MAHATMA GANDHI UNIVERSITY

KOTTAYAM

B. Voc. DEGREE PROGRAMME

IN

RENEWABLE ENERGY MANAGEMENT

REGULATION, SCHEME AND SYLLABUS

(2019 ADMISSION ONWARDS)

REGULATION SCHEME AND SYLLABUS FOR B. Voc. PROGRAMME UNDER

MAHATMA GANDHI UNIVERSITY

(2019 admissions onwards)

INTRODUCTION:

The University Grants Commission (UGC) has launched a scheme on skills development based higher education as part of college/university education, leading to Bachelor of Vocation (B. Voc.) Degree with multiple exits such as Diploma/ Advanced Diploma under the NSQF (National skill Qualifications framework). The B. Voc. The programme is focused on universities and colleges providing undergraduate studies which would also incorporate specific job roles along with broad based general education. This would enable the graduates completing B. Voc. to make a meaningful participation in accelerating India's economy by gaining appropriate employment, becoming entrepreneurs and creating appropriate knowledge.

OBJECTIVES:

The B. Voc – Renewable Energy Management is designed with the following objectives:-

- To provide judicious mix of skills relating to a profession and appropriate content of general education.
- To ensure that the students have adequate knowledge and skills, so that they are work ready at each exit point of the programme.
- To provide flexibility to students by means of pre-defined entry and multiple exit points.
- To integrate NSQF within the undergraduate level of higher education in order to enhance the employability of the graduates and meet industry requirements. Such graduates apart from meeting the needs of local and national industry are also expected to be equipped to become part of the global workforce.
- To provide vertical mobility to students coming out of:

  10+2 with vocational subjects.

  Community Colleges.

ELIGIBILITY FOR ADMISSION

The eligibility condition for admission to B. Voc programme shall be 10+2 or equivalent. Eligibility of admission, Norms for admission, reservation of seats for various B. Voc Programmes shall be according to the rules framed by the University from time to time.

CURRICULUM

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

ELIGIBILITY FOR HIGHER STUDIES

Those who pass B. Voc Renewable Energy Management Degree are eligible for admission to Master Degree in the relevant field, as per the concerned eligibility norms.

PROGRAMME STRUCTURE

The B. Voc Renewable Energy Management shall include:

- General Education Components
- Skill Components
- Project
- Hands-on training (HOT)
- On-Job Training (OJT)
- Soft Skills and Personality Development Programmes

CREDIT CALCULATION

- One Credit would mean equivalent of 15 periods of 60 minutes each, for theory, workshops/labs and tutorials;

PREAMBLE

We are facing unprecedented challenges – Skill and knowledge, the driving forces of economic growth and social development for any country. Presently, the country faces a demand – supply mismatch, as the economy needs more 'skilled' workforce than that is available. In the higher education sphere, knowledge and skills are required for diverse forms of employment in the sector of education, health care manufacturing and other services. Potentially, the target group for skill development comprises all those in the labour force, including those entering the labour market for the first time, those employed in the organized sector and also those working in the unorganized sector. Government of India, taking note of the requirement for skill development among students launched National Vocational Education Qualification Framework (NVEQF) which was later on assimilated into National Skills Qualifications Framework (NSQF). Various Sector Skill Councils (SSCs) are developing Qualification Packs (QPs), National Occupational Standards (NOSs) and assessment mechanisms in their respective domains, in alignment with the needs of the industry.

The University Grants Commission (UGC) has launched a scheme on skills development based higher education as a part of college/university education, leading to Bachelor of Vocation (B. Voc.) Degree with multiple exits such as, Diploma/Advanced Diploma under the NSQF (National skill Qualifications framework). The B. Voc. programme is focused on universities and colleges providing undergraduate studies which would also incorporate specific job roles along with broad based general education. This would enable the graduates completing B. Voc. to make a meaningful participation in accelerating India's economy by gaining appropriate employment, becoming entrepreneurs and creating appropriate knowledge. The proposed vocational programme will be a judicious mix of skills, professional education related to concerned vocation and also appropriate content of general education.

The **Mahatma Gandhi University** gave a strong momentum to the initiatives of UGC-NSQF in the very beginning itself. This University provides opportunities to its affiliating colleges since Academic Year 2014-15 to start skill based vocational Graduate programmes strictly under the guidelines of UGC and NSQF.

1. TITLE

These regulations shall be called "**MAHATMA GANDHI UNIVERSITY REGULATIONS FOR B. Voc PROGRAMME 2018".**

2. SCOPE

Applicable to all regular B. Voc Programme conducted by the University with effect from 2018 admissions onwards, except for B. Voc. Programmes, having scheme and syllabus already approved by MGU under 2014 regulation and scheme.

During the academic year 2019-20 admission onwards, all regular B. Voc Programme in affiliating colleges under MG University should strictly follow *Mahatma Gandhi University Regulations For B. Voc Programme 2018*.

3. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University and UGC in this regard, from time to time.

4. TYPE OF COURSES AND AWARDS:

There will be full time credit-based modular programmes, wherein banking of credits for skill and general education components shall be permitted so as to enable multiple exit and entry.

The multiple entry and exit enables the learner to seek employment after any level of Award and join back as and when feasible to upgrade qualifications / skill competencies either to move higher in the job profile or in the higher educational system. This will also provide the learner an opportunity for vertical mobility to second year of B. Voc degree programme after one year diploma and to third year of B. Voc degree programme after a two year advanced diploma. The students may further move to Masters and Research degree programmes mapped at NSQF Level 8 – 10.

5. CURRICULA AND CREDIT SYSTEM FOR SKILL BASED COURSES

In order to make education more relevant and to create 'industry fit' skilled workforce, the institutions recognized under B. Voc Degree programme offering skill based courses will have to be in constant dialogue with the industry and respective Sector Skill Councils (SSC's) so that they remain updated on the requirements of the workforce for the local economy. These institutions should also preserve and promote the cultural heritage of the region, be it art, craft, handicraft, music, architecture or any such thing, through appropriately designed curriculum leading to gainful employment including self-employment and entrepreneurship development.

The curriculum in each of the semester/years of the programme(s) will be a suitable mix of general education and skill development components. The General Education Component shall have 40% of the total credits and balance 60% credits shall be of Skill Component.

The institution(s) shall prepare draft curriculum as per the UGC guidelines for Curricular Aspects Assessment Criteria and Credit System for Skill based Vocational Courses and place it for vetting by the UGC Advisory Committee constituted under these guidelines.

The Curriculum shall be finally approved by the Board of Studies (BoS) and Academic Council of the University / Autonomous College. The Universities where BoS for Vocational subjects has not yet been constituted, the curriculum may be considered by the BoS in allied subject area or an ad-hoc BoS may be constituted till the time regular BoS is notified in the university. The BoS should consider the programme wise curriculum based QP for skill component and relevant general education subjects *i.e.* the curricula for programmes in one broad subject area may vary from institution to institution in case the different progressive QPs are mapped with the programmes being offered. The choice of different progressive Job roles for a course may also be enabled under CBCS.

6. STRUCTURE OF THE PROGRAMME

6.1 Skill Development Components - 60% Weight age

6.2 General Education Component - 40% Weight age

The B. Voc Programme should comprise 60% Skill Development Components (60 % of total Credit) and 40% General Education Component (40% total Credit) as per guidelines of UGC and NSQL.

As an illustration, awards shall be given at each stage as per Table 1 below for cumulative credits awarded to the learners in skill based vocational courses.

Table 1

NSQF Level	Skill Component Credits	General Education Credits	Total Credits for Award	Normal Duration	Exit Points / Awards
7	108	72	180	Six Semesters	B. Voc Degree
6	72	48	120	Four semesters	Advanced Diploma
5	36	24	60	Two semesters	Diploma
4	18	12	30	One semester	Certificate

7. SCHEME AND SYLLABUS

7.1 B. Voc Programme should include (**a)** General Education Component, (**b**) Skill Education Component

7.2 The B. Voc Programme should followed Credit and Semester System of MGU.

7.3 A separate minimum of 30% marks each for internal and external (for both theory and AOC) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, **Grade P** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **P Grade** or above within the permitted period.

8. ASSESSMENT AND EVALUATION BY MG UNIVERSITY.

General Education Components and Skill Development Components shall be assessed and evaluated by MG University as per University Norms and UGC-NSQF guidelines.

9. ASSESSMENT AND CERTIFICATION BY SECTOR SKILL COUNCIL (SSC)

The affiliated colleges should make necessary arrangements for the simultaneous assessments and certification of Skill Development Component by aligned SSC having the approval of National Skill Development Corporation of India (NSDC).

10. EXAMINATIONS

10.1 The evaluation of each paper shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

10.2 The internal to external assessment ratio shall be 1:4.

Both internal and external marks are to be rounded to the next integer. All the courses (theory practical & AOC), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	O (Outstanding)	10
90 to below 95	A+ (Excellent)	9
80 to below 90	A (Very Good)	8
70 to below 80	B+ (Good)	7
60 to below 70	B (Above Average)	6
50 to below 60	C (Average)	5
40 to below 50	P (Pass)	4
Below 40	F(Fail)	0
	Ab (Absent)	0

11. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a paper is calculated using the formula:-

CP = C × GP, where C is the Credit and GP is the Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course. TC is the total credit of that category of course

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	**Grade**	
9.5 and above	**O**	**Outstanding**
9 to below 9.5	**A+**	**Excellent**
8 to below 9	**A**	**Very Good**
7 to below 8	**B+**	**Good**
6 to below 7	**B**	**Above Average**
5 to below 6	**C**	**Average**
4 to below 5	**P**	**Pass**
Below 4	**F**	**Failure**

12. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

For all Theory Courses

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

Components of Internal Evaluation – Theory	**Marks**
Attendance	5
Assignment/ Seminar/ Viva	5
Test paper(s) (1 or 2) (1×10 =10; 2×5 =10)	10
Total	20

For all AOC Courses total marks for external evaluation is 80 and total marks for internal evaluation is 20.

For all AOC Courses

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

Components of Internal Evaluation – AOC	**Marks**
Attendance	5
Record	5
Skill Test	5
Lab Performance / Punctuality	5
Total	20

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory.

12.1 Project Evaluation

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

Components of Internal Evaluation	Marks
Punctuality	5
Experimentation/Data Collection	5
Skill Acquired	5
Report	5
Total	**20**

*Marks for dissertation may include study tour report if proposed in the syllabus.

Components of External Evaluation	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

(Decimals are to be rounded to the next higher whole number)

12.2 Internship

After the completion of every even semester, the student will undergo a minimum of two weeks Internship Programme in an Industry, having a good exposure in the concerned skill (Established at least two years prior), capable of delivering the skill sets to the students. At the end of the Internship, the students should prepare a comprehensive report.

12.3 Attendance Evaluation For All Papers

Attendance Percentage	Marks
Less than 75 %	1 Mark
75 % & less than 80%	2 Marks
80% & less than 85%	3 Marks
85% & less than 90%	4 Marks
90% & above	5 Marks

(Decimals are to be rounded to the next higher whole number)

12.4 Assignments

Assignments are to be done from 1st to 4th Semesters. At least one assignment per course per semester should be submitted for evaluation.

12.5 Internal Assessment Test Papers

Two test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

12.6 Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Department Level:

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

Level 2: **College level**

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

Level 3: **University Level**

A Committee constituted by the Vice-Chancellor as Chairman, Pro-Vice-Chancellor, Convener - Syndicate Standing Committee on Students Discipline and Welfare, Chairman-Board of Examinations as members and the Controller of Examination as member-secretary.

The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of first semester.

The internal evaluation marks/grades in the prescribed format should reach the University before the 4th week of October and March in every academic year.

12.7 External Examination

The external examination of all semesters shall be conducted by the University at the end of each semester.

- Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission.
- Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also.

- Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch.
- There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch.
- Student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.
- A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.
- A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the University examination for the same semester, subsequently.

13 PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

13.1 Pattern Of Questions For External Examination – Theory Paper

Question Type	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
Very short answer type	12	10	2	20
Short answer (Not to exceed 60 words)	9	6	5	30
Long essay	4	2	15	30
TOTAL	**25**	**18**		**80**

13.2 Pattern Of Questions For External Examination – AOC

Question Type	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
Theory Assessment- Short Answer Type	8	5	4	20
Skill Assessment- Practical	1	1	60	60
TOTAL	**9**	**6**		**80**

13.3 Mark Division For External AOC/ LAB Examination

Record	Theory/ Procedure/ Design	Activity/ Neatness	Result	Viva	Total
10	10	20	10	10	60

14. RANK CERTIFICATE

The University publishes rank list of top 10 candidates for each programme after the publication of 6th semester results. Rank certificate shall be issued to candidates who secure positions from 1st to 3rd in the rank list. Candidates who secure positions from fourth to tenth in the rank list shall be issued position certificate indicating their position in the rank list.

