 ETE: 40 PRE: 0**
5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about of ecological principles applicable to aquatic resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	6
2.	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	9
3.	System analysis, ecosystem models, Stressed ecosystems, homeostasis, ecological succession, ecosystem resilience	5
4.	Pollution of lakes and rivers, causes, impacts and control of eutrophication; principles and application of restoration methods, ecotechnologies	6
5.	National/international perspectives, policies, Ramsar convention, NLCP, NRCD, case studies of Dal lake, Nainital lake, Chilka, Loktak and Asan wetlands, Tehri dam reservoir, river Ganges and Yamuna.	5
6.	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.	5
7.	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.	6
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Odum, E.P., Barrick, M., and Barrett, G.W., "Fundamentals of Ecology", 3 rd edition, W.D. Saunders.	2005
2.	Wetzel, R.G., "Limnology: Lakes and Rivers Ecosystems", 3 rd edition, W.D. Saunders.	2005
3.	Christer, B. and Lars, A.H., "The Biology of Lakes and Ponds", Oxford University Press.	2005
4.	Cooke, G.D. et al, "Restoration and Management of Lakes and Reservoirs", 3 rd edition, Taylor and Francis publication.	2005
5.	Roberts, M.B.V. and Ingram N.R., "Biology", Nelson Science Publishers.	1995
6.	Smith, J.E., "Biotechnology", 5 th edition, South Asian Press.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-526** Course Title: **INSTRUMENTATION FOR SMALL POWER STATION**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge about instrumentation used for the measurement of electrical and mechanical parameters in small hydro and other renewable energy projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Industrial instrumentation, transducers and their applications.	6
2.	Instrumentation for power system, analog and digital instruments, principles of measurement of voltage, current and power.	7
3.	Electronic voltmeters for non-sinusoidal voltages, dc voltmeter, mechanical and electrical tachometer, altimeter.	5
4.	Current transformers and potential transformers, AC/DC current probs.	5
5.	Digital instrumentation, technology of regulators, sensors and actuators, recorders, signal processing circuits, data acquisition system.	6
6.	Types of a.c. bridges, equation for bridge balance, measurement of self inductance, capacitance, mutual inductance and frequency.	8
7.	Case study of the instrumentation scheme used in small hydro power development.	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Doebelin, E. O., "Measurement Systems Application and Design", 5 th edition, Tata McGraw-Hill Publishing Company.	2003
2.	Patranabis, D., "Principles of Industrial Instrumentation", 2 nd edition, Tata McGraw-Hill Publishing Company.	2004
3.	Oliver, B., "Electronic Measurements and Instrumentation", 1 st edition, Tata McGraw-Hill Publishing Company.	2001
4.	Bouwens A., "Digital Instrumentation", 1 st edition, Tata McGraw-Hill Publishing Company.	2001
5.	Beckwith, T.G., Marangoni, R.D. and Lienhard, J.H., "Mechanical Measurements", 6 th edition, Prentice Hall Publishers.	2006
6.	Sawhney, A.K., "A course in Electrical and Electronic Measurement and Instrumentation", 11 th edition, Dhanpat Rai and Sons Publishers.	1997

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-527** Course Title: **LABORATORY COURSE**
2. Contact Hours: **L: 0** **T: 0** **P: 3**
3. Examination Duration (Hrs.): **Theory: 0** **Practical: 3**
4. Relative Weight: **CWS: 0** **PRS: 50** **MTE: 0** **ETE: 0** **PRE: 50**
5. Credits: **2** 6. Semester: **Spring** 7. Subject Area: **PCC**
8. Pre-requisite: **Nil**
9. Objective: To provide practical knowledge about various methods of analysis related to environmental degradation.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Solid waste characterization, soil characteristics: permeability, porosity, LL, PL, grain size distribution, soil classification and resistivity.	3
2.	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.	2
3.	Performance evaluation of toilets, crematoria and river fronts.	1
4.	Flow measurement techniques: 'V' notch and area-velocity method.	1
5.	Sediment analysis	1
6.	Trace element analysis	4
7.	Performance evaluation of various waste water treatment systems: lagoons, oxidation pond, ASP, UASB and other treatment plants	2
8.	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	Throughout the semester
9.	Demonstration of latest equipment of Institute Instrumentation Centre.	
TOTAL		14 x 3 = 42

Continuous evaluation will be carried out for each experiment.

