Study & Evaluation Scheme
of
Bachelor of Science (Biofuels)

(Syllabus Applicable w.e.f. Academic Session 2017-18)

Uttarakhand Residential University
Almora,Uttarakhand-263001

www.urualmora.org

In partnership with

RedIT Innovators USA/Bhumi IT India

About the programme

Bio-fuel Technologies: Towards Cost Effective Eco-friendly and Renewable Energy

- The global energy demand is steadily increasing with the economic growth combined with the population explosion. The fossil fuels are depleting at faster rate with the economic development. Thus, the continued use of fossil-based fuels is not sustainable owing to its limited availability and emission of the green house gases and other air contaminants upon combustion. Therefore, development of an alternate renewable and clean energy source has gained serious attention worldwide.
- According to the feedstock and technology used, the biofuel technologies have been categorized as the first, second, third and fourth generation biofuels.

First generation bio-fuel technologies

First generation bio-fuels are the fuels derived from sugar, starches or vegetable oils. Bio-diesel and bio-ethanol are widely known as first generation or conventional biofuels. The use of vegetable oil as a fuel dates back to more than a century when Rudolph Diesel invented the compression-ignition (CI) engine. In order to lower the viscosity and improve volatility, the triglyceride oils require some chemical modifications such as transesterification or emulsification. The fatty acid methyl esters (FAME) obtained by transesterification of oil with methanol is popularly known as bio-diesel. The physical properties of fatty acid methyl esters resemble to petroleum derived diesel fuel. Presently, bio-diesel is derived from food grade edible oils in many developed and developing countries *i.e.* Soyabean oil in USA, Canola in Canada, Rapeseed in Europe, Palm in Malaysia and Indonesia, etc. India being one of the largest edible oil importers, it can't divert these edible sources for fuel purpose. The non-edible oilseeds *i.e.* Karanja (*Pongamia pinnata*) and Jatropha (*Jatropha curcas*) are suitable feed stock for bio-diesel in India.

Second generation bio-fuel technologies

The first generation biofuels compete with inputs for food, so the alternative may be the advanced or second generation biofuels which uses cellulosic products such as wood, straw, long grass or wood waste for biofuel production. The advantage of second generation biofuels is the ability to use the whole plant and not just its parts (for example grains), as is the raw material for the first generation. All plants contain lignin, hemicellulose and cellulose. Lignocellulosic ethanol is made by freeing the sugar molecules from cellulose using enzymes, steam heating, or other pre-treatments. These sugars can then be fermented to produce ethanol in the same way as first generation bioethanol production.

Second generation biofuels from lignocellulosic biomass can be broadly obtained through biochemical and thermo-chemical processes. Biochemical processes typically employ pre-treatment to accelerate the hydrolysis process, which separates out the lignin, hemicellulose and cellulose. Once these ingredients are separated, the cellulose fractions can be fermented into alcohols. Liquid biofuels from biomass can be obtained through thermo-chemical processing or bychemical treatment. Thermo-chemical treatment comprises thermal decomposition and chemicaltransformation of substrates by the action of the temperature in the presence of variousconcentrations of oxygen. The advantage of thermal treatment in relation to the biochemical is able toconvert all organic ingredients, not just the polysaccharides, as is the case with chemical treatment. Carbon-based materials can be heated at high temperatures in the absence (pyrolysis) or presence of oxygen, air and/or steam (gasification).These thermo-chemical processes yield

combustible gas and solid char. The gas can be fermented or chemically synthesized into a range of fuels, including ethanol, synthetic diesel or jet fuel. However, the majority of these processes are still under development phase and trying to secure a market share due to various challenges, right from suitable infrastructure, raw material, technical limitations, government policies, and social acceptance.

Third generation bio-fuel technologies

The biofuels derived from microalgae, the unicellular algae, are referred as third generation biofuels. Microalgae are a promising feedstock for biofuels owing to their rapid growth rate and higher lipid productivity than the best oil producing terrestrial plants. Further, the higher photosynthetic efficiency and wider adaptability to different environmental conditions are the other reasons for interest in microalgae for biofuels. Microalgae, does not need fertile land and can be grown in sewage water, thus eliminating or minimizing the competition with food crops for resources, consequently avoiding the food vs fuel conflict. In addition to source of different types of biofuels, microalgae are useful as nitrogen fixing bio-fertilizers and in phyto-remediation.

Fourth generation Bio-fuel technologies

Omics advancements contribute to the development of the fourth generation biofuelsfrom genetically engineered species. The omics technological advancement has tremendous future scope to extract deeper biological knowledge and thereby cost effective production of renewable energy. It mainly includes key area of research such as new strain development, improved cultivation, low energy harvesting and high-yield extraction-conversion technology.

In order to advance the economic feasibility of the microalgae or other feed stocks, much attention is being given on genetic and metabolic engineering to increase the yield of biofuel relevant lipids without compromising the growth. Genetic engineering approach has been widely used for improvement in biofuel traits in terrestrial plants as well. Commercial application of genetically engineered species is however subject to strict bio-safety regulations.

Future perspectives

Natural petroleum resources, synthesized over millions of years are likely to be exhausted shortly. Though, a number of alternative fuels have been discovered, none of them is as usable as biofuels are, primarily because we do not need to change the way we currently use our fuels or energy resources. However, both the cultivation of the raw material for biofuels, as well as the extraction of the yields at present is a challenging task, simply because neither we have been accustomed to cultivate them, nor the nature has destined these resources to be utilized so. Thus, huge amount of investments on Research and Development of these resources are required.