Candidates shall be ranked in the order of merit based on the CGPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

15. MARK CUM GRADE CARD

The University shall issue to the students grade/marks card (by online) on completion of each semester, which shall contain the following information:

- Name of University
- Name of the College
- Title & Model of the B. VOC Programme
- Semester concerned
- Name and Register Number of student
- Code, Title, Credits and Max. Marks (Int, Ext & Total) of each course opted in the semester
- Internal marks, External marks, total marks, Grade, Grade point (G) and Credit point in each course in the semester
- Institutional average of the Internal Exam and University Average of the External Exam in each course.
- The total credits, total marks (Max & Awarded) and total credit points in the semester (corrected to two decimal places)
- Semester Credit Point Average (SCPA) and corresponding Grade
- Cumulative Credit Point Average (CCPA)

The final Grade/mark Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme and shall include the final grade/marks scored by the candidate from 1st to 5th semester, and overall grade/marks for the total programme.

16. READMISSION

Readmission will be allowed as per the prevailing rules and regulations of the university.

There shall **be 3 level monitoring** committees for the successful conduct of the scheme. They are:

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior-most teachers as members.
2. College Level Monitoring Committee (CLMC), comprising Principal, Dept. – Co- Ordinator and A.O/Superintendent as members.
3. University Level Monitoring Committee (ULMC), headed by the Vice – Chancellor and Pro–Vice – Chancellor, Conveners of Syndicate subcommittees on Examination, Academic Affairs and Staff and Registrar as members and the Controller of Examinations as member-secretary.

17. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice Chancellor shall, for a period of one year from the date of coming into force of these regulations shall be applied to any programme with such modifications may be necessary.

PROGRAMME SUMMARY OF B.Voc -Renewable Energy Management

SEMESTER 1

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG101	General	Listening and Speaking Skills in English	4	60	3	20	80
REMTG102	General	Mathematics	4	60	4	20	80
REMTS103	Skill	Basic Electrical and Electronics	6	90	5	20	80
REMTS104	Skill	Fundamentals of sustainable energy and development	6	90	5	20	80
REMPS105	Skill	*Practical- General Physics Lab*	6	90	5	20	80
REMPG106	General	*Practical- Introduction to Computers*	4	60	3	20	80

SEMESTER 2

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG201	General	Writing and Presentation Skills in English	4	60	4	20	80
REMTG202	General	Fundamentals of Electrochemistry	4	60	4	20	80
REMTS203	Skill	Photovoltaic Module Installation	6	90	6	20	80
REMPG204	General	*Practical- Computer Application Lab: MATLAB*	4	60	5	20	80
REMPS205	Skill	*Practical- Electronics and Photovoltaic module installation*	6	90	6	20	80
REMHOTS206	Skill	**Hands On Training**	6	90		20	80

SEMESTER 3

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
REMTG301	General	Water and Wastewater Treatment	4	60	3	20	80
REMTG302	General	Operation and maintenance of Solar PV systems	4	60	4	20	80
REMTG303	General	Solar Thermal Technology	4	60	3	20	80
REMTS304	Skill	Wind Energy	6	90	5	20	80
REMPS305	Skill	*Practical- Thermodynamics and Solar Thermal*	6	90	5	20	80
REMPS306	Skill	*Practical- Fluid dynamics and Wind Energy*	6	90	5	20	80

SEMESTER 4

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
REMTG401	General	Planning and Installing Solar Thermal Systems	4	60	4	20	80
REMTG402	General	Waste to Energy Conversion	4	60	4	20	80
REMTG403	General	Bioenergy	4	60	5	20	80
REMTS404	Skill	Energy Storage Systems	4	60	6	20	80
REMPS405	Skill	*Practical- Solar Photovoltaics and Energy Storage Systems*	4	60	6	20	80
REMOJTS406	Skill	**On Job Training**	10	150		20	80

SEMESTER 5

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG501	General	Environmental Studies	4	60	3	20	80
REMTG502	General	Material Science for Energy Applications	4	60	3	20	80
REMTS503	Skill	Energy Conservation Techniques	6	90	5	20	80
REMTG504	General	Industrial Health and Safety	4	60	4	20	80
REMPS505	Skill	*Practical- Advanced Solar Photovoltaic Lab*	6	90	5	20	80
REMPS506	Skill	*Practical- Advanced Solar Thermal Lab-I*	6	90	5	20	80

SEMESTER 6

Course Code	Component	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BRCTG601	General	Project Management and Entrepreneurship	4	60	5	20	80
REMTG602	General	Energy Management and Auditing	4	60	6	20	80
REMTG603	General	Grid Integration	4	60	7	20	80
REMPS604	Skill	*Practical- Renewable Energy System Design Using software*	6	90	7	20	80
REMTPVS605	Skill	**Industrial Training, Final Project Report and Viva**	12	180		20	80

DETAILED SYLLABUS
SEMESTER I

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG101	Listening and Speaking Skills in English	4	60	3	20	80
REMTG102	Mathematics	4	60	4	20	80
REMTS103	Basic Electrical and Electronics	6	90	5	20	80
REMTS104	Fundamentals of sustainable energy and development	6	90	5	20	80
REMPS105	*Practical- General Physics Lab*	6	90	5	20	80
REMPG106	*Practical- Introduction to Computers*	4	60	3	20	80

SEMESTER – I

BOCG101 LISTENING AND SPEAKING SKILLS IN ENGLISH

General paper 1

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

Aim:

To develop learner's ability to express themselves through speech.

Objectives:

- To improve students' listening skill in getting the gist of the text and reconstruct it
- To improve students' listening activity
- To enhance the speaking level of the student
-

MODULE – I **(10 hrs.)**

Speech Sounds: Phonemic symbols – Vowels – Consonants – Syllables – Word stress – Stress in polysyllabic words – Stress in words used as different parts of speech – Sentence stress –Weak forms and strong forms – Intonation

Sample activities:

1- *Practice reading aloud. Use a variety of texts including short stories, advertisement matter, brochures, etc.*
2- *Read out a passage and ask the students to identify the stressed and unstressed syllables.*

MODULE – II **(15 hrs.)**

Basic Grammar: Articles - Nouns and prepositions - Subject-verb agreement -
Phrasal verbs - Modals - Tenses - Conditionals – Prefixes and suffixes – Prepositions -Adverbs – Relative pronouns - Passives - Conjunctions - Embedded questions - Punctuation –Abbreviations-concord- collocations-phrasal verbs- idiomatic phrases

Sample activities:

1- *Ask students to write a story/report/brochure, paying attention to the grammar.*

MODULE – III **(10 hrs.)**

Listening: Active listening – Barriers to listening – Listening and note taking – Listening to announcements – Listening to news on the radio and television.

Sample activities:

1- *Information gap activities (e.g. listen to a song and fill in the blanks in the lyrics given on a sheet)*
2- *Listen to BBC news/ a play (without visuals) and ask the students to report what they heard*.

MODULE– IV **(15 hrs.)**

Speaking- Fluency and pace of delivery – Art of small talk – Participating in conversations – Making a short formal speech – Describing people, place, events and things – Group discussion skills, interview skills and telephone skills.

Sample activities:

1- *Conduct group discussion on issues on contemporary relevance.*
2- *Ask students to go around the campus and talk to people in the canteen, labs, other departments etc. and make new acquaintances.*
3- *Conduct mock interviews in class.*
4- *Record real telephone conversations between students and ask them to listen to the recordings and make the corrections, if any are required.*

MODULE – V **(10 hrs.)**

Reading: Theory and Practice – Scanning – Surveying a textbook using an index – reading with a purpose – Making predictions – Understanding text structure – Locating main points –Making inferences – Reading graphics – Reading critically – Reading for research.

Books for Reference:

1. V.Sasikumar, P KiranmaiDutt and GeethaRajeevan,. Communication *Skills in English*.Cambridge University Press and Mahatma Gandhi University.
2. Marilyn Anderson, Pramod K Nayar and Madhucchandra Sen. *Critical Thinking,Academic Writing and Presentation Skills*. Pearson Education and Mahatma Gandhi University.

For Further Activities

1. *A Course in Listening and Speaking I & II,* Sasikumar, V.,KiranmaiDutt and GeethaRajeevan, New Delhi: CUP, 2007
2. *Study Listening: A Course in Listening to Lectures and Note-taking* Tony Lynch New Delhi: CUP,2007.
3. *Study Speaking: A Course in Spoken English for Academic Purposes.* Anderson, Kenneth, Joan New Delhi: OUP, 2008

REMTG102 MATHEMATICS

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

AIM

To acquire fundamental knowledge to build mathematical structure and quantitative analysis of various data.

OBJECTIVES

- Apply mathematical concepts and principles to perform computations.
- Apply mathematics to solve problems.
- Create, use and analyse graphical representations of mathematical relationships.

MODULE 1 **(15 hrs.)**

Sets and Functions

Power set of a set, Product of two sets, Equivalence relations, partitions of sets, Equivalence classes Definition of a function. Domain, co- domain and the range of a function. Review of injective, surjective and bijective functions, Composition of functions. Invertible functions and the inverse of a function. Graphing of functions.

References:

1. Set Theory and Related Topics, LipSchutz, Schaum Outline Series, 2009, 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi.
2. Discrete Mathematics and its Applications, K. H. Rosen, 6th Edition, Tata McGraw Hill Publishing Company, New Delhi.

MODULE 2 **(15 hrs.)**

Theory of Matrices

Definition, Types of Matrices, Operations on Matrices, Transpose of a Matrix, Elementary Transformations of a Matrix, Invertible Matrices, Finding Rank and Inverse of a Matrix using elementary row transformations.

References:

1. Matrices: Schaum's Outline Series, Frank Ayres Jr., TMH Edition.
2. A Text Book of Matrices, Shanthi Narayanan and P. K. Mittal, S. Chand Publications.
3. Matrix Theory, David W. Lewis, Allied Publications.

MODULE 3 **(10hrs.)**

Limit, Continuity and Differentiability

Limits of Functions, calculating limits using the limit laws, one sided limits and limits at infinity, Continuity, Rates of change and Differentiability, standard results, Differentiation Rules, Chain Rule.

Applications of Derivatives
Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test. (Proofs Excluded)

Partial Derivatives

Functions of several variables (Definition only), Partial derivatives, The Chain Rule.

Reference

1. Thomas' Calculus, George B. Thomas Jr., 2008, 11th Edition, Pearson. (Sections 2.1 to 2.6 and 3.1 to 3.2)

2. Thomas' Calculus, George B. Thomas Jr., 2008, 11th Edition, Pearson. (Sections 4.1 to 4.3)

3. Thomas' Calculus, George B. Thomas Jr., 2008, 11th Edition, Pearson. (Sections 14.3 to 14.4)

MODULE 4 **(20 hrs.)**

Statistical Methods of Analysis

Types of data: - quantitative, qualitative. Classification and Tabulation. Diagrammatic representation: - Bar diagram, pie diagram; pictogram and cartogram. Graphical representation: - histogram; frequency polygon; frequency curve; ogives. Measures of Central Tendency: - Mean; Median; Mode; Geometric Mean; Harmonic Mean and Properties. Absolute and Relative measures of Dispersion: - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation.

Numerical Analysis

Bisection Method, Method of False Position, Iteration Method, Newton-Raphson Method.

References:

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).

2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

4. ParimalMukhopadhyay: Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta

5. Murthy M.N.: Sampling theory and Methods, Statistical

6. Introductory Methods of Numerical Analysis, S. S. Sastry, 4th Edition, PHI (Sections 2.2 to 2.5)

REMTS103 BASIC ELECTRICAL AND ELECTRONICS

No. of credits: 6 **No. of contact hours: 90 (5 hours per week)**

AIM

To provide awareness on basics of Electrical and Electronics essential in Renewable Energy Systems

OBJECTIVES

- To expose the students to the basics of units, measurements and electrical circuits
- To expose the students to various electronic components, its working and some of the applications

MODULE 1 **(25 hrs.)**

Measurements: Units Necessity of measurement, concept of unit of a physical quantity, requirements of standard unit, Various system of units (CGS, MKS, SI, FPS), fundamental and derived physical quantities
Measuring instruments: Measurement of time – water clocks – sundials – pendulum clocks – digital clocks – atomic clocks -Length measurements – rulers – standard meter – micrometer – screw gauges – travelling microscopes – laser range finder – sonar – GPS-Electrical measurements – Working principle of galvanometer – voltmeter – ammeter and digital multimeters

Reference
Fundamentals of Physics; David Halliday & Robert Resnick; 2010; John Wiley & Sons

MODULE 2 **(25 hrs.)**

Fundamentals of Electric circuits

Electric current -Electromotive force – Electric potential & Potential difference -Resistance-Factors affecting resistance- Conductance-Ohm's law -Kirchoff's current and voltage laws - Electric circuits and classification – Electrical work, power and energy

AC – Advantages of AC-Production of ac voltage – Frequency- Period- Average and RMS values-Form factor- power factor-measurement of power in AC circuit-AC watt meter- Distribution of three phase current: star connection – delta connection

MODULE 3 **(20 hrs.)**

Semiconductor Diode: Types of semiconductors – P & N Types – charge carriers – P & N junction theory-VI characteristics –ideal diode -Rectifiers-types of rectifiers- Filters-C, LC and π – Regulators (*basics only*) – Zener diode -voltage Regulator, Series voltage Regulator Different types of filters-clipping and clamping circuits –LED-7-segment –Photodiode-LDR.