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	"Standard Methods of Analysis", 20 th edition, Joint publication of APHA, AWWA and WEF.	2003
2.	Indian and International Standards.	-
3.	"Standard Method for the Examination of Water and Sewage", American Public Health Association.	2008
4.	Ramesh, R., and Anbu, M., "Chemical Methods for Environment Analysis: Water and Sediment", Macmillan Publishers India,	1996
5.	Carter, M.R. and Gregorich, E.G., "Soil Sampling and Methods of Analysis", 2 nd edition, John Wiley and Sons Inc.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-528** Course Title: **RURAL ELECTRICAL ENERGY SYSTEM PLANNING AND DESIGN**
Code:
2. Contact Hours: **L: 3 T: 1 P: 0**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about the planning and design aspects of electrification of rural areas.

Details of Course:

S. No.	Contents	Contact Hours
1.	Electrical load survey and forecasting, rural load management.	5
2.	Route survey and profiling of transmission and distribution lines.	4
3.	Mechanical design of low-tension distribution lines, selection of poles/supports etc.	5
4.	Electrical design of low-tension distribution lines: selection of conductors and insulators etc.	5
5.	Planning, selection and design of substations for rural electrical system.	5
6.	Load flow methods for transmission and distribution system; fault analysis: different types of faults and their calculation procedures	6
7.	Co-ordination between power and tele-communication lines	3
8.	Maintenance of transmission and distribution lines	5
9.	Case study of a typical system	4
TOTAL		42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Kamaraju, V., "Electric Power Distribution System", Tata McGraw Hill Education Private Limited.	2009
2.	Grainger, J.J. and Stevenson, W.D., "Power System Analysis", Tata McGraw Hill Publishing Company Limited.	2003
3.	Jangwala, N.K., "Modern Trends and Practices in Power Subtransmission and Distribution Systems", Vol.-I and II, CBIP Publication.	1996
4.	Widmer, P. and Arter, A., "Village Electrification", MHPG, SKAT Publication.	1993
5.	Pabla A.S., "Electric Power Distribution", 5 th edition, Tata McGraw Hill Publishing Company.	2004
6.	Harker, K., "Power System Commissioning and Maintenance Practice", The Institution of Electrical Engineers.	1998
7.	Raina, K.B. and Bhattacharya, S.K., "Electrical Design Estimating and Costing", New Age International Publisher Limited.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-530** Course Title: **REMOTE SENSING AND GIS FOR SHP PLANNING**

2. Contact Hours: **L: 3 T: 0 P: 2**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To provide knowledge for Remote Sensing and Geographical Information System for planning of small hydro projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Remote sensing: Introduction, Satellite platforms and sensors, data acquisition, Indian satellite system.	4
2.	Satellite image: format, resolution, multispectral images, Image processing software, Geo-referencing, pre-processing and enhancement. Information extraction: supervised and unsupervised classification	6
3.	Geographical Information System: introduction, components, Coordinate system, Projection system.	3
4.	Data sources and data collection for small hydro projects: Field survey, topographic maps, satellite images, GPS, Digitization and layers creation.	4
5.	Data types – Spatial, non-spatial, Vector and Raster data, Topological relationship.	3
6.	Data base development for SHP: Database structure, editing, data retrieval and query. Managing data errors: Rubber sheeting, Edge matching, Removal of sliver polygon.	6
7.	Digital elevation model: characteristics, DEM generation, parameters extraction from DEM.	4
8.	SHP data analyses–Catchments delineation - Overlay analyses, Buffering, Neighborhood operation, and distance and area measurement. Network based analysis.	5
9.	Runoff modeling, suitable site selection for small hydro power projects.	3
10.	GIS based Case study for development of small hydro power projects.	4
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Lillesand, T.M. and Kiefer, R.W., “Remote Sensing and Image Interpretation”, 5 th edition, John Willey and Sons Pte. Ltd.	2009
2.	Panda, B.C., “Remote Sensing Principles and Applications”, Viva Books Private Limited.	2006
3.	Lo, C.P. and Yeung, A. K.W., “Concepts and Techniques of Geographic Information Systems”, Prentice Hall Inc.	2009
4.	Chang, K.T., “Introduction to Geographic Information Systems”, Tata Mc Graw-Hill.	2007
5.	Burrough, P.A., “Principles of GIS for Land Resources Assessment”, Oxford University Press.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-534** Course Title: **CONSTRUCTION PLANNING AND MANAGEMENT**
Code:

