DEPARTMENT OF MECHANICAL ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech., / Mechanical Engineering**		
Course Title	**BIOFUELS**		
Course Code	**MEPE14**	No. of Credits	**3**
Course Code of Pre-requisite subject(s)	**MEPC16**		
Session	**JAN. 2021**	Section (if, applicable)	
Name of Faculty	**S. Vijayan** Postdoctoral Fellow	Department	**Mechanical**
Name of Course Coordinator(s) (if, applicable)	-		
E-mail	vijiyan@nitt.edu	Telephone No.	**9865266082**
Course Type	☐ **Core course**	☑ **Elective course**	

Syllabus

Importance of bioenergy and biofuels in solving energy crisis and global warming. Introduction to various biomass types – constituents, characterization. Biogas & bio-electricity, Bio-heat; Clean sustainable bioenergy, bio-electricity and biogas production from Dairy manure and Food Waste streams.

Biomass pre-treatment: Acid/alkali treatment, steam explosion, ammonia fibre expansion, enzymatic, ball milling, other non-conventional techniques, choice of pre-treatment based on biomass types. Pellets made from wood or grass biomass are commercially available at stores for heating homes, schools, businesses.

Seed-based biodiesel, bioethanol, conversion of waste oil to biodiesel, advanced biofuels including algae-biofuel, microbial biofuel, Conversion of waste vegetable oil into biodiesel, and advanced innovations in enzymatic conversion of non-food feed-stocks. Fuel properties, engine applications.

Biomass conversion technologies for biofuel. Thermochemical processes: Combustion, gasification, pyrolysis, hydrothermal liquefaction, hydropyrolysis, torrefaction, choice of thermal process based on biomass type and product requirement.

Biofuels/energy related environmental, economics, & social issues. The source, processing, and social impacts of biofuel utilization

COURSE OBJECTIVES

1. To characterize different biomass feedstock's based on its constituents and properties & understand the analytical techniques to characterize biomass.
2. To Understand and evaluate various biomass pre-treatment and processing techniques in terms of their applicability for different biomass types.
3. To provide students with the basic principles of biofuels and bioenergy systems design.
4. To identify biofuels and bioenergy sources; describe biofuels and bioenergy technologies,
5. To distinguish applications and efficiency; analyze biofuels and bioenergy manufacturing, distribution and integration issues.

COURSE OUTCOMES (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
On completion of this course, the students will be able to	
1. Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications	1,3,5,6,7,8,12
2. Address the desirable features of these biomass energy sources and their advantages over traditional fuels such as coal and oil	1,2,3,4,5,6,7,12
3. Identify their limited scope in terms of suitable sites, dependence on the elements, capital costs, and cost effectiveness compared with traditional sources	1,2,5,6,7,8,11

COURSE PLAN – PART II

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	**Week**	**Topic**	**Mode of Delivery**
1	1st Week	Importance of bioenergy and biofuels in solving energy crisis and global warming. Introduction to various biomass types – constituents, characterization.	**Online mode** PPT/virtual white board
2	2nd Week	Biogas & bio-electricity, Bio-heat; Clean sustainable bioenergy, bio-electricity	
3	3rd Week	Biogas production from Dairy manure and Food Waste streams.	
4	4th Week	Biomass pre-treatment: Acid/alkali treatment, steam explosion, ammonia fibre expansion, enzymatic, ball milling	
5	5th Week	Non-conventional techniques, choice of pre-treatment based on biomass types	

6	6th Week	Pellets made from wood or grass biomass are commercially available at stores for heating homes, schools, businesses.	**Online mode** PPT/virtual white board
7	7th Week	Seed-based biodiesel, bioethanol, conversion of waste oil to biodiesel	
8	8th Week	Advanced biofuels including algae-biofuel, microbial biofuel, Conversion of waste vegetable oil into biodiesel	
9	9th Week	Advanced innovations in enzymatic conversion of non-food feed-stocks. Fuel properties, engine applications.	
10	10th Week	Biomass conversion technologies for biofuel. Thermochemical processes: Combustion, gasification, pyrolysis,	
11	11th Week	Thermochemical processes: Hydrothermal liquefaction, hydropyrolysis, torrefaction	
12	12th Week	Choice of thermal process based on biomass type and product requirement.	
13	13th Week	Biofuels/energy related environmental, economics, & social issues.	
14	14th Week	The source, processing, and social impacts of biofuel utilization	

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle Test - I	6th Week	1 hour*	20
2	Cycle Test - II	10th Week	1 hour*	20
3	Assignments	-	1 week	15
4	Online MCQ	12th Week	I hour	15
CPA	*Compensation Assessment*	*11th Week*	*1 hour**	*20*
5	Final Assessment	14th Week	3 hours	30

(* Assessment time duration will be more than 1 hour for mode of test 1, 2 and 3)

ESSENTIAL READINGS: Textbooks & Reference books:

1. Filemon A. Uriarte Jr., Biofuels from plant oils, National Academy of Science and Technology, 2010.
2. Anju Dahiya, Bioenergy: Biomass to Biofuels, Eslevier, 2015
3. Sunggyu Lee and Y.T. Shah, Biofuels and Bio-energy Processes and Technology, CRC Press, Taylor and Francis Group, 2013.

4. Pandey, A., Larroche, C., Ricke, S.C., Dussap, C.-G., Gnansounou, E., Biofuels: Alternative feedstocks and conversion processes, Academic Press, U.S.A., 2011.
5. Brown, R.C. (Ed.) Thermochemical processing of biomass into fuels, chemicals and power, Wiley, 2011.
6. Clark, J., Deswarte, F. (Ed.) Introduction to chemicals from biomass, John Wiley and Sons, U.K., 2008.
7. Understanding clean energy and fuels from biomass, H. S. Mukunda, 2011

COURSE EXIT

- Feedback from the students during class committee meetings.
- Anonymous feedback through questionnaire and unknown formats.

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism)

MODE OF CORRESPONDENCE (email/ phone)

All the students are advised to attend the classes regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/any other information regarding this course) will be intimated in the Class only.

ASSESSMENTS:

- Attending all the assessments are MANDATORY for every student.
- If any student is not able to attend any of the continuous assessments (CAs: 1 and 2 only) due to genuine reason, student is permitted to attend the compensation assessment (CPA) with % weightage equal to maximum of the CAs.
- At any case, CPA will not be considered as an improvement test.
- The minimum marks for passing this course and grading pattern will adhere to the regulations of the Institute.

ATTENDANCE

- At least 75 % attendance in each course is mandatory.
- A maximum of 10 % shall be allowed under On Duty (OD) category.
- Students with less than 65 % of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC HONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both

students get the same penalty of zero mark.

- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

ADDITIONAL INFORMATION

- The faculty is available for consultation at times as per the intimation given by the faculty.
- Queries (if required) to the course teacher shall only be emailed to the email id specified by the teacher(vijiyan@nitt.edu)

FOR APPROVAL

Course Faculty _____ 02.02.2021
S.Vijayan

CC-Chairperson _____
(M.Shahul hameed.)

HOD _____
Dr.A.R.Veerappan