MODULE 4 **(20 hrs.)**

Resistors: Fixed and Variable type (preliminary ideas) - Colour Code of Standard Resistors.
Capacitors: Fixed and Variable type, Colour Coding of capacitors.
Cables/Wires: Types: flexible, hook-up, coaxial and fiber optic. Multi-core Power and Control cables.
Switches: Different Types: Slide, Toggle, Push to ON, Push to OFF, Rocker: - Their applications
Relays: Construction, rating & working principle of general purpose relay, Reed relay.

Reference

1. Basic Electrical and Electronics Engineering by R.K. Rajput, Laxmi publications (P) Ltd.
2. Basics of Electrical and Electronics Engineering by Uday A. Baksh, Technical publications
3. Basic Electronics- Solid state; BL Thereja; 2005; S. Chand & Co.
4. Instrumentation devices and systems, C.S Rangan, G.R. Sharma, V.S.V. Mani, Tata McGraw–Hill

REMTS104 FUNDAMENTALS OF SUSTAINABLE ENERGY AND DEVELOPMENT

No. of credits: 6 **No. of contact hours: 90 (5 hours per week)**

Aim:
Provide an overview of the different renewable energy technologies and their applications.

Objectives:
- Understand the difference between renewable and non-renewable energies
- Create awareness in understanding the types of renewable energy benefits of harvesting renewable energy
- Understand the characteristics and operations of each type of renewable energy
- Become aware of the importance of renewable energy generation

MODULE 1 **(15hrs.)**

Introduction to Energy Sources

Energy sources and their availability- Conventional energy sources- Renewable energy sources- Need of renewable energy sources

Reference
1. Non-conventional energy sources; G.D. Rai; 2011; Fifth Edition, Khanna Publishers

MODULE 2 **(25hrs.)**

Solar Energy

Potential of Solar Energy-solar radiation and Measurement-types of solar energy collectors -Solar water heating systems- Solar air heating and cooling systems -Solar thermal electric conversion- Solar photovoltaic system -Other applications of solar energy like distillation, pumping, furnace, green house.

References

1. Non-conventional energy sources; G.D. Rai; 2011; Fifth Edition, Khanna Publishers
2. Non-conventional Energy Sources and Utilization (Energy Engineering); R.K. Rajput; 2012; First Edition.; S. Chand & Company Ltd.

MODULE 3 **(25hrs.)**

Biomass and Biogas energy

Introduction – usable forms of biomass, their composition and fuel properties -Biomass conversion technologies- Biomethanation: Phases in biogas production, Parameters affecting biogas Production - Classification of biogas plants – Types of biogas plants- Methods for maintaining biogas production

Reference
- Non-conventional energy sources; G.D. Rai; 2011; Fifth Edition, Khanna Publishers.
- Solar Thermal and Biomass Energy; G. Lorenzini, C. Biserni& G. Flacco; 2010; First Edition; WIT Press, UK.

MODULE 4 **(25hrs.)**

Wind Energy

Scope for Wind energy in India- Basic principles of wind energy conversion- Site selection considerations- Basic components of wind energy conversion system -Types of wind machines- Performance of Wind machines- Application of Wind Energy- Solar wind hybrid system

Other sources of sustainable energy

Tidal Energy- Geothermal Energy- Magnetohydrodynamic energy- Chemical energy sources - Hydrogen Energy

References

1. Non-conventional energy sources; G.D. Rai; 2011; Fifth Edition, Khanna Publishers
2. Non-conventional Energy Sources and Utilization (Energy Engineering); R.K. Rajput; 2012; First Edition.; S. Chand & Company Ltd.

REMPS105 PRACTICAL- GENERAL PHYSICS LAB

No. of credits: 6 **No. of contact hours: 90 (5 hours per week)**

Aim:
To allow students to witness the concepts and physical laws

Objectives:
- To expose students to elementary laboratory techniques
- To identify physical concepts in their everyday experience.
- To develop habits and practices that minimize uncertainty in physical measurements.

List of Experiments

1. Spectrometer-Angle of prism

2. Symmetric compound pendulum

3. Verification of Ohm's law

4. Conversion of Galvanometer into voltmeter

5. Determination of the end correction of a meter bridge

6. Determination of the specific resistance of the material of a wire using meter bridge

7. Measurement of average resistance per unit length of a wire using Carey Foster's bridge

8. Potentiometer-Calibration of a low range voltmeter

9. Potentiometer-Calibration of a low range ammeter

10. Potentiometer-Measurement of e.m.f. of a cell

11. Series LCR circuit-frequency response

REMPG106 PRACTICAL- INTRODUCTION TO COMPUTERS

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

Aim:

- To educate students to analyze, design, integrate, and manage information systems using information technology.

Objective:

- Hands-On Practice Helps Students Master IT Skills

BASICS OF COMPUTER ARCHITECTURE AND NETWORKING

1. Knowledge of hardware that goes in the making of a computer: Assembling of PC.
2. Installation of OS, setting up of dual boot, installation of hardware and software.
3. Hands on experience on the basic utilities in computers.
4. Execution of File handling commands in DOS Prompt.
5. Learning the methodology of accessing websites and Online resources through the Internet

OFFICE AUTOMATION SOFTWARE

Note: students can use version of office from office 2007 onwards

1. Prepare a sales invoice using Excel.

Use the template below and create your own invoice for purchased products. You must include sales tax, discount percentages and at least four items in your invoice. Do all the formulas, required. Format the invoice is:

Item	Quantity	List Price	Discount	Your Price	Total
Subtotal					

Sales Tax					
Amount Due					

4. Create your bio-data using proper formatting in MS-Word.

5. Open a new MS Word file and type the following text given below;

Academy award

The Academy Awards, informally known as The Oscars®, are a set of awards given annually for excellence of cinematic achievements. The Oscar statuette is officially named the Academy Award of Merit and is one of nine types of Academy Awards. The Academy Awards ceremony is also the oldest award ceremony in the media; its equivalents, the Grammy Awards (for music), Emmy Awards (for television), and Tony Awards (for theatre) are modelled after the Academy.

Current special categories
Academy Honorary Award: since 1929
Academy Scientific and Technical Award: since 1931
Gordon E. Sawyer Award: since 1981

a. Change the layout of the page as given below.
   >Page size: A4 (8.27″ x 11.69″) >Page orientation: Landscape
b. Change the page margins as follows:
   >Top: 1.25″ >Bottom: 1.25″ >Right: 1.25″ >Left: 1.25″
c. Format the entire document as given below.
   >Line spacing: 1.15" >Font: Times New Roman >Font size: 14>Align: Justify
d. Select the heading “Academy award” and format it as given below.
   >Font color: blue >Style: Bold and underline >Align: Center >Change all the letters to UPPERCASE.
e. Make the first letter of the paragraph larger and fall into three lines (Drop cap).
f. Format the heading “Current special categories” with Style: Heading 2.
g. Create a bulleted list for the last 3 lines of text given under “Current special categories” and format it as follows.

6. Use mail merge for the admission form as shown:

PHOTO	
NAME	
DOB	
GENDER	
COURSE	
ADDRESS	
EXAM PASSED	
CATEGORY	

NEXT→

7. Using excel create PPF (public provident fund calculator).
   It gives the amount with interest after 15 years onwards. Ask user for input. (monthly investment by 5th of every month, no interest for the month when investment after 5th, rate

take as 8.7%. Interest calculated should be added only at the end of the financial year that is April)

8. A Computer company is trying to sell a software that costs 10$ per copy with a fixed cost of 50$.The data from previous sales shows the following:

Selling Price (p)	**10**	**15**	**20**	**25**	dollars
Quantity Sold (q)	**40**	**25**	**13**	**5**	units

Make formulas for each function:
Revenue = (Selling price) (Quantity)
Cost= $10 per unit + fixed Cost
Profit = Revenue – Cost

Cost					**dollars**
Revenue					**dollars**

Profit					**dollars**

Use the above tables and create a graph showing R, C and P with the Quantity as the X axis for each function. For chart type, use the XY Type. Now, add Trend line and choose the Polynomial type for R and P, and Linear type for C. Make sure you activate Display Equation on Chart which can be found under Option Tab

9. Create a presentation having Proper layout, images, sound, graph, some animation

10. Demonstrate use of VLOOKUP, HLOOKUP, COUNTIF, COUNTIFS, PMT, SUMIF, SUMIFS.

11. To Demonstrate the operation of a diode ROM

12. To show how address decoding reduces the number of input lines required for a ROM. To implement arithmetic functions using diode ROMs.

SEMESTER 2

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG201	Writing and Presentation Skills in English	4	60	4	20	80
REMTG202	Fundamentals of Electrochemistry	4	60	4	20	80
REMTS203	Photovoltaic Module Installation	6	90	6	20	80
REMPG204	*Practical- Computer Application Lab: MATLAB*	4	60	5	20	80
REMPS205	*Practical- Electronics and Photovoltaic module installation*	6	90	6	20	80
REMHOTS206	**Hands On Training**	6	90		20	80

SEMESTER – II

BOCG201 WRITING AND PRESENTATION SKILLS IN ENGLISH

General Paper 2

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

Aim:

To develop the student's ability to communicate.

Objectives:

- To improve students' soft skills which would be vital in an industry.
- To improve and enhance students' demeanor.

MODULE – I **(15 hrs.)**

Letter Writing: Letters - letters to the editor - resume and covering letters -parts and layout of business letters-business enquiry letters offers, quotation-orders and execution-grievances and redressal-sales letters-follow-up letters-status enquiry-collection letters-preparation of power of attorney for partnership- job application letters-resume-CV-reference and recommendation letters-employment letters.

MODULE II **(10 hrs.)**

Other types of Academic and business Communication(written): Seminar papers- project reports - notices - filling application forms - minutes, agenda-reports-essays.

MODULE – III **(15 hrs.)**

Presentation Skills: Soft skills for academic presentations - effective communication skills – structuring the presentation - choosing appropriate medium – flip charts – OHP – Power Point presentation – clarity and brevity - interaction and persuasion.

Compulsory activity: PowerPoint presentations to be conducted by each student in class

MODULE IV **(10 hrs.)**

Non-verbal communication-Body language-Kinesics,Proxemics-Para languageChannels-Barriers-Principles of effective communication

MODULE V **(10 hrs.)**

Online writing and Netiquette- Writing e-mails- use of language – writing for blogs – social media etiquette- professional networking online (LinkedIn, E-factor etc.)

Compulsory activity: *Each student should create a blog and/or profile in LinkedIn.*

Books for Reference:

1. Marilyn Anderson, Pramod K Nayar and Madhucchandra Sen. *Critical Thinking,AcademicWriting and Presentation Skills*. Pearson Education and Mahatma Gandhi University.
2. Antony Thomas,Business Communication and MIS, Pratibha Publications. Bhatia R.C.Business Communication
3. SaliniAgarwal Essential communication skill. Reddy P.N, and Apopannia, Essentials of Business communication.
4. Sharma R.C,KRISHNA Mohan, Business Communication and Report writing Leod,M.C.,Management Information system

REMTG202 FUNDAMENTALS OF ELECTROCHEMISTRY

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

Aim:

To provide a detailed idea about electrochemistry and electroanalytical chemistry

Objectives:

- To allow the students to gain necessary basic knowledge in order to understand, analyze and solve problems related to electrochemical processes.
- To acquire knowledge about the applications of electrochemistry in the fields of fuel cells, batteries, electrolytic processes and electrochemical corrosion.
- To gain basic abilities in calculations on electrochemical systems and in experimental methods in electrochemistry

Module 1 **(15 hrs.)**

Electrochemistry: Conductance of electrolytic solution, electrolytic conductivity (K), and molar conductivity of solutions of electrolytes. Variation of conductivity and molar conductivity with concentration. Kohlrausch's law – application. Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, transport number-determination by Hittorf's method. Applications of conductance measurements – Kw, Ksp.
Ostwald's dilution law, hydrolysis of salts.