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area : **PEC**

8. Pre-requisite: **Nil**

9. Objective: To provide knowledge of construction techniques, equipments, planning, monitoring and overall management of projects.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Planning for construction of projects, advantages, stages and limitations of planning	6
2.	Project objectives and activities, tender documents, types of tenders and procedures, cost estimates	6
3.	Construction schedules, network techniques, interrelationship of activities, advantages of network diagrams	8
4.	Construction methods, direct and indirect costs, construction plants and machinery, resource mobilisation	8
5.	Importance of safety, safety measures and benefits	4
6.	Quality control and management, coordination between different organizations and monitoring	6
7.	Construction planning for river diversion, foundation construction and treatment	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Peurifoy, R. L., Ledbetter, W. B. and Schexnayder, C. J., "Construction Planning, Equipment and Methods", McGraw-Hill Book Company.	1996
2.	Sengupta, B. and Guha, H., "Construction Management and Planning", Tata McGraw-Hill Publishing Company Ltd.	1995
3.	Seetharaman, S., "Construction Engineering and Management", 4 th edition (Reprint), Umesh Publications.	2007
4.	Hutchings, J. F., "Project Scheduling Handbook", Marcel Dekker Inc.	2004
5.	Kaushik, S. K., Asawa, G. L. and Ahuja, A. K., "Civil Engineering Practices", Vol. I-III, New Age International (P) Ltd.	1996

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-536** Course Title: **BIOMASS PRODUCTION AND UTILISATION**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To impart knowledge about biomass resources, production and conversion technologies.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Energy crisis, rural and urban energy loads, biomass as a source of energy, energy plantation, forest and agro residues, aquatic biomass, animal waste.	8
2.	Classification, shape, size, ash content and volatile matter in biomass.	4
3.	Biomass characteristics, procedures, proximate and ultimate analysis, ash deformation and fusion characteristics, calorific value, bulk density, devolatilisation	6
4.	Biomass production through energy plantation, agroforestry, short rotation intensive culture, biomass harvesting, handling and pre-conversion processes.	6
5.	Physical, biological and thermo-chemical conversion processes, combustion, pyrolysis, gasification, bio-diesel, biogas production, biogas plants, briquetting/size reduction.	8
6.	Synthetic fuel production, bagasse based co-generation for power, utilization of biomass for the generation of solid, liquid/gaseous fuels for meeting heat and power needs	5
7.	Environmental aspects of biomass production and utilisation and waste minimization system.	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Richard, B.D.O., "Fats and Oils Formulating and Processing for Application", 3 rd edition, CRC Press.	2004
2.	Donald, K., "Biomass for Renewable Energy, Fuels and Chemicals", Academic press.	1998
3.	Venkat, R.P. and Srinivas, S.N., "Biomass Energy Systems", Proceeding of International Conference, Feb. 26-27, 1996, TERI Press.	1997
4.	Maheshwari, R.C., "Bioenergy for Rural Energisation", Concept publication company	1997
5.	Nair, Ramchandra P.K., "An Introduction to Agroforestry", Springer (India) Pvt. Ltd.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-538** Course Title: **OPERATION AND MAINTENANCE OF SMALL HYDRO PLANTS**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To provide in depth knowledge of operation, maintenance, safety and financial aspects of various components of small hydropower plants.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Intake weir, desilting tank, forebay, power channel, spillways and power house building	6
2.	Gates, valves, trash rack and penstock	4
3.	Turbines, governors and auxiliaries	6
4.	Hydro-generator and excitation system	6
5.	Control panels, relays, circuit breakers, transformers, batteries and charging equipments	6
6.	Earthing system, switchyard and interconnecting transmission lines	5
7.	Safety aspects and disaster management in small hydropower plants	5
8.	Financial management for operation and maintenance of small hydropower plants	4
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	“Maintenance and Repair Manual for Private Micro Hydropower: Plants”, developed by DCS Technology Development, ICIMOD publication.	1999
2.	“Installation and Commissioning Manual for Micro Hydro Plants”, developed by DCS Technology Development, ICIMOD publication.	1999
3.	Facilities, Instructions, Standards and Techniques (FIST) Manuals, Vol. I-VI, USBR.	2009
4.	Fischer, G. et al, “Governor product information”, SKAT.	1990
5.	Gulliver, J.S. and Arndt, E.A., “Handbook of Hydro Electric Engineering”, McGraw Hills.	1993
6.	Harker, K., “Power System Commissioning and Maintenance Practice”, The Institution of Electrical Engineers.	1998

