West Bengal State Council of Technical & Vocational Education and Skill Development

TEACHING AND EXAMINATION SCHEME FOR DIPLOMA COURSES

COURSE NAME: RENEWABLE ENERGY ENGINEERING

COURSE CODE : REE

DURATION OF COURSE : 6 SEMESTERS

SEMESTER - VI

Sl. No.	Course Code	Course Title	Hours Per Week			Total Contact Hours /Week	Credit	MARKS	
			L	T	P			IA	ESE
1.	REEPC302	Renewable Energy Power Plants	3	0	0	3	3	40	60
2.	REEPC304	Renewable Energy Power Plants Laboratory	0	0	2	2	1	60	40
3.	HS302	Entrepreneurship & Start - ups	3	1	0	4	4	40	60
4.	REEOE302	Open Elective – II (Any one from Open Elective list)	3	0	0	3	3	40	60
5.	REEOE304	Open Elective – III (Any one from Open Elective list)	3	0	0	3	3	40	60
6.	AU302	Indian Constitution	2	0	0	2	0	---	---
7.	PR302	Major Project	0	0	6	6	4^	120	80
8.	SE302	Seminar	2	0	0	2	1	100	---
		Total	**16**	**1**	**8**	**25**	**19**	**440**	**360**

L- Lecture, T-Tutorial, P-Practical, IA-Internal Assessment , ESE-End Semester Exam
Total Marks : 800

The student has to obtain 40% marks individually both in internal assessment and end semester examination to pass.

^ One credit is carried forward from the 5th. Semester major project evaluation.

Semester : Sixth	
Course Code : REEPC302	
Course Title : Renewable Energy Power Plants	
Number of Credit: 3 (L- 3; T- 0; P- 0)	
Prerequisite: Nil	
Course Category: PC	
Course objectives: 1. To know the working of the components of Solar PV and CS, wind power, micro hydro and biomass-based power plants. 2. To maintain the efficient operation of various types of renewable energy power plants.	
Course Contents (Theory):	
Unit : 1	**1. Solar PV and Concentrated Solar Power Plants:** 1.1 Solar Map of India: Global solar power radiation. 1.2 Solar PV system and its utilization. 1.3 Concentrated Solar Power (CSP) plants, Construction and working of: Power Tower. 1.4 Parabolic Trough, Parabolic Dish, Fresnel Reflectors. 1.5 Solar Photovoltaic (PV) power plant: Components Layout, Construction, Working principle. 1.6 Rooftop / Ground solar PV power system. 1.7 Safety factors in Solar PV and concentrated solar power plants.
Unit : 2	**2. Large Wind Power Plants:** 2.1 Wind Map of India: Wind power density in watts per square meter, Lift and drag principle, Long path theory. 2.2 Geared type wind power plants: components, layout and working. 2.3 Direct drive type wind power plants: components, layout and working. 2.4 Use of Variable Speed and Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG), Doubly-fed induction generator (DFIG), Wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG).

	2.5 Safety factors in large wind power plants.
Unit : 3	**3. Small Wind Turbines:** 3.1 Horizontal axis small wind turbine: Direct drive type, components and working. 3.2 Horizontal axis small wind turbine: Geared type, components and working. 3.3 Vertical axis small wind turbine: Direct drive and geared, components and working. 3.4 Types of towers and installation of small wind turbines on roof tops and open fields. 3.5 Description of the Electric generators used in small wind power plants.
Unit : 4	**4. Micro-hydro Power Plants:** 4.1 Energy conversion process of hydro power plant. 4.2 Classification of hydro power plant: High, medium and low head. Layouts of micro-hydro power plants 4.3 Construction and working of hydro turbines used in different types of hydro power plant: 4.3.1 High head – Pelton turbine 4.3.2 Medium head – Francis turbine 4.3.3 Low head – Kaplan turbine. 4.4 Safety factors in Micro-hydro power plants.
Unit : 5	**5. Biomass-based Power Plants:** 5.1 Properties of solid fuel for biomass power plants: Bagasse, Wood chips, Rice husk, Municipal waste. 5.2 Properties of liquid and gaseous fuel for biomass power plants: Jatropha, Bio-diesel, Gobar gas. 5.3 Layout of a Bio-chemical based (e.g. biogas) power plant and components required. 5.4 Layout of a Thermo-chemical based (e.g. Municipal waste) power plant and components required. 5.5 Layout of an Agro-chemical based (e.g. bio-diesel) power plant and components required. 5.6 Limitations of Biomass-based power plants.