Reference

1. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M.S. Pathania, 2013, 46th edn. chapter 23, Vishal Pub. Co.
2. Introduction to Electrochemistry, S. Glasstone, 2011, chapter 2 & 3, Biblio Bazar.

Module 2 **(15 hrs.)**

Electromotive force: Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – effect of electrolyte concentration on electrode potential and emf, Nernst equation. Electrochemical series, representation of cell, EMF of cell. EMF and equilibrium constant of cell reaction, concentration cells – general discussion of electrode – concentration cell and electrolyte concentration cells. Liquid junction potential.

Reference

1. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M.S. Pathania, 2013, 46th edn., chapter 24 & 25, Vishal Pub. Co.
2. Physical Chemistry, G. W. Castellan, 2004, 3rd edn., chapter 17, Narosa Publishing House, New Delhi.
3. Introduction to Electrochemistry, S. Glasstone, 2011, chapter 6 & 7, Biblio Bazar.

Module 3 **(10 hrs.)**

Electroanalytical methods:conductometric titration, amperometric titration, potentiometric titration, coulometry, voltammetry, polarography.

Reference

1. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. S.R. Holler, Crouch, 2006, 8th edn, Chapter 22 & 23, Thomson Brooks/Cole.
2. A Text Book of Quantitative Analysis including Instrumental Analysis, A.I. Vogel, 1961, John Wiley & Sons.

Module 4 **(20 hrs.)**

Photochemistry

Basic interaction of radiation with matter: Laws of photochemistry – Grothus-Draper law, Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert's law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield, primary and secondary processes. Concepts of Photosensitized reactions, flash photolysis and chemiluminescence. Photosynthesis, photosystem– 1 and 2. Chemistry of Ru(bpy)2 complexes in charge transfer reactions.

Reference

1. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M.S. Pathania, 2013, 46th edn. Chapter 29, Vishal Pub. Co.
2. Fundamentals of Photochemistry, K.K. Rohatgi-Mukherjee, 1986, 2nd Edn., New Age, International.

REMTS203 PHOTOVOLTAIC MODULE INSTALLATION

No. of credits: 6 **No. of contact hours: 90 (6 hours per week)**

AIM

- Provide understanding of the science and engineering issues related to the design and development and installation of Solar PV modules

OBJECTIVES.

- To understand the fundamental physical mechanism, manufacturing, classification and processing issues which impact upon the final performance and durability of PV cells.
- To make the students equipped for site surveys and installing PV panels according to the need based requirement.

MODULE 1 **(20 hrs.)**

Solar Cells and PV modules:

Solar cell types -Equivalent circuit diagrams of solar cells - Spectral sensitivity -Efficiency of solar cells and PV modules -Types of modules -Design options for PV modules -Module cable outlets and junction boxes -Wiring symbols - Characteristic I-V curves for modules -Irradiance dependence and temperature characteristics -Hot spots, bypass diodes and shading -Quality certification for modules

MODULE 2 **(25 hrs.)**

PV array combiner/junction boxes, string diodes and fuses -Grid-connected inverters -Wiring symbol and method of operation -Grid-controlled inverters -Self-commutated inverters - characteristic curves and properties of grid-connected inverters -Further developments in grid-connected inverter technology Cabling, wiring and connection systems - Module and string cables -Connection systems - DC main cable -AC connection cable -Direct current load switch (DC main switch) -AC switch disconnector.

MODULE 3 **(20 hrs.)**

Site Surveys and Shading Analysis

On-site visit and site survey -Consulting with the customer Shadow types-Temporary shading - Shading resulting from the location -Shading resulting from the building -Shading analysis-Using a site plan and sun path diagram-Using a sun path diagram on acetate Shade analysis tools using software-Shading, PV-array configuration and system concept -Connection in series -& in parallel-Comparison of connection concepts Shading with free-standing/rack-mounted PV arrays -Reducing the mutual shading losses of rack-mounted PV modules -Checklists for building survey

MODULE 4 **(25 hrs.)**

PV System designing- Planning and Sizing Grid-Connected Photovoltaic Systems-System size and module choice - System concepts -Central inverter, Sub-array and string, module inverter-Inverter installation site- Sizing the inverter -Choosing the number and power rating of inverters -Determining the number of strings -Selecting and sizing cables for grid-tied PV systems -Cable voltage ratings - current carrying capacity -Minimizing the cable losses/voltage drops – Sizingthe module and string cabling -Sizing the DC main cable-Sizing the AC connection cable 171 Selection and sizing of the PV array combiner/junction box and the DC main disconnect/isolator switch -Lightning protection, earthing/grounding and surge protection

Reference

1. Planning and installing photovoltaic systems-A guide for installers, architects and engineers; The German Energy Society; 2008; Second Edition; Earthscan, UK.
2. Introduction to Photovoltaic System Design, John R. Balfour, Michael Shaw, Jones & Bartlett Publishers, 2011

REMPG204 PRACTICAL- COMPUTER APPLICATIONS LAB: MATLAB

No. of credits: 4 **No. of contact hours: 60 hours (5 hours per week)**

Aim:

To introduce the software MATLAB for numerical computations and to familiarize with the Matlab Desktop, basic commands through the Command window and output through the Graph window

Objectives:

- To familiarize the student in introducing and exploring MATLAB software.
- To enable the student on how to approach for solving problems using MATLAB programs.
- To prepare the students to use MATLAB in their project works.
- To provide a foundation in use of this softwares for real time application

List of Experiments:

1. Create a structure for an employee database storing information about employee code, name, designation and salary. First create 3 records and then write command to read the second employee's designation.

2. Write a program to illustrate using menu function to select a candidate from given choices: - (Kiran, Sham, Johns, Fielder, Margret, Green Field, Tom, Mark Ryan, Alex Paul, Simson.)

3. Plot a 2D graph with axes, x= cos θ, y = sin θ, where $0 \leq \theta \leq 2\pi$, taking 100 linearly spaced points in the given interval. Label the axes and title the graph with text string.

4. Plot a graph for 'power *V/S* time' $0< t < 10$ sec, with power on the log scale and time in linear scale for a motor whose performance equations are given as follows:

a) Rotational speed, ω =190(1 – e-0.15t)
b) Torque, T= 8e-0.15t
c) Power = ωT

5. Write a program to plot a bar graph to show the comparison of average temperature in cities: - Ernakulam, Palakkad, Kollam, for months from October to May.

6. Write a program for following:

a) To generate 100 random data points using ROSE function.
b) To show rating of different small scale industries as per the given data, using 'pie' function.

7. Write a program to

a) Draw the stairs to plot, to show the function y= x3, where $-3 \leq x \leq 3$.
b) Draw the stem plot for the following data:
X= [0 1 2 3 4 5 6 7] Y = [3 -9 8 -7 5 3 1 3]

8. Plot a graph by dividing the figure window into four sub- windows and plot the following functions:

a) Plot V *v/s* I, where V= 4I and I= 2,4,6,8,10
b) Plot Y *v/s* X, where $Y= 3X^2$ and X= 3,4,5,6,7,8

c) For 0: π/30:6π, plot tan(t) *v/s* t.
d) For t= 0: π/60:5π, plot cos(t) *v/s* t.

9. Write a program to find the largest of given ‘n’ numbers using for loop and if structure.

Given data:45,67,10,33,50.

10. Write a program to draw the curves for function, y=sin(3x), y=4x3+5x, y=cos(4x) in a single graph figure window using single plot command.

11. Write a program using while loop to reverse the digits of a number.

12. Write a program to add two given row vectors, with the following data:
[4 5 8] and [34 56].

REMPS205 PRACTICAL- ELECTRONICS AND PHOTOVOLTAIC MODULE INSTALLATION

No. of credits: 6 **No. of contact hours: 90 hours (6 hours per week)**

Aim:
The laboratory session provides learning opportunities that enable the student to study various electronic components and basic components of PV system

Objectives:
- To study the basic electronic components, their working and characteristics
- To familiarize with PV system components and the basic tools for PV module installation.

1. Multimeter-Familiarization

2. Diode Characteristics

3. Half wave rectifier with and without filter-ripple factor and load regulation

4. Characteristics of Zener diode

5. LED characteristics

6. Solar cell I-V characteristics in the dark and under illumination

7. Familiarize appropriate access equipments and basic roofing techniques for PV module installation

8. Positioning, fixing and installing

9. Connecting PV system to the grid through a domestic distribution board

10. Carry out measurement within modules and array

11. Fault diagnosis on modules and array

12. Operational testing for an inverter

Note:

- After the first year of the course the student will be qualified in PV module installation and can be certified by Skill Council for Green Jobs as they get practical as well as theoretical knowledge in the field through classes and On Job Training.
- Qualification Title: Solar PV Installer
- Body/bodies which will assess candidates:**SCGJ affiliated Assessment Agency**
- Body/bodies which will award the certificate for the qualification: **Skill Council for Green Jobs**
- Occupation(s) to which the qualification gives access: **Solar PV installer, Solar PV Installation Supervisor**

SEMESTER 3

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
REMTG301	Water and Wastewater Treatment	4	60	3	20	80
REMTG302	Operation and maintenance of Solar PV systems	4	60	4	20	80
REMTG303	Solar Thermal Technology	4	60	3	20	80
REMTS304	Wind Energy	6	90	5	20	80
REMPS305	*Practical- Thermodynamics and Solar Thermal*	6	90	5	20	80
REMPS306	*Practical- Fluid dynamics and Wind Energy*	6	90	5	20	80

REMTG301 WATER AND WASTEWATER TREATMENT

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

AIM

- To provide the students general awareness on water management, necessity and techniques for wastewater treatment

OBJECTIVES

- To introduce basic unit processes involved in drinking water and wastewater treatment.
- To make the students aware of the necessity of water management in the present scenario

MODULE 1 **(20 hrs.)**

Water Quality and Purification

Physical, chemical and biological parameters of water- Water Quality requirement – Potable water standards -Wastewater Effluent standards -Water quality indices.

Physical processes-chemical processes and biological processes -Primary, Secondary and Tertiary treatment -Unit operations-unit processes.

Reference

1. Physicochemical processes for water quality control, Weber, W.J., John Wiley and sons, New York, 1983

2. American Public Health Association, 1998. Standard Methods for the Examination of Water and Wastewater, APHA, Washington D.C. (chapter 2, 3 & 4)

MODULE 2 **(15 hrs.)**

Sedimentation and Disinfection

Types, Aeration and gas transfer, Coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids transport of colloidal particles, Clariflocculation.

Theory of Disinfection - Factors affecting disinfection, Disinfection - chlorine dioxide; chloramines; ozonation; UV radiation.

MODULE 3 **(15 hrs.)**

Filtration

Theory of granular media filtration; Classification of filters; slow sand filter and rapid sand filter; mechanism of filtration; modes of operation and operational problems; negative head and air binding; dual and multimedia filtration, pressure filters, principle of working and design.

Reference

1. Water & Waste Water Engineering by Fair and Gayer.

2. Water and Wastewater Treatment: A Guide for the Nonengineering Professional, Joanne E. Drinan, Frank Spellman. (Chapter 7). CRC Press, Taylor and Francis.

MODULE 4 **(10 hrs.)**

Miscellaneous Methods

Ion Exchange-processes, Application of Membrane Processes, Reverse Osmosis, Microfiltration, Nano-filtration, Ultrafiltration and Electrodialysis.

Reference

1. C.A. Sastry, Water Treatment Plants, Narosa Publishing House, Bombay, 1996.

2. Handbook of Water and Wastewater Treatment Technologies. Nicholas P. Cheremisin (Chapter 10)

REMTG302 OPERATION AND MAINTENANCE OF SOLAR PV SYSTEMS

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

AIM

- To improve the quality of Solar PV system installations, especially in the rooftop solar segment

OBJECTIVE

- To make the students aware of operation and maintenance involved in the solar PV sector as well as to introduce them to concepts of safety, electricity billing and documentation.

MODULE 1 **(10 hrs.)**

Introduction to Solar PV Operations and Maintenance: Need of operation and maintenance - Overview of PV system components - Maintenance categorization - Common Tools & Equipments Used.

MODULE 2 **(15 hrs.)**

Photovoltaic modules: Inspection and fault identification - Dust accumulation, Module shading, Module mismatch, Physical integrity, Maintenance and troubleshooting - Basic level, Advanced level, Methods and techniques for shading analysis, Important points.