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-540** Course Title: **SOLAR PHOTO-VOLTAIC DESIGN AND APPLICATION**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

Pre-requisite: **Nil**

8. Objective : To provide knowledge about solar photo-voltaic technology, its design and application.

9. Details of Course:

S. No.	Contents	Contact Hours
1.	Solar energy data, estimation of solar energy on different planes.	6
2.	Principle, characteristics and types of solar photo-voltaic (PV) cell	6
3.	Manufacturing and performance testing of solar PV modules	5
4.	PV modules, array, batteries, battery chargers, block diodes, inverters, load distribution unit, monitoring equipment, circuit breakers	7
5.	Load estimation, sizing of array and battery	5
6.	Types of PV system, isolated and grid connected PV power plants	6
7.	Installation and maintenance, grid interfacing, field monitoring; economic analysis, cost effective hybrid designs	7
	TOTAL	42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Boyle, G., "Renewable Energy Power for a Sustainable Future", Oxford University Press.	1996
2.	Sukhatme, S.P., "Solar Energy Principles of Thermal Collection and Storage", 2 nd edition", Tata McGraw Hill.	1996
3.	Tiwari, G.N., "Solar Energy: Fundamentals, Design, Modeling and Applications", Narosa Publishing House.	2002
4.	Goswami, D.Y., Kreith, F. and Kreider, J.F., "Principles of Solar Engineering", 2 nd edition, Taylor and Francis.	1999
5.	Hsieh, J.S., "Solar Energy Engineering", Prentice-hall Inc.	1986
6.	Bansal, N.K., Kleemann, M. and Heliss, M., "Renewable Energy Sources and Conversion Technology", Tata McGraw-Hill Publishing Company.	1990

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-542** Course Title: **ENERGY CONSERVATION AND MANAGEMENT**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To provide the knowledge about energy conservation and management.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Definition, organization of an energy conservation programme, definition of energy conservation, energy management, energy conservation opportunities, general principles, types, procedures and instruments for energy auditing.	5
2.	Assessments of technical merits of energy conservation methods and techniques in specific applications, energy saving methods, energy strategy, industrial energy applications.	5
3.	Methods of cost estimation for potential savings of fuel and electricity.	4
4.	Supply and demand side management of energy in residential, commercial, transport and industrial sectors, electricity utilities.	5
5.	Energy conservation in steam boilers, engines; principles, types and applications of different heat recovery systems.	5
6.	Energy conservation in electrical motors, transformers and conductors.	5
7.	Energy conservation in illumination in building shells.	4
8.	Material conservation and recycling, buildings heat losses, effect of fabrics, solar gains, ventilation, cooling, thermal storage and heat pumps.	5
9.	Topping and bottoming cogeneration cycles, total energy systems.	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Paul, O'Callaghan, "Energy Management", McGraw-Hill Book Company	1993
2.	Charles, M. G., "Industrial Energy Conservation", John Wiley and Sons.	1996
3.	Bhatia, R., "Energy Demand Analysis, Management and Conservation", Wiley Eastern Publication.	1990
4.	Paul, K.A., "Wetland Ecology Principles and Conservation", Cambridge University Press.	2002
5.	"Energy Conservation Act", Ministry of Power.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-544** Course Title: **PROJECT FORMULATION AND IMPLEMENTATION**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PCC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge about project management, related activities and monitoring.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Project objectives and formulation, preparation of pre-feasibility and detailed project reports,	5
2.	Project implementation methods and management, project management agencies, public hearing process	4
3.	Project planning, background of network charts, network elements, drawing the network, PERT and CPM comparison and application, monitoring and control, management concepts.	10
4.	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	6
5.	Cost estimates, economic and financial analysis, internal rate of return, cost benefit analysis	5
6.	Financial management, resource mobilization and sustainability of the project, use of application softwares in project management, equipment development of lab, identification of appropriate equipment	8
7.	Specific regulations/statutory acts of other countries not practiced in India, problems of project implementation,	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	“The Engineering and Constructive Contract”, The Institutions of Civil Engineers.	1995
2.	“Quality in the Constructed Project- A Guide for Owners, Designers and Constructors”, Vol.-I, Manual No. 73, American Society of Civil Engineers.	1990
3.	Tambari, L.P. and Jha, C.N., “Commentary on MP Works Department Manual”, Suvidha Law House.	2002
4.	Hutchings, J.F., “Project Scheduling Handbook”, Marcel Dekker Inc.	2004
5.	Sengupta, B. and Guha, H., “Construction Management and Planning”, Tata McGraw-Hill Publishing Company.	1995

