ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

No. Acd./ 3162 /IAPC-78 Dated: February 05, 2020

Head, Department of Hydro and Renewable Energy
(through e-mail)

The IAPC in its 78th meeting held on 31.12.2019 vide **Item No. 78.2.5 (b)** considered the proposal of Department of Hydro and Renewable Energy to introduce the following new Open Elective Courses (OEC) for B.Tech. students:

1. IAH-304: Energy Resources, Economics and Sustainability
2. IAH-305: Alternate Fuels for Transportation

The IAPC accepted the proposal with minor modifications. Duly modified syllabi is attached as **Appendix-A**.

Assistant Registrar (Curriculum)

Encl: as above

Copy to (through e mail):-

1. All faculty
2. All Heads of Departments/ Centres
3. Dean, Academic Affairs
4. Associate Dean of Academic Affairs (Curriculum)
5. Channel I/ Academic webpage of iitr.ac.in

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

NAME OF DEPARTMENT: Hydro and Renewable Energy

1. **Subject Code:** IAH-304 **Course Title:** Energy Resources, Economics and Sustainability
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory**: 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective of Course:** To provide the basic knowledge about energy systems along with economic and sustainability principles.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Overview of World energy scenario, primary energy demand and supply, fossil fuel reserves - estimates, overview of India's energy scenario and its comparison with other countries, trends in energy use patterns, energy and development linkage, formulation of energy Sankey diagrams.	5
2.	Energy chain, primary energy analysis, net energy analysis examples	4
3.	Energy economics - simple payback period, time value of money, internal rate of return, net present value, life cycle costing, levelized cost of energy.	5
4.	Project cost and benefits, economic and financial models, cost of saved energy.	5
5.	Environmental impacts of energy use - air pollution, particulates solid and water pollution, formation of pollutants, measurement and controls; sources of emissions, effect of operating and design parameters on emission	7
6.	Introduction to Life cycle assessment (LCA) and its relation with environmental decision support, LCA framework methods and standards	5
7.	LCA: mass flow, data estimation, multi functionality, Input-Output methods, impact categories, mid-point and end-point indicators, interpretation: consistency and sensitivity.	6
8.	Future energy scenarios and elements of sustainability.	5
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Energy and the Challenge of Sustainability, World energy assessment, Denim Anderson, UK, Michael Jefferson, UK, John P. Holdren, US, UNDP New York	2000
2.	Sustainable Energy - without the hot air, David JC MacKay, UIT Cambridge, England, version 3.5.2, November 03, 2008	2009
3.	Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, Mary Ann Curran, Wiley	2012
4.	Introduction to Energy Economics, Subhes C. Bhattacharyya, Springer London Dordrecht Heidelberg, New York	2011
5.	The Age of Sustainable Development, Jeffrey D. Sachs, Ki-moon Ban, Columbia University Press	2015

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

NAME OF DEPARTMENT: Hydro and Renewable Energy

1. **Subject Code:** IAH-305 **Course Title:** Alternate fuels for transportation
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory**: 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective of Course:** To provide the basic knowledge about the potential alternative fuels for transportation, the need and the challenges in the development of alternative fuels.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Indian energy scenario, need for alternate fuels, alternate fuels for land, water and air transport, policy and regulations, environment emissions, emission standards	6
2.	Overview of engine technology, efficiency and emission challenges, liquid and gaseous fuels, engine compatibility, lubricating oils, dual fuel, multi fuel engines	4
3.	Biofuels (bio-diesel, bio-ethanol, bio-crude, biogas & bio-CNG), biomass availability and resources, conversion processes, infrastructure needs, safety, barriers etc.	6
4.	Electric vehicles, current status, capabilities, charging infrastructure, electricity from renewable energy, barriers	6
5.	Advances in other alternate fuels: Hydrogen, natural gas, methanol, ethanol, DME.	5
6.	Energy storage, the need for energy storage, chemistry of energy storage, storage for liquid and gaseous fuels, rechargeable electric batteries.	5
7.	Economic, methods for estimating the cost of energy for alternate fuels and comparison with fossil fuels	4
8.	Environmental aspects of various transportation modes, well to wheel emission analysis, health hazards, sustainable transport solutions case studies	6
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Alternative Fuels for Transportation, Arumugam S. Ramadhas, CRC Press, published by Taylor & Francis group	2011
2.	Transitions to Alternative Vehicles and Fuels, The National Academies Press, Washington DC	2017
3.	Sustainable Energy and Transportation Technologies and Policy, Vol.-I, Springer	2018
4.	Avoiding Carbon Apocalypse Through Alternative Energy, Springer	2017
5.	Alternative Fuels: Transportation fuels for today and tomorrow, Richard L. Bechtold, Publisher: Society of Automotive Engineers.	2002

6.	Alternative Fuels and advance vehicle technologies for improved environmental performance, 1st edition, Rechard Folkson, Publisher: Woodhead Publishing, Elsevier, Society of Automotive Engineers	2014
7.	Alternative Transportation Fuels: Utilization in combustion engine, M.K. Gajendra Babu, K.A. Subramanian, CRC Press, published by Taylor & Francis group	2017