MODULE 3 **(20 hrs.)**

Inverters: Inspection and fault identification - Classification of solar inverters, Routine inspection, Maintenance and troubleshooting - Basic level, Advanced level, Important points.

Balance of systems: Inspection and fault identification - Cables, Protection Devices, Batteries, Maintenance and troubleshooting - Basic level, Advanced level, Important points.

MODULE 4 **(15 hrs.)**

Jobsite safety: General safety procedures, Personal safety procedures.

Understanding electricity bill: Calculating consumption of electrical energy, calculating energy generated by RTPV system.

Documentation : Importance of documentation and itssignificance- System documentation, Maintenance documentation, Component documentation.

Reference

1. Best Practices in Operation and Maintenance of Rooftop Solar PV Systems in India, Jaya Vasita, AkhileshMagal, Hand Book by Gujarat Energy Research & Management Institute (GERMI).
2. Use, Operation and Maintenance of Renewable Energy Systems: Experiences and Future Approaches, Miguel A. Sanz-Bobi, Springer, 09-May-2014
3. Photovoltaics for Professionals: Solar Electric Systems Marketing, Design and Installation, Antony Falk, Christian Durschner, Karl-Heinz Remmers, Routledge, 18-Oct-2013

REMTG303 SOLAR THERMAL TECHNOLOGY

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

AIM

- Developing student knowledge of solar thermal energy and radiation along with its application.

OBJECTIVES

- To understand the solar resource and utilization of solar thermal energy
- To convey the principle, operation and various applications of solar thermal energy

MODULE 1 **(10 hrs.)**

Solar radiation: The sun as the source of Radiation-Solar Constant-Spectral distribution of extraterrestrial radiation and its Variation-Basic Earth Sun Angles-Diffuse Radiation-Availability of solar radiation-measurement of diffuse and direct radiation

MODULE 2 **(10 hrs.)**

Flat Plate Collectors: Liquid Flat Plate Collector- Materials for flat plate Collector-Efficiency of flat plate collectors-Flat plate air heating collectors-Types and novel designs-Solar ponds

MODULE 3 **(20 hrs.)**

Solar Concentrating Collectors: Parameters characterizing solar concentrators-Classification of solar concentrators- Thermodynamic limits to concentration- Solar concentrator mountings-Performance analysis of cylindrical parabolic collector- Compound parabolic collector- Point focusing solar concentrators- Materials for solar concentrators

MODULE 4 **(20 hrs.)**

Solar Thermal Applications: Solar water heater-Natural and forced circulation type- Solar cookers-Types-Solar Still- Solar drying of food-Basics- Types-Solar heating of buildings-active and passive-Solar cooling of buildings-refrigeration and air conditioning- Solar furnaces-Solar thermal energy storage

Reference

1. Solar Energy: Fundamentals and Applications; H. P. Garg & J. Prakash; 2000; Tata McGraw-Hill.

REMTS304 WIND ENERGY

No. of credits: 6 **No. of contact hours: 90 (5 hours per week)**

AIM

- To improve the understanding of the main wind energy concepts and the application of general engineering knowledge in the design and construction of wind energy equipment

OBJECTIVES

- To make the student understand, analyse and utilize wind resource
- To familiarize with the components, principle of operation and economics of wind power generators.

MODULE 1 **(30 hrs.)**

Basics of Wind Energy Conversion
History of wind energy, Current status and future prospects, Wind Energy in India- Power available in the wind- Wind Turbine power and torque characteristics-Types of rotors: Horizontal and Vertical axis wind turbine-Characteristics of wind rotor-Analysis of wind regimes- Local effects, wind shear, Turbulence and acceleration effects- Measurement of wind: Ecological indicator, Anemometers-wind direction-Wind speed statistics: Time and Frequency distribution, Mean wind speed and-distribution of wind velocity- Statistical model for wind data analysis : Weibull distribution-Energy estimation of wind regimes.

MODULE 2 **(25 hrs.)**

Aerodynamics of wind turbine:
Airfoil, lift and drag characteristics- Aerodynamic theories- Axial momentum theory- Blade element theory- Strip theory- Power coefficient and tip speed ratio characteristics-Rotor design and Performance analysis

MODULE 3 **(20 hrs.)**

Wind energy conversion systems:
Wind electric generators- Tower, rotor, gearbox, power regulation, safety mechanisms- Generator: Induction and synchronous generator-Grid integration- Wind pumps- Wind driven piston pumps, limitations and performance analysis

MODULE 4 **(15 hrs.)**

Wind Energy and Environment: Environmental benefits and problems of wind energy
Economics of wind energy: Factors influencing the wind energy economics- Site specific parameters-machine parameters- Life cycle cost analysis

Reference

1. Wind Energy: Fundamentals, Resource Analysis and Economics; Mathew Sathyajith; 2006; Springer

Additional reading

1. Johnson GL. Wind Energy Systems, (Electronic Edition), Prentice Hall Inc, 2006
2. Burton T. Sharpe D. Jenkins N. Bossanyi E. Wind Energy Handbook. John Wiley, 2001
3. Jha AR. Wind Turbine Technology, CRC Press,- Taylor & Francis, 2011
4. Jain P. Wind Energy Engineering. McGraw Hill 2011

REMPS305 PRACTICAL-THERMODYNAMICS AND SOLAR THERMAL

No. of credits: 6 **No. of contact hours: 90 hours (5 hours per week)**

Aim:
To investigate and experiment with basic thermodynamic concepts and solar thermal application in the laboratory.

Objective:

- To familiarize with thermodynamic aspects of various materials
- To use various equipments used for measuring solar radiation and to provide hands on experience in operation of solar water heaters.

Experiments:

1. Thermal conductivity of bad solid conductor- Lee's Disc

2. Thermal conductivity of powder samples- Lee's Disc

3. Thermal conductivity of rubber

4. Specific latent heat of steam-using condenser

5. Specific heat of liquid –Newton's law of cooling

6. Specific heat capacity of a solid

7. Operational experience on Pyranometer

8. Familiarization of Sunshine recorder

9. Measurement of temperature using Infrared Thermometer and Thermocouple

10. Evaluation of different parameters of Flat-Plate/ Evacuatedtube Collector in thermosyphonic mode of flow with fixed input parameters

11. Evaluation of different parameters of Flat-Plate/ Evacuated tube Collector in thermosyphonic mode of flow with different radiation level

12.Evaluation of different parameters of Flat-Plate/ Evacuated tube Collector in thermosyphonic mode of flow with different inlet water temperature

13. Experiment on solar distillation Units

REMPS306 PRACTICAL- FLUID DYNAMICS AND WIND ENERGY

No. of credits: 6 **No. of contact hours: 90 hours (5 hours per week)**

Aim:

Provide knowledge of wind energy applications and measuring wind data.

Objectives:

- To study the characteristics of wind,and wind quality measuring equipments
- To understand various applications of wind energy

1. Surface tension - Capillary rise method.

2. Density of a liquid - U-Tube and Hare's apparatus.

3. Measurement of wind speed.

4. Evaluation of cut-in speed and cut-off speed.

5. I-V characteristics of wind turbine at different wind speed.

6. Characteristics of wind turbine with electrolysis and water pump.

7. P, V and F measurement of output of wind generator.

8. Demonstration of system with charge controller.

9. Demonstration of system with charge controller and inverter.

10. Power quality of AC output of system.

11. Impact of wind speed on power output and its quality.

12. Impact of load on power output and its quality.

13. Matlab Simulation Experiments on Wind turbines

SEMESTER 4

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
REMTG401	Planning and Installing Solar Thermal Systems	4	60	4	20	80
REMTG402	Waste to Energy Conversion	4	60	4	20	80
REMTG403	Bioenergy	4	60	5	20	80
REMTS404	Energy Storage Systems	4	60	6	20	80
REMPS405	*Practical- Solar Photovoltaics and Energy Storage Systems*	4	60	6	20	80
REMOJTS406	**On Job Training**	10	150		20	80

REMTG401 PLANNING AND INSTALLING SOLAR THERMAL SYSTEMS

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

AIM

- Understand the basic principles of design and operation of solar thermal energy conversion and apply those principles to a wide variety of solar thermal systems and applications

OBJECTIVES

- Understand how to estimate available solar energy for a given site and application
- Understand the design and economics of solar thermal systems

MODULE 1 **(20 hrs)**

Components of Solar Thermal Systems: Working of a Solar Thermal System -Collectors- Heat Stores- Solar Circuit-Controller

Systems for Single-Family Houses: Systems for Charging/Discharging the Store - Systems for Heating Domestic Water-Systems for Heating Domestic Water and Space Heating- Planning and Dimensioning-Costs and Yields

Installation, Commissioning, Maintenance and Servicing: A Brief Study of Roofing and Materials-Installation Methods and Safety- Installation-Starting Up, Maintenance and Servicing- Information Sources for Specific Countries

MODULE 2 **(15 hrs)**

Large-scale Systems

Systems- Control of the Systems- Heat Exchangers- Safety Technology- Economic Considerations-Solar Contracting- Solar District Heating

Solar Concentrating Systems

Concentration of Solar Radiation- Concentrating Systems Providing Process Heat-Concentrating Solar Thermal Systems for Electricity Generation

MODULE 3 **(15 hrs)**

Solar Air Systems: Introduction- Components- Systems- Planning and Dimensioning-Installation-Costs and Yields- Examples

Solar Cooling: Theoretical Bases- Integrated Planning of Solar Cooling/Air-conditioning Systems-System Technology- System Design

MODULE 4 **(10 hrs)**

Simulation Programs for Solar Thermal Systems

Introduction- Evaluation of Simulation Results- Simulation with Shading- Market Survey, Classification and Selection of Simulation Programs- Brief Description of Simulation Programs

TEXT BOOK

Planning and Installing Solar Thermal Systems: A Guide for Installers, Architects and Engineers by German Solar Energy Society (DGS); 2010; Earthscan

REMTG402 WASTE TO ENERGY CONVERSION

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

AIM

- To keep the knowledge of students upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

OBJECTIVES

- To understand the various waste generation sources and their management.
- To know the various waste to energy conversion technologies.
- To understand various impacts like health and environment issues and significance of different technologies.
- To get acquainted with commercial aspects of waste to energy.

MODULE 1 **(15 hrs)**

Introduction: Introduction to waste and waste processing, Definitions, sources, types and composition of various types of wastes; Characterization of Municipal Solid Waste (MSW) , Industrial waste and Biomedical Waste (BMW), Waste collection and transportation; Waste processing-size reduction, Separation; Waste management hierarchy, Waste minimization and recycling of MSW; Life Cycle Analysis (LCA), Material Recovery Facilities (MRF), Recycling processes of solid waste.

MODULE 2 **(15 hrs)**

Waste Treatment and Disposal: Aerobic composting, Incineration, different type of incineration; medical and pharmaceutical waste incinerations, Landfill classification, types, methods and sitting consideration, layout and preliminary design of landfills: composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for landfill gases, Rules related to the handling, treatment and disposal of MSW and BMW in India.

MODULE 3 **(15 hrs)**

Waste to Energy Conversion Technologies: Sources of energy generation, incineration, gasification of waste using gasifiers, briquetting, utilization and advantages of briquetting.

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, landfill gas generation and utilization.

MODULE 4 **(15 hrs)**

Environmental and Commercial Aspects of Waste to Energy: Present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages, Environmental and health impacts of incineration and other waste to energy conversion systems, case studies of commercial waste to energy plants, Strategies for reducing environmental impacts.

Reference:

1. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, ISBN: 9780470539675, John Wiley and Sons.
2. Velma I. Grover and Vaneeta Grover, Recovering Energy from Waste Various Aspects, ISBN 978-1-57808-200-1.

3. Shah, Kanti L., Basics of Solid and Hazardous Waste Management Technology, Prentice Hall.
4. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers.
5. Marc J. Rogoff, Waste-to-Energy, Elsevier.
6. Parker, Colin and Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London.
7. ManojDatta, Waste Disposal in Engineered Landfills, Narosa Publishing House.
8. Bhide A.D., Sundaresan B. B., Solid Waste Management in Developing Countries, INSDOC, New Delhi.

REMTG403 BIOENERGY

No. of credits: 4 **No. of contact hours: 60 (5 hours per week)**

AIM

- To provides an overview of key topics on sustainable bioenergy production, including the main biomass systems for bioenergy generation and the wide range of bioenergy conversion and utilisation methods.

OBJECTIVES

- To enable students to analyse the main biomass systems that can be used for biomass energy conversion and utilisation.
- To enable students to develop designs for biomass energy conversion and utilisation within the context of a whole systems approach.
- To enable students to critically evaluate the environmental benefits and consequences of biomass energy production.