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-548** Course Title: **SIMULATION OF SMALL HYDROPOWER PLANTS**
2. Contact Hours: **L: 3** **T: 1** **P: 2/2**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 20** **PRS: 20** **MTE: 20** **ETE: 40** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To provide knowledge about modelling and simulation of electrical, mechanical and civil components of SHP Plant.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of system modelling and simulation, system states, lumped and distributed parameters, experimental and mathematical simulation, overview of numerical methods for simulation	8
2.	Modelling of water conductor system for low, medium and high head plants	8
3.	Modelling of turbines and governing system	8
4.	Modelling of generators, excitation and power evacuation system	8
5.	Dynamic simulation of SHP plants, different responses of SHP plant	6
6.	Case-studies, introduction to real-time digital simulator for SHP plant	4
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication /Reprint
1.	Law, A. M., "Simulation, Modeling and Analysis", 4 th edition, McGraw-Hill.	2008
2.	Zeigler, B. P., Praehofer, H. and Kim, T. G., "Theory of Modeling and Simulation", 2 nd edition, Academic Press.	2000
3.	Deo, N., "System Simulation with Digital Computer", Prentice Hall of India Pvt Ltd.	2006
4.	Som, S. and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", 1 st edition, McGraw-Hill.	2007
5.	Kundur, P., "Power System Stability and Control", McGraw-Hill Inc.	2008
6.	French, R.H., "Open Channel Hydraulics", McGraw-Hill Book Company.	1985

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-550** Course Title: **APPLICATION OF RS AND GIS IN ENVIRONMENT MANAGEMENT**
2. Contact Hours: **L: 3 T: 1 P: 0**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To familiarize with the application of Remote Sensing and GIS Techniques for Environmental Management and Conservation.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Definition of remote sensing, ideal remote sensing system, sensors and their characteristics.	4
2.	Image processing software, image registration, image enhancement, image classification.	5
3.	Definition and components of GIS, sources of data, coordinates and projection system, global Positioning System.	5
4.	Spatial and non spatial data, raster and vector data, data errors and editing creation of data base, special data operations and analysis.	5
5.	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.	6
6.	Re-modelling of water distribution and sewer network systems using GIS.	5
7.	GIS for sustainable land use urban development planning, rivers, lakes and coastal areas.	6
8.	Groundwater vulnerability modelling using GIS, environmental degradation and soil erosion of catchment, reservoir capacity and sedimentation.	6
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Clarke, K.C., Parks, B.O. and Crane, M.P., "Geographic Information Systems and Environmental Modeling", Prentice Hall of India Pvt Limited.	2006
2.	Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation", 5 th edition, John Willey and Sons Pte. Ltd.	2009
3.	Panda, B.C., "Remote Sensing Principles and Applications", Viva Books Private Limited.	2006
4.	Lo, C.P. and Yeung, A. K.W., "Concepts and Techniques of Geographic Information Systems", Prentice Hall	2009
5.	Burrough, P.A., "Principles of GIS for Land Resources Assessment", Oxford University Press.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject **AHN-552** Course Title: **HYDROLOGY AND MODELLING OF WATER BODIES**
Code:

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge about hydrology and modeling of water bodies.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	5
2.	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.	6
3.	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.	6
4.	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.	7
5.	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.	5
6.	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.	5
7.	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	8
	TOTAL	42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/Reprint
1.	Subramanya, K., "Engineering Hydrology", 3 rd edition, Tata McGraw Hill.	1994
2.	Raghunath, H.M., "Hydrology", Wiley Eastern Publication.	2006
3.	Sharma, R.K. et al, "Hydrology and Water Resources Engineering", Oxford and IBM.	2009
4.	Rutherford, J.C., "River Mixing", 1 st edition, John Wiley and Sons.	1994
5.	Fischer, H.B., et al, "Mixing in Inland and Coastal Waters", Academic Press.	1979
6.	Martin, L.M. and McCurthen, S.C., "Hydrodynamics and Transport for Water Quality Modelling", Levis Publishers.	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AH-556** Course Title: **ENVIRONMENTAL LAWS, PUBLIC PARTICIPATION AND INSTITUTIONAL DEVELOPMENT**
2. Contact Hours: **L: 3 T: 1 P: 0**
3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**
4. Relative Weightage: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**
5. Credits: **4** 6. Semester: **Both** Subject Area: **PEC**
7. Pre-requisite: **Nil**
8. Objective: To acquaint with legal aspects of environmental protection, public awareness, participation of civil society and institutions in the management of natural resources.