Given the current state of technology, and the uncertainty remaining about thefuture breakthroughs that would potentially make some advanced-generation biofuels cost competitive,policymakers need to carefully consider what goals are to be pursued inproviding support to different biofuels. Biofuels that simultaneously advance multiplepolicy goals could warrant greater support when designing incentive mechanisms. Anintegrated approach combining economically sustainable rural development, climatechange mitigation, and alternative energy provision provides a good policy frameworkfor

advanced-generation biofuels. It is also necessary to consider regional and internationaldevelopments in policies and trade in order to maximize the potential benefits achievablethrough the policies implemented.

Uttarakhand Residential University Almora has started B.Sc (Biofuels) course from academic session 2017-18. The objective of this course is to provide students with the basic principles of biofuels and bioenergy systems design. Students in this course will identify biofuels and bioenergy sources; describe biofuels and bioenergy technologies, applications and efficiency; analyze biofuels and bioenergy manufacturing, distribution and integration issues; evaluate biogas and its sources and site location; design a biofuels and bioenergy process and its related components.

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Study&EvaluationScheme

SUMMARY

Programme	:	**B.Sc.(Biofuels)**
Duration (Six Semesters)	:	**Three Years**
Medium	:	**English**
Minimum Required Attendance	:	**75%**
Credit	:	
Maximum Credit	:	**180**
Minimum Credit required for the degree	:	**180**

Assessment :

Internal	External	Total
25	75	100

Evaluation of Practical/Dissertations & Project Reports :

External	Internal	Total
50	50	100

Duration of Examination :

External	Internal
3 hrs	1 ½ hrs

To qualify the course a student is required to secure a minimum of 40 marks in aggregate including the semester end examination and teachers continuous evaluation (i.e. both internal & external).A candidate who secures less than 40% of marks in a course shall be deemed to have in that course. The student should have at least 40 % marks in aggregate to clear the semester

Question Paper Structure:

Semester where Class room teaching is taking place in University

1. *The question paper shall consist question one as compulsory of 15 marks. In addition there will be two questions from each unit of which one question will have to be answered by the student. Each question will carry equal weightage.*

Semester where Class room teaching is taking place in University

1. *The question paper shall consist question of Multiple choice Questions and the same would take place using computer software in a manner that the result would be known to the student at the end of the paper.*

2. STUDY&EVALUATIONSCHEME

B.Sc.(Biofuels)SESSION2017-2018

SEMESTERI

S. N.	Subject Code	Subject	Periods			Credits	EvaluationScheme		
			L	T	P		Internal	External	Total
1		Professional &Confident Communication	5	-	-	5	25	75	100
2		Computers Basics	5	-	-	5	25	75	100
3		Biofuels Basics	5	-	-	5	25	75	100
4		Professional Communication Lab	-	-	4	2	25	75	100
5		Computer Lab	-	-	4	2	50	50	100
6		Biofeuls Lab	-	-	4	2	50	50	100
7		Project work				6	50	50	100
Total			**15**	**-**	**12**	**27**	**250**	**450**	**700**

	TITLE	Object of the course
01	Professional and confident communication	This course will help students to read, write, think and communicate critically. The goal is simply not to memorize terminology but to learn critically. It will enable students to know how to use concepts and relate the concepts to other subjects and other dimensions of life such as personal life, social life and professional life.
02	Computer basics	This course is the simplest and quickest way to be acquainted with basic IT skills and usages of the internet through simple fun filled programs. The programs shall equip students with basic IT skills thereby bridging the digital divide.
03	Bio fuel	The objectives of this course are to provide students with the basic principles of bio fuels and bio energy system design. Students in this course will identify bio fuel and bio energy sources.
	PRACTICAL	
01	Professional communication Lab	It shall comprise of the four skills of learning – Listening, Speaking, Reading and Writing in addition to their theory. The lab training shall be given with the assistance of Networked Computers and specially designed software.
02	Computer lab	After getting introduction of windows, students will have hands on lab for learning the basics of DOS, Word, Operating systems, spread sheet, communication and internet.
03	Bio fuel lab	1- Fermentation by yeast 2- Bio fuel yielding plants 3- Algae which produce bio fuel 4- Equipment for microbial culture technique

Second Semester

Paper First - Introduction to Bio- Energy

Introduction to Bio- Energy ; The need for alternative fuels, composition of fossil fuels; Further definition and introduction to the major bio-energy feed stocks; Potential benefits of replacing fossil fuels with biofuel, Biomass and Biogas; Food verses fuel.

Paper Second – Bioethanol –

Introduction; fermentation of sugars to ethanol, Sucrose; Synthesis of plants; sugarcane; Bioethanol from starch; Bioethanol from wheat; Bioethanol from other grains.
Second generation bio-ethanol from cellulose and other cell wall polysaccharides , plant cell wall.
Bio- ethanol from algal cell wall polysaccharides.

Paper Third –Biodiesel –

Introduction, oil synthesis in oil seed crops; Biodiesel manufacturing.
Biodiesel feed stock, soybean oil, oil seeds (canola oil, palm oil), tallow and waste oil.
The potential first generation feed stock, potential second generation biodiesel feedstock.
Biotechnology.

Practical Biofuel

1. Bio- production from maize (corn).
2. Collection and identification of different species of Blouin artifno
3. Collection and identification of different species of Lantana Camarao
4. Bio- diesel production from bukol (blowing artifino) and Lantana camara by burning them with different plastic items and rubber