MODULE 1 **(15 hrs.)**

Biomass

Sources and Classification, Chemical composition, properties of biomass, Energy plantations, Size reduction, Briquetting, Drying, Storage and handling of biomass**.**

MODULE 2 **(15 hrs.)**

Biogas

Feedstock for biogas, Microbial and biochemical aspects- operating parameters for biogas production. Kinetics and mechanism- Types of biogas plants

MODULE 3 **(15 hrs.)**

Thermochemical conversion of lignocelluloses biomass. Incineration, Processing for liquid fuel production. Pyrolysis -Effect of particle size, temperature, and products obtained. Thermo chemical Principles: Effect of pressure, temperature , steam and oxygen. Fixed and fluidized bed Gasifiers- Partial gasification of biomass by CFB

MODULE 4 **(15 hrs.)**

Combustion of woody biomass-Design of equipment-Cogeneration using bagasse- Case studies: Combustion of rice husk.

Reference:

Renewable energy sources and emerging technologies by D.P. Kothari, K. C. Singal, Rakesh Ranjan

REMTS404 ENERGY STORAGE SYSTEMS

No. of credits: 4 **No. of contact hours: 60 (6 hours per week)**

AIM

- To understand the fundamental theory of energy storage technologies

OBJECTIVES

- To make the students understand the key energy storage technologies work, and novel developments in energy storage technology research.
- Understand how storage technologies solve real-world problems at domestic, city and grid scales.

MODULE 1 **(10 hrs.)**

Energy Storage: Need of energy storage- Different modes of Energy Storage- Mechanical Energy Storage Electrical Storage- Chemical Storage- Electromagnetic energy storage- Thermal Energy Storage.

Reference

1. Non-conventional energy sources; G.D.Rai; 2011; Fifth Edition, Khanna Publishers

MODULE 2 **(20 hrs.)**

Electrochemical, electrical and magnetic energy storage systems: Primary and Secondary Batteries- Solid-State and Molten Solvent Batteries- Lead acid batteries- Nickel Cadmium Batteries, Advanced Batteries-Superconducting Magnet Energy Storage (SMES) Systems- Capacitors-Supercapacitor-Electrochemical Double Layer Capacitor (EDLC)

Reference

1. Handbook of batteries; David Linden & Thomas B. Reddy; 2002; Third Edition; McGraw-Hill Companies, Inc.
2. Energy Storage; Robert A. Huggins; 2010; Springer

MODULE 3 **(10 hrs.)**

Sensible heat storage (SHS): Mediums for SHS- Stratified storage systems- Rock-bed storage systems- Thermal storage in buildings- Energy storage in aquifers

Reference

1. Solar Thermal Energy Storage; H.P. Garg, S.C. Mullick and A. K. Bhargava; 1985; Springer

MODULE 4 **(20 hrs.)**

Latent Heat Thermal Energy Storage (LHTES): Phase Change Materials (PCMs)- Selection criteria of PCMs- Solar thermal LHTES systems Energy conservation through LHTES systems- LHTES systems in refrigeration and air conditioning systems

Reference

1. Solar Thermal Energy Storage; H.P. Garg, S.C. Mullick and A. K. Bhargava; 1985; Springer

REMPS405 PRACTICAL- SOLAR PHOTOVOLTAICS AND ENERGY STORAGE SYSTEMS

No. of credits: 4 **No. of contact hours: 60 (6 hours per week)**

Aim:

To build a foundation for understanding Solar PV system and Energy storage technology integration.

Objectives:

- To study the characteristics of PV System components
- To analyse the properties of various energy storage devices.

Experiments:

1. Temperature dependent conductivity of semiconductor.

2. Lux meter and Power meter familiarization.

3. Illuminated I-V characteristics of a solar cell-Calculation of Fill Factor and Efficiency.

4. Comparison of the illuminated I-V characteristics of a photodiode with that of a solar cell.

5. Battery charging and discharging characteristics.

6. Combine AC and DC load system with battery.

7. Evaluation of heat transfer during charging and discharging of Phase Change Material (PCM).

8. Inspection of temperature distribution inside the PCM.

9. Calculation of LMTD of the heat exchangers.

10. Evaluation of system thermal efficiency during charging storing and discharging the PCM.

11. Evaluation of overall system thermal efficiency.

12. Calculation FOM of the system.

Note:

On completing the 2nd year of the course the students can be certified by certified by Skill Council for Green Jobs in the following job roles

- Solar PV Maintenance Technician
- Solar Domestic Water Heater Technician

SEMESTER 5

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BOCG501	Environmental Studies	4	60	3	20	80
REMTG502	Material Science for Energy Applications	4	60	3	20	80
REMTS503	Energy Conservation Techniques	6	90	5	20	80
REMTG504	Industrial Health and Safety	4	60	4	20	80
REMPS505	*Practical- Advanced Solar Photovoltaic Lab*	6	90	5	20	80
REMPS506	*Practical- Advanced Solar Thermal Lab-I*	6	90	5	20	80

BOCG501 ENVIRONMENTAL STUDIES

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

AIM

- To bring about an awareness of a variety of environmental concerns

OBJECTIVES

- To create a pro-environmental attitude and a behavioral pattern in society that is based on creating sustainable lifestyles
- To acquire knowledge of pollution and environmental degradation.

MODULE 1 **(15 hrs.)**

Multidisciplinary nature of environmental studies
Definition, scope and importance-Need for public awareness.

Natural Resources:
Renewable and non-renewable resources:
Natural resources and associated problems.
Forest resources: Use and over-exploitation, deforestation, case studies.Timber extraction, mining, dams and their effects on forest and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources : Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources.
Equitable use of resources for sustainable lifestyles.

MODULE 2 **(15 hrs.)**

Ecosystems
Concept of an ecosystem-Structure and function of an ecosystem-Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation
Introduction – Definition : genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation Hot-spots of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts., Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

MODULE 3 **(15 hrs.)**
Environmental Pollution
Definition, Cause, effects and control measures of: - Air Pollution-Water Pollution-Soil Pollution Marine Pollution-Noise Pollution-Thermal Pollution-Nuclear hazards

Solid waste Management : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies, Disaster management : floods, earthquake, cyclone and landslides.

Human Population and the Environment

Population growth, variation among Nations-Population explosion – Family Welfare Programme-Environment and human health-Human Rights-Value Education-HIV/AIDS-Women and Child Welfare- Role of Information Technology in Environment and human health-Case Studies.

MODULE 4 (15 hrs)

Social Issues and the Environment

From Unsustainable to Sustainable Development-Urban problems related to energy-Water conservation, rain water harvesting, watershed management-Resettlement and rehabilitation of people; its problems and concerns-Case Studies

Environmental ethics: Issues and possible solutions.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Case Studies.

Wasteland reclamation-Consumerism and waste products-Environment Protection Act-Air (Prevention and Control of Pollution) Act-Water (Prevention and control of Pollution) Act-Wildlife Protection Act-Forest Conservation Act-Issues involved in enforcement of environmental legislation-Public awareness

TEXT BOOK

Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education ErachBharucha for University Grants Commission

Further activities

- Field work
- Visit to a local area to document environmental assets river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

REMTG502 MATERIAL SCIENCE FOR ENERGY APPLICATIONS

No. of credits: 4 **No. of contact hours: 60 (3 hours per week)**

AIM

- To introduce the students to basics of materials science and engineering.

OBJECTIVES

- To learn about the properties of various materials and special coatings and applications.
- To understand the testing of materials behavior suitable for application in solar energy systems and environmental impact on solar system materials and corrosion protection.

MODULE 1 **(15 hrs)**

Fundamental Principles of Materials Science: Electronic and Atomic Structures, Atomic Bonding in Solids, Crystal Structure, Microstructure, Solidification, Alloys, Semiconductors, Ceramics, Polymers.

MODULE 2 **(15 hrs)**

Properties of Materials: Superconductivity and Applications. Mechanical, Optical, Thermal Electrical and Magnetic Properties of Metals, Alloys, Semiconductors, Polymers, Glass, Nanomaterials and Magnetic Materials.

MODULE 3 **(15 hrs)**

Testing of Materials: Concepts of Stress and Strain, Hooke's Law, Tension, Compression and Shear. Stress-strain Diagram and Thermal Stresses. Elasticity in Metals and Polymers, Plastic Deformation, Yield Stress, Shear Strength, Strengthening Mechanisms.

MODULE 4 **(15 hrs)**

Effects on Materials: Environmental Effects - Corrosion, Erosion, Thermal Stress and Weathering Properties of Solar Materials, Effect of Temperature, Fracture Behavior of Various Materials, Failure Analysis of Solar Materials.

References:

1. Ramamrutam S., "Strength of Materials", 16th edition, Danpat Rai Publications, 2010
2. Callister W.D.., Materials Science and Engineering 6th edition, Wiley India, 2009
3. Sheckel ford J., F. Muralidham M.K., "Introduction to Materials Science for Engineers", 6th edition, Pearson, 2007.
4. RaghavanV., "Materials Science and Engineering", Prentice-Hall India, 2007. Askeland D.R., " Science and Engineering of Materials" , 4th edition, Thomson, 2003.
5. Balasubramaniam R., " Callister's Materials Science and Engineering", Wiley India, 2007.
6. Ben G. Streetman, Solid State electronic devices, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.

REMTS503 ENERGY CONSERVATION TECHNIQUES

No. of credits: 6 **No. of contact hours: 90 (5 hours per week)**

AIM

- To develop skill and capacity for effective energy conservation

OBJECTIVES

- To impart knowledge in the domain of energy conservation
- To inculcate knowledge and skills about assessing the energy efficiency of an entity/ establishment
- To know various types of energy losses and the associated energy efficient technologies for the routinely used thermal and electrical energy systems.

MODULE 1 **(25 hrs.)**

Introduction

Energy conservation & its importance - The Energy Conservation Act 2001 & its features

Waste Minimization & Resource Conservation

Need of waste minimization - Waste minimization method & its classification - Effects of waste environment & Role of pollution control board - Case study.

MODULE 2 **(25 hrs.)**

Energy Conservation Methods in Electrical System

Motors - Power factor improvement techniques - Effects of harmonics - Star-Delta conversion techniques - Variable speed drive (VSD) - Energy conservation in electric furnaces. - Pumps, Compressors, Fans & Blowers - Lighting systems - HVAC systems

MODULE 3 **(20 hrs.)**

Energy Conservation In Thermal System

Boiler & furnace - Steam distribution system –HVAC - Waste heat recovery - Insulation of pipes - Condensate recovery - Fuel Handling - Other heat based application - Case Study

MODULE 4 **(20 hrs.)**

Energy Conservation in Housing & Commercial Building

In Lighting System - Water heating system - Optimization cooking method - Energy efficient building.

REFERENCES

1. Energy Conservation in the Chemical & Allied Industries; S.K. Awasthi; 1989; South Asian Publishers, New Delhi
2. Energy Management Handbook; Wayne C. Turner; 2001; Fairmont Press
3. Industrial Energy Conservation; Melvin H. Chiogioji; 1979; M. Dekker

ADDITIONAL READING

1. www.bee-india.com
2. Energy Efficiency in Thermal Utilities, 2010, BEE guide book
3. Energy Efficiency in Electrical Utilities, 2010, BEE guide book

REMTG504 INDUSTRIAL HEALTH AND SAFETY

No. of credits: 4 **No. of contact hours: 60 (4 hours per week)**

Aim

- To foster a safe and healthy work environment at work.

Objectives:

- To become familiar to occupational environment
- To assure safe and healthful working conditions

MODULE 1 **(15 hrs.)**

Occupational Health and Hygiene

Need for developing Environment, Health and Safety systems in workplaces. Status and relationship of Acts, Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Ergonomics and workplace. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

References

1. Jogdand S.N., 1995. Environmental biotechnology and industrial pollution management; Himalaya Publishing House.
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005
3. Kumar R. (Editor)., 1997. Environmental pollution and health hazards in India. Ashish Publication.
4. Ghosh G.K., 1987. Environmentalpollution: a scientific dimension. Ashish Publication.

MODULE 2 **(15 hrs.)**

Workplace Safety and Safety Systems

Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

References

1. Jogdand S.N., 1995. Environmental biotechnology and industrial pollution management. Himalaya Publishing House.
2. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
3. Ian Paulford., Hugh Flowers., 2006. Environmental Chemistry at a Glance. Blackwell.
4. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant,

MODULE 3 **(15 hrs.)**

Techniques of Environmental Safety

Elements of a health and safety policy and methods of its effective implementation and review. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents-

Principles of quality management systems in health and safety management. Relationship between quality manuals, safety policies and written risk assessments. Records and other documentation required by an organisation for health and safety. Industry specific EHS issues.