9. Details of Course:

S. No.	Contents	Contact Hours
1.	Genesis of environmental acts and main national laws, water (prevention and control of pollution) act/rules, constitution of central and state boards	5
2.	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	6
3.	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	10
4.	Notification of MoEF for construction projects, National environmental tribunal act and appellate authority	5
5.	Environment audit, international protocol, treaties and conventions, Latest International global environmental concepts like global warming and its impact on water resources, Stockholm and Basal convention, Copenhagen conference, Rio-Earth summit, maintenance of biodiversity, awareness	6
6.	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, role of institutions, evaluation of existing institutions, design of institutions, Case studies, Laws related to institutions.	10
TOTAL		42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	“Manual on Environmental Law”, Commercial Law Publishers.	2001
2.	Upadhyay, S. and Upadhyay, V., “Handbook on Environmental Laws (Vol. II)-Water Laws, Air Laws and the Environment”, 1 st edition, Reed Elsevier India Private Limited.	2002
3.	Trivedi, P.R., “International Environmental Laws”, APH Publishing Corporation.	1996
4.	Magdolna, T.N., et al, “Manual on Public Participation in Environmental Decision Making, Current Practice and Future Possibilities in Central and Eastern Europe”. Budapest	1994
5.	“Pollution Control Acts, Rules and Notifications”, Vol.-I, Central Pollution Control Board	1996

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AH-558** Course Title: **COASTAL POLLUTION MONITORING AND IMPACT ASSESSMENT**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge of coastal pollution and its impact assessment and monitoring on ocean water quality.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Brief history, importance, fields of application and fundamental concepts of coastal pollution, collection, processing, analysis and quality control of data.	7
2.	Fundamentals of acoustic wave propagation in ocean waters, sound velocity computation, attenuation, refraction and reflection, frequency band width, multibeam echosounders, sea floor classification.	5
3.	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.	7
4.	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.	7
5.	Coastal pollution, types, causes and impact, concept and guidelines of sewage or sludge disposal into the sea.	7
6.	Notification of coastal regulation zone (CRZ) and environment clearance with practical case studies, desalination units for drinking water.	4
7.	Case studies of EIA of developmental projects on coastal areas.	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Ingham, A.E., "Sea Surveying", John Wiley and Sons Inc.	1975
2.	Andersen, A.T., "A Manual of Chemical and Biological Methods for Seawater Analysis", Oxford Pergamon Press.	1984
3.	Hocking, M.B., "Handbook of Chemical Technology and Pollution Control", 3 rd edition, Academic Press.	2006
4.	Spellman, F.R., "The Science of Environmental Pollution", 2 nd edition, CRC Press.	2009
5.	Bhatia, S.C., "Textbook of Air Pollution and its Control", Atlantic Publishing Company.	2007
6.	Pepper, I.L., Gerba C.P. and Brusseau, M.L. "Environmental and Pollution Science", 2 nd edition, Academic Press.	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AH-576** Course Title: **PLANNING AND MANAGEMENT OF ENVIRONMENTAL FACILITY**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weightage: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To provide knowledge about conservation and management of environment facility.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	4
2.	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.	5
3.	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).	7
4.	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.	8
5.	Financial aspects, cost price and its different forms, gross and net income, outgoings and its types, obsolescence, annuity, year's purchase.	5
6.	Capital cost, operating cost, capitalized value, time value of money, sinking fund, depreciation and methods of its calculation, cost fixation on the produced commodity.	5
7.	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.	4
8.	Measures for sustainability, operation and maintenance of the assets and facilities.	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Dutta, B.N., "Estimating and Costing", S. Dutta and Company.	1996
2.	Mahajan, D.C., "Estimating and Costing in Civil Engineering", 5 th edition, Rainbow Book Company.	2010
3.	Amin, R.K., "Economics for Engineers", Charotar Book Stall.	1963
4.	Chand, T., "Engineering Economics", Nem Chand and Brothers.	2000
5.	"Manuals on Water Supply and Wastewater Treatment", CPHEEO.	1993
6.	Current Schedule of Rates (SR) of PWD, KUWS and DB.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AH-580** Course Title: **CLIMATE CHANGE AND WATER RESOURCES**