Text / Reference Books:

Sl. No.	Titles of Book	Name of Author	Name of Publisher
1.	Renewable Energy Systems	David M. Buchla, Thomas E. Kissell, Thomas L. Floyd	Pearson Education
2.	Wind Electrical Systems	Bhadra, S.N., Kastha, D.,	Oxford University

	installation	Banerjee, S,	Press, New Delhi,
3.	Energy Technology	O.P. Gupta	Khanna Publishing House, New Delhi
4.	Wind Power Technologies	Rachel, Sthuthi; Earnest, Joshua	PHI Learning, New Delhi
5.	From Sunlight to Electricity: a practical handbook on solar photovoltaic application;	Deambi, Suneel:	TERI, New Delhi ISBN:9788179935736

Course Outcomes:

After completing the course the student will be able to:

1. Identify the components of Solar PV and CS, wind power, micro hydro and biomass-based power plants and know their functions.
2. Maintain the working of solar PV and CS power plants.
3. Maintain the working of large wind power plants.
4. Maintain the working of small wind turbines.
5. Maintain the working of micro hydro power plants.
6. Maintain the working of biomass-based power plants.
7. Identify the troubleshooting of the above plants.

END SEMESTER EXAMINATION SCHEME (Renewable Energy Power Plants) – 60 Marks

GROUP	UNIT	OBJECTIVE QUESTIONS (20) (One/Two Sentences, MCQ)				SUBJECTIVE QUESTIONS (40)			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	11	20	1	1 X 20 =20	5	5 (Taking at least two from each group)	8	8 X 5 = 40
B	4,5	11				4			

Note: Paper-setter should take into account of each unit and set the paper accordingly so that all units get equal importance.

Semester : Sixth
Course Code : REEPC304
Course Title : Renewable Energy Power Plants Laboratory
Number of Credit: 1 (L- 0; T- 0; P- 2)
Prerequisite: Nil
Course Category: PC
Course objectives: 1. To know the working of the components of Solar PV and CS, wind power, and biomass-based power plants. 2. To maintain the efficient operation of various types of renewable energy power plants.
List of Practicals: (At least Eight experiments are to be performed)
1. Set up the solar PV plant to produce electricity.
2. Set up the wind power plant of with a Small Wind Turbine to produce electricity.
3. Set up the Biogas power plant to produce electricity.
4. Integrate electrical power from solar PV plant, wind power plant and biogas power plant.
5. Apply the integrated power from different sources to Microgrid system.
6. Identify the troubleshooting of Microgrid system components.
7. Identify the routine maintenance parts of Microgrid system.
8. Identify the troubleshooting of solar PV plant.
9. Identify the troubleshooting of wind power plant.
10. Identify the troubleshooting of biogas power plant.
Course Outcomes: After completing the course the student will be able to: 1. Identify the components of Solar PV and CS, wind power, micro hydro and biomass-based power plants and know their functions. 2. Maintain the working of solar PV and CS power plants. 3. Maintain the working of large wind power plants

4. Maintain the working of biomass-based power plants.
5. Maintain the working of Microgrid system.
6. Identify the troubleshooting of the solar PV, wind power, biomass-based power plants.

EXAMINATION SCHEME (Renewable Energy Power Plants Laboratory) – 100 Marks
1. Internal Assessment (60 Marks): Evaluation is based on – **Work done-30, Quality of report & Presentation-15, Performance in Viva-voce-15.**
2. End Semester Examination (40 Marks): Evaluation is based on – **Work done -15, Quality of report & Presentation-15, Performance in Viva-voce-10.**

Semester : Sixth
Course Code : HS302
Course Title : Entrepreneurship & Start-ups
Number of Credit: 4 (L- 3; T- 1; P- 0)
Prerequisite: Nil
Course Category: HS
Course Objectives: 1. To acquire entrepreneurial spirit and resourcefulness. 2. To familiarize with various uses of human resource for earning dignified means of living. 3. To understand the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation. 4. To acquire entrepreneurial quality, competency, and motivation. 5. To learn the process and skills of creation and management of entrepreneurial venture. 6. To apply entrepreneurial skill for the interest of individual and the nation.

Course Contents (Theory):	
Unit : 1	**1. Introduction to Entrepreneurship and Start – Ups:** 1.1 Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation. 1.2 Types of Business Structures, Similarities/differences between entrepreneurs and managers.
Unit : 2	**2. Business Ideas and their implementation:** 2.1 Discovering ideas and visualizing the business. 2.2 Activity map. 2.3 Business Plan.
Unit : 3	**3. Idea to Start-up:** 3.1 Market Analysis – Identifying the target market. 3.2 Competition evaluation and Strategy Development. 3.3 Marketing and accounting. 3.4 Risk analysis.
Unit : 4	**4. Management:** 4.1 Company's Organization Structure. 4.2 Recruitment and management of talent. 4.3 Financial organization and management.
Unit : 5	**5. Financing and Protection of Ideas:** 5.1 Financing methods available for start-ups in India. 5.2 Communication of Ideas to potential investors – Investor Pitch. 5.3 Patenting and Licenses.
Unit : 6	Exit strategies for entrepreneurs, bankruptcy, and succession.