References

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
3. Khitoliya R.K., 2004, Environmental pollution management and control for sustainable development. S. Chand publication.
4. Bhattiya S.C., 2003. Managing industrial pollution. Mc Millan India Ltd.
5. Trivedi R.K. (Editor). Pollution and Bio monitoring of Indian Rivers. ABD publication.

MODULE 4 (15 hrs.)

Education and Training

Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

References:

1. Reddy, P. K., & Reddy, N. D. (2001). Environmental Education. Hyderabad: Neelkamal publications.
2. Kelu, P. (2000). Environmental education: A conceptual analysis. Calicut: Calicut University.
3. Agarwal, S.P. and Aggarwal, J.C. (1996) Environmental Protection, Education and Development. New Delhi: New Concepts.

REMPS505 PRACTICAL-ADVANCED SOLAR PHOTOVOLTAIC LAB

No. of credits: 6 **No. of contact hours: 90 hours (5 hours per week)**

Aim:

Analysis of Photovoltaic module characteristics under various circumstances can help to choose most economical/suitable practices of Photovoltaic array installation.

Objectives:

- Comprehend the electric characteristics of photovoltaic cells and modules
- Be able to assess the output of a module based on the manufacturer's STC figures
- Understand the influence of temperature on the performance of PV cells
- Understand the combination and characteristics of PV cells

Experiments:

1. Series and Parallel connection of solar cells
2. Study the temperature dependence of open-circuit voltage (Voc) and short-circuit current (Isc) of a solar cell
3. Study the variation of Voc and Isc of a solar cell with light intensity
4. I-V characteristics of a PV module-Calculation of series and shunt resistance
5. I-V characteristics of a PV module with variation in intensity of radiation.
6. P-V characteristics of a PV module with variation in intensity of radiation.
7. I-V characteristics of a PV module at different temperatures
8. P-V characteristics of a PV module at different temperatures
9. I-V characteristics with series combination of modules.
10. I-V characteristics with parallel combination of modules.
11. P-V characteristics with series combination of modules.
12. P-V characteristics with parallel combination of modules.
13. Simulation experiments using relevant and appropriate software.

REMPS506 PRACTICAL-ADVANCED SOLAR THERMAL LAB

No. of credits: 6 **No. of contact hours: 90 hours (5 hours per week)**

Aim:
To study different types of solar thermal collector systems, components, and materials used in solar heating systems and determine their parameters.

Objective:

- To learn the basics of how solar domestic hot water heating systems work
- To study different parameters affecting the performance of Solar water heating system
- To assess the performance of Parabolic Trough collector

Experiments:

1. Evaluation of different parameters of Flat-Plate Collector in thermosyphonic mode of flow with different tilt angle
2. Evaluation of different parameters of Flat-Plate Collector in forced mode of flow with fixed input parameters
3. Evaluation of different parameters of Flat-Plate Collector in forced mode of flow for different flow rate
4. Evaluation of different parameters of Flat-Plate Collector in forced mode of flow for different radiation level
5. Evaluation of different parameters of Flat-Plate Collector in forced mode of flow with different inlet water temperature
6. Evaluation of different parameters of Flat-Plate Collector in forced mode of flow for different tilt angle.
7. To determine the performance of the Parabolic Trough collector with fixed input parameters (Forced mode).
8. To determine the performance of the Parabolic Trough collector for different flow rates (Forced mode).
9. To determine the performance of the Parabolic Trough collector for different radiation level (Forced mode).
10. To determine the performance of the Parabolic Trough collector with different inlet water temperature (Forced mode).
11. To determine the performance of the Parabolic Trough collector for various wind speed (convection losses).
12. To determine the variation of mean water-temperature in the storage tank with different tank volumes
13. Simulation experiments using relevant and appropriate software.

SEMESTER 6

Course Code	Course title	Credit	Total Hrs	Hrs/ Week	Internal	External
BRCTG601	Project Management and Entrepreneurship	4	60	5	20	80
REMTG602	Energy Management and Auditing	4	60	6	20	80
REMTG603	Grid Integration	4	60	7	20	80
REMPS604	*Practical- Renewable Energy System Design Using software*	6	90	7	20	80
REMTPVS605	**Industrial Training, Final Project Report and Viva**	12	180		20	80

BRCTG601 PROJECT MANAGEMENT AND ENTREPRENEURSHIP

No. of credits: 4 **No. of contact hours: 60 (5 hours per week)**

Aim:
To provide an understanding of the key elements in project management as well as the processes and motivations of innovation and entrepreneurship.

Objectives:

- To develop entrepreneurial spirit among students
- To empower students with sufficient knowledge to start up their venture with confidence
- To mould young minds to take up challenges and become employer than seeking employment and to make them aware of the opportunities and support for entrepreneurship in India

MODULE I

Introduction to Entrepreneurship
Meaning and importance
Qualities of an entrepreneur, Functions of an entrepreneur

MODULE II
Classification of Entrepreneurship
Production sector, Service sector, Dealership
Networking and franchising. Micro Small Medium Enterprises (MSME). Steps to establish an enterprise

MODULE III
Project Identification and Management
Identification of project- Sources of project idea, Sources of business idea, Legal protection in India Trademark, Copyright patent, Financing, Subsidy

MODULE IV
Project formulation and report
Formation of a project, Stages in project formulation- Preparation of a project report, Content, Project appraisal

Reference:
1. Anjan, R. Managing New Ventures, Concepts and Cases in Entrepreneurship, New Delhi, PHI Learning Private limited.
2. Bhide A, The Origin and Evolution of New Businesses, New York, Oxford University Press.
3. Brandt, S. C. (1997). Entrepreneuring: The 10 Commandments for Building a Growth Company. New Delhi: Mc Millan Business Books.
4. Manjunath, N. (2008). Entrepreneurship & Management. Bangalore: Sanguine Technical Publishers.
5. Khanka S S- Entrepreneurial Development- S Chand and Sons
6. Desai,Vasant- Small Scale Business and Entrepreneurship- Himalaya Publications
7. AP Padnekar, Entrepreneurship, Himalaya Publishing House, Mumbai.
8. Rao, V S P- Business, Entrepreneurship and Management- Vikas Publishing House
9. Pandya, Rameswary- . Skill Development and Entrepreneurship in India, New Century Publications

REMTG602 ENERGY MANAGEMENT AND AUDITING

No. of credits: 4 **No. of contact hours: 60 (6 hours per week)**

AIM

- To encourage implementation and proper and efficient use of energy

OBJECTIVES

- To minimise energy costs / waste without affecting production & quality
- To minimise environmental effects.

MODULE 1 **(15 hrs.)**

Energy Scenario – Introduction -Types of energy sources - Indian energy scenario-Energy V/s economic growth - Energy Policies, pricing & reforms. - Energy security - Energy strategy for future

Basic of energy & its various forms - Various forms of energy - Terms & definitions used in electrical energy - Terms & definitions used in thermal energy -Energy – Units & Conversion

MODULE 2 **(15 hrs.)**

Energy Management & Audit - Definition and Objective of Energy Management - Principle of Energy Management - Energy Management skills - Energy Management Strategies

Energy Audit - Types & Methodology - Energy Audit Reporting format - understanding energy carts - Benchmarking & energy performance - Matching energy usage to requirement - Maximizing System - Fuel & energy Substitution

MODULE 3 **(15 hrs.)**

Initializing and Organizing - Managing Energy Management Programmers - Organizing Energy Management Programmers -Initializing Energy Management Programmers - Initializing Planning, Leading, Controlling - Promoting, Monitoring and Reporting.

Energy Action Planning - Key Elements - Force Field Analysis - Energy Policy - Organizing – Location of energy Manager - Top Management Support - Energy Manager: Responsibilities & duties to be assigned under energy conservation Act 2001 – accountability - Motivation of Employees - Requirements for Energy Action Planning - Information System - marketing & Communicating - Planning & Training.

MODULE 4 **(15 hrs.)**

Energy Audit Instruments - Principal and working of Electrical Measuring Instruments (Voltmeter, ammeter ,Power Factor meter, Tri-vector meters for , Speedometer contact /non-contact type) - Flue gas analyzer , Principal of measurements by Chemical Methods, Electronic Methods, - Temperature Measurement Contact type methods, Non-Contact type methods - Pressure and velocity Measurement (Bourdon gauge, Manometers, Anemometer) - Flow Measurement of steam, water and air -Humidity Measurement and leak Detectors

Reference:

1. Energy Management Handbook; Wayne C. Turner; 2001; Fairmont Press
2. General Aspects of Energy Management & Energy Audit, Bureau of Energy Efficiency

REMTG603 GRID INTEGRATION

No. of credits: 4 **No. of contact hours: 60 (7 hours per week)**

AIM

- To equip the students for qualifying Roof top grid solar engineer course by sector skill council for green jobs.
- To get acquainted with various hybrid renewable systems for power

OBJECTIVES

- To get knowledge on pre-commissioning Inspection and post commissioning testing of the Grid Connected Rooftop Solar PV Power Plant
- Maintain Personal Health & safety at project site

MODULE 1 **(15 hrs.)**

Basics of Power Grid-Generation, transmission and distribution, Substation: basic layout, substation components: protection and metering equipments, major faults,earthing - synchronisation

Reference:

- Principles of Power System, V. K. Mehta, Rohit Mehta, S. Chand Publications

MODULE 2 **(15 hrs.)**

Type of Rooftop Solar PV Power Plants and working principles-System components and operating principles- Metering arrangement for Rooftop Solar-Policy and regulatory framework-regulatory parameters for interconnection and metering arrangement including power quality of the grid-IEC standards or relevant Indian standards for rooftop PV-safety of earthing and lightning protection of the rooftop solar PV power plant-Single line diagram of a rooftop solar PV power plant

MODULE 3 **(15 hrs.)**

Metering system-import and export of energy-inverter operation-including anti-islanding functionality-overload-power quality of rooftop PV power plant: harmonics,current,voltage-power factor-Generators- Transformers (Basic Working and types)- Basic concepts of smart grid and micro grid

Reference:

- Grid Integration of Solar Photovoltaic Systems By Majid Jamil, M Rizwan, D P Kothari
- Grid-Connected Solar Electric Systems: The Earthscan Expert Handbook By Geoff Stapleton, Susan Neill
- Principles of Power System, V. K. Mehta, Rohit Mehta, S. Chand Publications

MODULE 4 **(15 hrs.)**

Hybrid energy systems

Introduction-Need for hybrid systems-**Types of hybrid systems**:PV hybrid with Diesel generator,Wind-diesel hybrid systems,Biomass diesel hybrid system,Wind-PV hybrid system,Micro Hydel- PV hybrid system, Biogas-Solar thermal hybrid system (a case study), Solar-cum-Biomass dryer Hybrid (a case study)

Electric and Hybrid electric vehicles

E-Vehicles need-Emissions-Limitations

Hydrogen powered electric vehicles-Clean mobility options

Reference

- Renewable Energy Sources and Emerging Technologies by D.P. Kothari, K. C. Singal, Rakesh Ranjan

REMPS604 PRACTICAL- RENEWABLE ENERGY SYSTEM DESIGN USING SOFTWARE

No. of credits: 6 **No. of contact hours:90 (7 hours per week)**

Aim

- To give an introduction to Software assisted design and drawing

Objectives:

- Learn to take data and transform it into graphic drawings.
- Learn basic Autocad/PVsyst/PVSol skills.
- Learn basic engineering drawing formats for Renewable Energy systems

Experiments:

1. Familiarization of Autocad/PVsyst/PV Sol
2. Introduction to basic tools
3. Drawing RE system components
4. Introduction to line diagrams
5. Basic PV system layout

Note:

After the completion of the course the students can be specialized in Rooftop Solar Grid Engineer Qualifications Pack by Skill Council for Green Jobs.

- OCCUPATION: Inspection, Interconnection and Post – Commissioning Testing, Pre-commissioning

Model Question Papers

Reg No…….

Name……...

B.Voc Degree Examination

First Semester (New Scheme)

Model Question Paper

LISTENING AND SPEAKING SKILLS IN ENGLISH

Time: Three Hours **Maximum: 80 Marks**

PART A

Answer any 10 questions. Each question carries 2 marks.

1. Describe an auto rickshaw.
2. What is intensive reading?
3. What is the difference between a definite article and an indefinite article?
4. What is rising tone?
5. What is an index?
6. What is a phrasal verb?
7. Who is a good reader?
8. What is an embedded question?
9. Write a few phrases which can be used to express mild disagreement.
10. What are the three functions of conjunctions?
11. What are grammatical words?
12. What are people skills?