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weightage: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge about impact of climate change on water resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	8
2.	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.	8
3.	Biological and physico-chemical methods for carbon sequestration, CO ₂ capture from large point sources, pre-, post- and oxy-combustion technology, transport, storage and monitoring, feasibility, economics and public perceptions.	8
4.	Water resources and green house gas emissions, mitigation measures and adaptation to climate change.	8
5.	Kyoto protocol, UNFCCC, IPCC, geopolitics of GHG control, CDM and other emission trading mechanisms, non-CO ₂ GHGs, relevance for India, procedure for registration for CDM projects and its benefit.	6
6.	Case studies.	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Metz, B. et al, "Climate Change 2007: Mitigation of Climate Change", Working group III of IPCC, Cambridge University Press.	2007
2.	Pachauri, R.K., "Dealing with Climate Change", TERI Press.	2009
3.	Orford, M. et al, "Climate Change and the Kyoto Protocol's Clean Development Mechanism" 1 st edition, ITDG publication.	2004
4.	Graedel, T.E. and Crutzen, P.J., "Atmosphere, Climate and Change", W. H. Freeman Publishers.	1997
5.	Stevens, W.K., "The Change in the Weather: People, Weather and the Science of Climate", Delacorte Press.	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-554** Course Title: **WASTE WATER COLLECTION, TREATMENT AND DISPOSAL**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **PCC**

8. Pre-requisite: **Nil**

9. Objective: To provide knowledge about collection, treatment and disposal of waste water.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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	4
2.	Waste water collection, sewerage systems and sewage pumping, natural drainage system and waste water disposal	6
3.	Typical sewage quality, its composition and health hazards of handling and disposal	5
4.	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	12
5.	Operation and maintenance of waste water treatment plants, polishing of treated waste water, disinfection, nutrient removal, natural treatment systems	5
6.	Treatment of sludge, disposal of treated effluent and sludge	5
7.	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	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Tchobanoglous, G., Burton, F. L. and Stensel, H. D., "Waste Water Engineering: Treatment and Reuse", 4 th edition, Tata McGraw Hill Publishing Company.	2003
2.	Davis, M.L., David, A. and Cornwell, W.C.B., "Introduction to Environmental Engineering", 3 rd edition, McGraw Hill.	1998
3.	Bajwa, G.S., "Practical Handbook on Public Health Engineering", Deep Publisher.	2003
4.	"Manual of Sewerage and Sewage Treatment", CPHEEO.	1993
5.	Letterman, R.D., "Water Quality and Treatment- A Handbook of Community Water Supplies", 5 th edition, American Water Works Association – Mc Graw-Hill Inc.	1988

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-556** Course Title: **ENVIRONMENTAL LAWS, PUBLIC PARTICIPATION AND INSTITUTIONAL DEVELOPMENT**

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**

5. Credits: **4** 6. Semester: **Both** Subject Area: **PEC**

7. Pre-requisite: **Nil**

8. Objective: To acquaint with legal aspects of environmental protection, public awareness, participation of civil society and institutions in the management of natural resources.

9. Details of Course:

S. No.	Contents	Contact Hours
1.	Genesis of environmental acts and main national laws, water (prevention and control of pollution) act/rules, constitution of central and state boards	5
2.	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	6
3.	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	10
4.	Notification of MoEF for construction projects, National environmental tribunal act and appellate authority	5
5.	Environment audit, international protocol, treaties and conventions, Latest International global environmental concepts like global warming and its impact on water resources, Stockholm and Basal convention, Copenhagen conference, Rio-Earth summit, maintenance of biodiversity, awareness	6
6.	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, role of institutions, evaluation of existing institutions, design of institutions, Case studies, Laws related to institutions.	10
TOTAL		42

10. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	“Manual on Environmental Law”, Commercial Law Publishers.	2001
2.	Upadhyay, S. and Upadhyay, V., “Handbook on Environmental Laws (Vol. II)-Water Laws, Air Laws and the Environment”, 1 st edition, Reed Elsevier India Private Limited.	2002
3.	Trivedi, P.R., “International Environmental Laws”, APH Publishing Corporation.	1996
4.	Magdolna, T.N., et al, “Manual on Public Participation in Environmental Decision Making, Current Practice and Future Possibilities in Central and Eastern Europe”. Budapest	1994
5.	“Pollution Control Acts, Rules and Notifications”, Vol.-I, Central Pollution Control Board	1996