Text / Reference Books:

Sl. No.	**Titles of Book**	**Name of Author**	**Name of Publisher**
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607
3.	Demand: Creating What People Love	Adrian J.	Headline Book Publishing

	Before They Know They Want It	Slywotzky with Karl Weber	ISBN – 978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvard business ISBN: 978-142219602

SUGGESTED SOFTWARE / LEARNING WEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatestructure/
c. https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

Course Outcomes:

After completing the course the student will be able to:

1. Acquire entrepreneurial spirit and resourcefulness.
2. Familiarize with various uses of human resource for earning dignified means of living.
3. Understand the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquire entrepreneurial quality, competency, and motivation.
5. Learn the process and skills of creation and management of entrepreneurial venture.
6. Apply entrepreneurial skill for the interest of individual and the nation.

END SEMESTER EXAMINATION SCHEME (Entrepreneurship & Start-ups) – 60 Marks

GROUP	UNIT	OBJECTIVE QUESTIONS (20) (One/Two Sentences, MCQ)				SUBJECTIVE QUESTIONS (40)			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	11	20	1	1 X 20 =20	5	5 (Taking at least two from each group)	8	8 X 5 = 40
B	4,5,6	11				4			

Note: Paper-setter should take into account of each unit and set the paper accordingly so that all units get equal importance.

Semester : Sixth
Course Code : REEOE302
Course Title : Open Elective – II (To be chosen from Open Elective List)
Number of Credit: 3 (L- 3; T- 0; P- 0)
Prerequisite: Nil
Course Category: OE

Semester : Sixth
Course Code : REEOE304
Course Title : Open Elective – III (To be chosen from Open Elective List)
Number of Credit: 3 (L- 3; T- 0; P- 0)
Prerequisite: Nil
Course Category: OE

Semester : Sixth	
Course Code : AU302	
Course Title : Indian Constitution	
Number of Credit: 0 (L- 2; T- 0; P- 0)	
Course Category: AU	
Course Contents (Theory):	
Unit : 1	**1. The Constitution – Introduction:** 1.1 The History of the Making of the Indian Constitution

	1.2 Preamble and the Basic Structure, and its interpretation 1.3 Fundamental Rights and Duties and their interpretation 1.4 State Policy Principles
Unit : 2	**2. Union Government:** 2.1 Structure of the Indian Union 2.2 President – Role and Power 2.3 Prime Minister and Council of Ministers 2.4 Lok Sabha and Rajya Sabha
Unit : 3	**3. State Government:** 3.1 Governor – Role and Power 3.2 Chief Minister and Council of Ministers 3.3 State Secretariat
Unit : 4	**4. Local Administration:** 4.1 District Administration 4.2 Municipal Corporation 4.3 Zila Panchayat
Unit : 5	**5. Election Commission:** 5.1 Role and Functioning 5.2 Chief Election Commissioner 5.3 State Election Commission

Text / Reference Books:

Sl. No.	Titles of Book	Name of Author	Name of Publisher
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

Semester : Sixth
Course Code : PR302
Course Title : Major Project
Number of Credit: ^ 4 (L- 0; T- 0; P- 6)
Course Category: PR
Course Contents :
Major Project will be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup. **^ One credit is carried forward from the 5th. Semester major project evaluation.**

EXAMINATION SCHEME (Major Project) – 200 Marks
1. Internal Assessment (120 Marks): Evaluation is based on – **Work done-60, Quality of report & Presentation-30, Performance in Viva-voce-30.**
2. End Semester Examination (80 Marks): Evaluation is based on – **Work done -30, Quality of report & Presentation-30, Performance in Viva-voce-20.**

Semester : Sixth
Course Code : SE302
Course Title : Seminar
Number of Credit: 1 (L- 1; T- 0; P- 0)
Course Category: SE
Course Contents :
Seminar will be based on Technical topics related with any departmental subject from 3rd. Semester to 6th. Semester. Presentation will be prepared in Power Point Slides. Presentation will be followed by Questionnaire session. Marks of Questionnaire session will be based on Student's answer of the questions from experts / examiners and audience. **Each student will present at least two seminars throughout the semester.**

EXAMINATION SCHEME (Seminar) – 100 Marks
1. Internal Assessment (100 Marks): Evaluation is based on – **Work done-40, Quality of report & Presentation-40, Performance in Questionnaire Session-20.** **Total marks will be divided among the number of seminars.**