PART B

Answer any 6 questions. Each question carries 5 marks.

13. What is telephone etiquette?
14. Who is an active listener?
15. Prepare a vote of thanks to be presented for the residents' association meeting.
16. Write short note on conjunctions.
17. What are the features of fluent speech?
18. You are a project leader. Introduce the members of your team to a visiting dignitary.
19. Write a short note on reading for a purpose.
20. What are the steps in cancelling and rescheduling appointments?
21. Describe the qualities of your college to your friends.

PART C

Answer any 2 questions. Each question carries 15 marks.

22. Discuss ' the importance of social media' with two other participants in a group discussion.
23. a) Write a conversation with your panchayath member, complaining about the lack of streetlights.
    b) Write a model interview you make with an actor.
24. Write a note on subject-verb agreement.
25. What are the roles and functions in a group discussion?

Reg No…….

Name……..

B.Voc Degree Examination

Model Question Paper

First Semester B. Voc Renewable Energy Management

Mathematics

Time:3 hrs Maximum Marks:80

Section A

*Answer any **ten** of the following questions, each in two or three sentences. Each question carries 2 marks:*

1. Define power set. Write the power of {1,2,3}
2. Define the rank of a matrix.
3. Write the first derivative test.
4. Write the formula for false position method.
5. What are equivalence relations?
6. Write the transpose of matrix A = $\begin{bmatrix} 3 & 1 & 5 \\ 2 & 6 & 4 \\ 8 & 7 & 9 \end{bmatrix}$
7. Evaluate $\lim_{x \to 0} \left(\frac{e^{3x} - 1}{x} \right)$
8. Write down the condition for the convergence of the iterative method.
9. Explain inverse of a function with example.
10. If A = $\begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and B = $\begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$, then find A+B.
11. Find $\frac{\partial f}{\partial x}, where\ f(x, y) = 2x^2 - 3y - 4$
12. Distinguish between pictograph and cartogram.

(10x2 = 20)

Section B

*Answer any **six** of the following questions, each in about 100 words. Each question carries 5 marks:*

13. Find all partitions of S= {1,2,3,4}
14. If A = $\begin{bmatrix} 1 & -1 & 1 \\ -3 & -2 & -1 \\ -2 & 1 & 0 \end{bmatrix}$ and B = $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix}$, then find AB.

15. Find $\lim_{x\to 0}\left(\frac{Sin\ 2x}{Sin\ 3x}\right)$

16. Find the positive root of f (x) = $2x^3$ - 3x - 6 = 0 by Newton - Raphson method.

17. Find a formula for the inverse of $f(x)=\frac{2x-3}{5x-7}, x\neq\frac{7}{5}$. What is the domain of f^{-1}?

18. Find the rank of A = $\begin{bmatrix}1 & 2 & 3\\ 2 & 4 & 5\\ 3 & 5 & 6\end{bmatrix}$

19. Explain mean value theorem.

20. What is a Pie diagram? Illustrate with an example.

21. Distinguish between pictogram and cartogram

(6x5 = 30)

Section C

*Answer any **two** of the following questions, each in about 300 words. Each question carries 15 marks:*

22. Define an equivalence relation. Let A be a set of integers, and let ~ be a relation on A×A defined by (a,b) ~ (c,d) if a+d =b+c:

I. Prove that ~ is an equivalence relation.

II. Suppose A = {1,2,3,……..,8,9}, Find the equivalence class of (2,5).

23. Find the inverse of matrix A = $\begin{bmatrix}1 & 0 & -1\\ 3 & 4 & 5\\ 0 & -6 & -7\end{bmatrix}$

24. a) State continuity test. Find the value of k so that $f(x)=\begin{cases}x, & x<-2\\ kx^2 & x\geq -2\end{cases}$

b) Find $\frac{dy}{dx}$ if (i) y=$\left(\frac{x^2}{8}+x-\frac{1}{x}\right)^4$; (ii) y= sec(tan x).

25. Find the positive root of x^3 -x - 1 = 0 correct to four decimal places by Bisection method.

(2x15=30)

Reg No…….

Name……..

B.Voc Degree Examination

Model Question Paper

First Semester B. Voc Renewable Energy Management

Basic Electrical and Electronics

Time:3 hrs Maximum Marks:80

Section A

Answer any **ten** *of the following questions, each in two or three sentences. Each question carries 2 marks:*

1. Name the various system of units.
2. Write down the difference between water clock and sundial.
3. What is the difference between a voltmeter and ammeter.?
4. State Ohm's law.
5. Write any two advantages of AC.
6. Define form factor.
7. What are the different types of rectifiers.
8. How does LDR work.
9. What is the function of filter?
10. What is the difference between fixed and variable resistors.
11. List any four types of switches.
12. What is multi core wire.

(10x2 = 20)

Section B

Answer any **six** *of the following questions, each in about 100 words. Each question carries 5 marks:*

13. Why are units important in measurement.
14. How does a digital multimeter work.
15. Define Resistance. What are the factors influencing resistance?
16. What are the types of electrical circuits. Explain.
17. Differentiate between delta and star connection.
18. Explain zener diode as a voltage regulator.
19. What is the difference between clipping and clamping.
20. What is the difference between coaxial and fiber optic cables.
21. Explain any two of switches and write down any two applications.

(6x5 = 30)

Section C

Answer any **two** *of the following questions, each in about 300 words. Each question carries 15 marks:*

22. Briefly explain (a) Galvanometer (b) Voltmeter (c) Ammeter
23. Explain -Kirchhoff's current and voltage laws.
24. Write a note on PN junction diode and explain V-I characteristic.
25. Write short notes on (a) Capacitors (b) Switches (c) Relays

(2x15=30)

Reg No…….

Name……..

B.Voc Degree Examination

Model Question Paper

First Semester B. Voc Renewable Energy Management

Fundamentals of sustainable energy & development

Time:3 hrs Maximum Marks:80

Section A

Answer any **ten** *of the following questions, each in two or three sentences. Each question carries 2 marks:*

1. What are renewable energy sources?
2. What are non conventional energy sources?
3. Define solar constant.
4. Explain power coefficient of a wind turbine.
5. What are primary energy sources?
6. What is air mass? Explain.
7. Define Solar altitude angle.
8. State the advantages of geothermal energy.
9. Explain thermochemical conversion
10. State the advantages of renewable energy.
11. Give the basic principle of wind energy conversion
12. What is biodiesel?

(10x2 = 20)

Section B

Answer any **six** *of the following questions, each in about 100 words. Each question carries 5 marks:*

13. Explain conventional energy sources with examples.
14. Discuss the need of renewable energy sources in the present scenario.
15. State and explain the principle of a solar cell.
16. Discuss two applications of solar energy which are most success today.
17. Briefly explain any one type of biogas plant.
18. What are the parameters affecting biogas production.
19. Define magneto-hydrodynamic energy system.
20. Explain solar-wind hybrid system.
21. What are the basic components of wind energy conversion system.

(6x5 = 30)

Section C

Answer any **two** *of the following questions, each in about 300 words. Each question carries 15 marks:*

22. Discuss on any one renewable energy system which suits best for locality.Explain the reason and advantages.

23.Explain the methods for maintaining biogas production.

24. Give an account on different types of wind machines.

25. Prepare notes on (a) Tidal Energy (b) Geothermal Energy (c) Hydrogen Energy

(2x15=30)

Reg No…….

Name……...

B.Voc Degree Examination

Second Semester (New Scheme)

Model Question Paper

WRITING AND PRESENTATION SKILLS IN ENGLISH

Time: Three Hours **Maximum: 80 Marks**

PART A

Answer any 10 questions. Each question carries 2 marks.

1. What is a resume?
2. What is a group discussion?
3. What is a project report
4. What is proxemics?
5. What is a letter of enquiry?
6. What is a flip chart?
7. What is a seminar?
8. What is a power of attorney?
9. What is netiquette?
10. What are narrative essays?
11. What are the components of a typical seminar paper?
12. What is paralanguage?

(10x2 = 20)

PART B

Answer any 6 questions. Each question carries 5 marks.

13. What are the important points to be considered while sending collection letters?
14. What is a channel of communication? What are the different types of channel of communication?
15. Write a letter to the editor about the street dog menace in your city.
16. You want to sell your book collection. Prepare a notice to be put up in the college notice board.
17. Write a short note on Kinesics.
18. Prepare an agenda for the monthly board meeting of your firm.
19. What are the points to be remembered while filling an application form?
20. You are the owner of a supermarket. Write a letter inviting quotations from a wholesale dealer.
21. Write a short note on visual aids that are often used in presentations.

(6x5 = 30)

PART C

Answer any 2 questions. Each question carries 15 marks.

22. You are Ravi/Jaya. Prepare an application letter and a resume for the post of an assistant engineer.
23. Write an essay arguing for or against single sex educational institutions.
24. What are the barriers to effective communication? How can we overcome them?
25. Write a descriptive essay about your favourite place.

(2x15=30)

Reg No…….

Name……..

B.Voc Degree Examination

Model Question Paper

Second Semester B. Voc Renewable Energy Management

Fundamentals of Electrochemistry

Time:3 hrs Maximum Marks:80

Section A

Answer any **ten** *of the following questions, each in two or three sentences. Each question carries 2 marks:*

1. What is the difference between Conductors & Insulators?
2. Define Molar Conductivity of solutions?
3. How does the concentration of a solution affect its specific conductivity?
4. List out the types of salts that undergo hydrolysis?
5. What are different types of reversible electrodes?
6. What are the characteristics of electrochemical series?
7. What is EMF of a cell?
8. What are the advantages of Potentiometric titrations over Ordinary titrations?
9. Write a short note on Grothus-Draper law?
10. Define Photosensitization?
11. Explain Beer-Lambert's law?
12. What are the difference between photosystem I and photosystem II?

(10x2 = 20)

Section B

Answer any **six** *of the following questions, each in about 100 words. Each question carries 5 marks:*

13. Explain types of electrolytic conductors & factors affecting electrolytic conduction?
14. Briefly describe Kohlrausch's law and its applications?
15. Explain Faraday's First & Second law of electrolysis?
16. Describe the working of Galvanic cells?
17. What is Nernst equation and its application?
18. What is conductometric titration procedures and its different types?
19. Explain the laws of photochemistry?
20. Draw and explain Jablonsky diagram in molecular spectroscopy?
21. What is the principle of Amperometric titration?

(6x5 = 30)

Section C

Answer any **two** *of the following questions, each in about 300 words. Each question carries 15 Marks:*

22. How transport number is determined using Hittorf's method? Also, describe the Ostwald's dilution law?
23. What are the significance of Liquid junction potential? Explain the effect of electrolyte concentration on electrode potential and EMF?
24. Describe in detail, Coulometry and Voltammetry methods of analysis?
25. Write a note on
    a) Flash Photolysis
    b) Chemiluminescence

(2x15=30)

Reg No…….

Name……..

Mahatma Gandhi University

Model Question Paper

Second Semester B. Voc Renewable Energy Management

Photovoltaic Module Installation

Time:3 hrs Maximum Marks:80

Section A

Answer any **ten** *of the following questions, each in two or three sentences. Each question carries 2 marks:*

1. What are hotspots? Explain.
2. What are the merits of grid controlled inverter.
3. What is the purpose of on site visit.
4. How can we minimise cable losses.
5. Briefly explain the uses of I-V curves.
6. What is a string diode.
7. Give the checklist for building survey.
8. Explain sizing techniques for inverters.
9. Obtain the irradiance dependence of PV modules.
10. Give the main function of DC main cable.
11. What is meant by sun path diagram.
12. What is surge protection.

(10x2 = 20)

Section B

Answer any **six** *of the following questions, each in about 100 words. Each question carries 5 marks:*

13. Explain the fabrication of Czochralski process.
14. Write a note on DC main switch and AC switch disconnector..
15. Discuss shading analysis using software.
16. Give an account on choosing the number and power rating of inverters.
17. Obtain the efficiency of solar cells.

18. Discuss the properties of grid controlled inverters.
19. Obtain the advantages, limitations and considerations for site surveys.
20. Bring out the sub array and string for inverters.
21. Obtain a comparison of series and parallel connections of PVs.

(6x5 = 30)

Section C

*Answer any **two** of the following questions, each in about 300 words. Each question carries 15 marks:*

22. Discuss the design options for PV modules.
23. Describe the self commuted inverters with pros and cons.
24. Discuss the on site visit and site surveys as per customers requirements.
25. Bring out the planning and sizing of grid connected PV systems.

(2x15=30)