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-558** Course Title: **COASTAL POLLUTION MONITORING AND IMPACT ASSESSMENT**

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 0**

4. Relative Weight: **CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge of coastal pollution and its impact assessment and monitoring on ocean water quality.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Brief history, importance, fields of application and fundamental concepts of coastal pollution, collection, processing, analysis and quality control of data.	7
2.	Fundamentals of acoustic wave propagation in ocean waters, sound velocity computation, attenuation, refraction and reflection, frequency band width, multibeam echosounders, sea floor classification.	5
3.	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.	7
4.	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.	7
5.	Coastal pollution, types, causes and impact, concept and guidelines of sewage or sludge disposal into the sea.	7
6.	Notification of coastal regulation zone (CRZ) and environment clearance with practical case studies, desalination units for drinking water.	4
7.	Case studies of EIA of developmental projects on coastal areas.	5
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Ingham, A.E., "Sea Surveying", John Wiley and Sons Inc.	1975
2.	Andersen, A.T., "A Manual of Chemical and Biological Methods for Seawater Analysis", Oxford Pergamon Press.	1984
3.	Hocking, M.B., "Handbook of Chemical Technology and Pollution Control", 3 rd edition, Academic Press.	2006
4.	Spellman, F.R., "The Science of Environmental Pollution", 2 nd edition, CRC Press.	2009
5.	Bhatia, S.C., "Textbook of Air Pollution and its Control", Atlantic Publishing Company.	2007
6.	Pepper, I.L., Gerba C.P. and Brusseau, M.L. "Environmental and Pollution Science", 2 nd edition, Academic Press.	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-576** Course Title: **PLANNING AND MANAGEMENT OF ENVIRONMENTAL FACILITY**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**
4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**
5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**
8. Pre-requisite: **Nil**
9. Objective: To provide knowledge about conservation and management of environment facility.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	4
2.	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.	5
3.	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 surfing, water supply distribution lines, surface and sub-surface drainage line (including stone-ware pipes).	7
4.	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.	8
5.	Financial aspects, cost price and its different forms, gross and net income, outgoings and its types, obsolescence, annuity, year's purchase.	5
6.	Capital cost, operating cost, capitalized value, time value of money, sinking fund, depreciation and methods of its calculation, cost fixation on the produced commodity.	5
7.	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.	4
8.	Measures for sustainability, operation and maintenance of the assets and facilities.	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Dutta, B.N., "Estimating and Costing", S. Dutta and Company.	1996
2.	Mahajan, D.C., "Estimating and Costing in Civil Engineering", 5 th edition, Rainbow Book Company.	2010
3.	Amin, R.K., "Economics for Engineers", Charotar Book Stall.	1963
4.	Chand, T., "Engineering Economics", Nem Chand and Brothers.	2000
5.	"Manuals on Water Supply and Wastewater Treatment", CPHEEO.	1993
6.	Current Schedule of Rates (SR) of PWD, KUWS and DB.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Department/Centre: **ALTERNATE HYDRO ENERGY CENTRE**

1. Subject Code: **AHN-580** Course Title: **CLIMATE CHANGE AND WATER RESOURCES**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge about impact of climate change on water resources.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	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.	8
2.	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.	8
3.	Biological and physico-chemical methods for carbon sequestration, CO ₂ capture from large point sources, pre-, post- and oxy-combustion technology, transport, storage and monitoring, feasibility, economics and public perceptions.	8
4.	Water resources and green house gas emissions, mitigation measures and adaptation to climate change.	8
5.	Kyoto protocol, UNFCCC, IPCC, geopolitics of GHG control, CDM and other emission trading mechanisms, non-CO ₂ GHGs, relevance for India, procedure for registration for CDM projects and its benefit.	6
6.	Case studies.	4
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors/Books/ Publisher	Year of Publication/ Reprint
1.	Metz, B. et al, "Climate Change 2007: Mitigation of Climate Change", Working group III of IPCC, Cambridge University Press.	2007
2.	Pachauri, R.K., "Dealing with Climate Change", TERI Press.	2009
3.	Orford, M. et al, "Climate Change and the Kyoto Protocol's Clean Development Mechanism" 1 st edition, ITDG publication.	2004
4.	Graedel, T.E. and Crutzen, P.J., "Atmosphere, Climate and Change", W. H. Freeman Publishers.	1997
5.	Stevens, W.K., "The Change in the Weather: People, Weather and the Science of Climate", Delacorte Press.	1999