Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

Curriculum Structure and Syllabus

of

B. Voc. Solar System

(Regulations 2023)

Effective from Academic Year 2024-25

Institute Vision

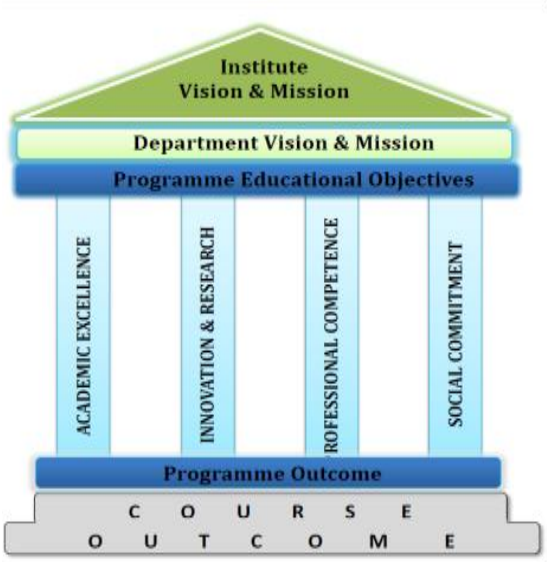
To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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ABBREVIATIONS

Abbreviations	Course Full Name
MJ	Major Course
MI	Minor Course
MD	Multidisciplinary Course
AEC	Ability Enhancement Course
VAC	Value added Course
SEC	Skill Enhancement Course
FA	Formative Assessment
SA	Summative Assessment

CURRICULUM STRUCTURE

STRUCTURE FOR IST YEAR B. Voc. (SOLAR SYSTEMS)

SEMESTER I

B. Voc. Structure		Sem-I	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Total**
VSS21101	MJ	Major Course I:: Fundamentals of Solar Energy I	3	-	3	3	25	25	50	-	-	-	100
VSS21201	MI	Minor Course I: Engineering Drawing	3	-	3	3	25	25	50	-	-	-	100
VSS21301	MD	Multidisciplinary Course I: Applied Science	2	-	2	2	20	20	40	-	-	-	80
VSS21401	AEC	Ability Enhancement Course I: Writing skills		2	2	1	-	-	-	50	-	-	50
VSS21501	VAC	Value added Course I: Health & wellness		2	2	1	-	-	-	50	-	-	50
VSS21601	SEC	Internship I: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

SEMESTER II

B. Voc. Structure		Sem-II	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Total**
VSS22102	MJ	Major Course II: Fundamentals of Solar Photovoltaic Energy systems	3	-	3	3	25	25	50	-	-	-	100
VSS22202	MI	Minor Course II: Basics of Electrical & Electronics	3	-	3	3	25	25	50	-	-	-	100
VSS22302	MD	Multidisciplinary Course II: Applied Mathematics	2	-	2	2	20	20	40	-	-	-	80
VSS22402	AEC	Ability Enhancement Course II: Soft Skills		2	2	1	-	-	-	50	-	-	50
VSS22502	VAC	Value added Course II: IT Tools I		2	2	1	-	-	-	50	-	-	50
VSS22602	SEC	Internship II: On Job Training.	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA**-Summative Assessmen; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

STRCTURE FOR IIND YEAR B. Voc. (SOLAR SYSTEMS)
SEMESTER III

B. Voc. Structure		Sem-III	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VSS23103	MJ	Major Course III: Fundamental of Solar Energy II	2	-	2	2	20	20	40	-	-	-	80
VSS23104	MJ	Major Course IV: Fundamental of Solar Energy II Lab	-	2	2	1	-	-	-	-	-	50	50
VSS23203	MI	Minor Course III: Design and Development of solar Liquid Flat Plate Collector	2	-	2	2	20	20	40	-	-	-	80
VSS23204	MI	Minor Course IV: Design and Development of solar Liquid Flat Plate Collector Lab	-	2	2	1	-	-	-	-	-	50	50
VSS23303	MD	Multidisciplinary Course III: IT Tools II	2	-	2	2	20	20	40	-	-	-	80
VSS23403	AEC	Ability Enhancement Course III: Business Communication I		2	2	1	-	-	-	50	-	-	50
VSS23503	VAC	Value added Course III: Health & Wellness II		2	2	1	-	-	-	50	-	-	50
VSS23603	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**6**	**28**	**34**	**20**	60	60	**120**	**100**	**-**	**300**	**640**

SEMESTER-IV

B. Voc. Structure		Sem-IV	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Total**
VSS24105	MJ	Major Course V: Fundamental of Solar Energy III	2	-	2	3	25	25	50	-	-	-	100
VSS24106	MJ	Major Course VI: Fundamental of Solar Energy III Lab	-	2	2	1	-	-	-	-	-	50	50
VSS24205	MI	Minor Course V: Design and Development of Solar Air Heater	2	-	2	2	20	20	40	-	-	-	80
VSS24404	AEC	Ability Enhancement Course IV: Business Communication II		2	2	1	-	-	-	50	-	-	50

VSS24504	VAC	Value added Course IV: Environmental Science		2	2	1	-	-	-	50	-	-	50
VSS24604	SEC	Project I: Mini Project	-	4	4	2	-	-	-	-	-	50	50
VSS24605	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**4**	**30**	**34**	20	45	45	**90**	**100**	**-**	**300**	**580**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA-**Summative Assessmen; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

FOR IIIRD YEAR B. Voc. (SOLAR SYSTEMS)
SEMESTER V

B. Voc. Structure		Sem-V	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VSS25106	MJ	Core Course VI	2	-	2	3	25	25	50	-	-	-	100
VSS25107	MJ	Core Course VII	-	2	2	1	-	-	-	-	-	50	50
VSS25108	MJ	Core Course VIII	2	-	2	3	25	25	50	-	-	-	100
VSS25109	MJ	Core Course IX	-	2	2	1	-	-	-	-	-	50	50
VSS25206	MI	Pr. Sp. Course VI	2	-	2	2	20	20	40	-	-	-	80
VSS25606	SEC	Internship V: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**6**	**24**	**30**	20	70	70	**140**	**-**	**-**	**300**	**580**

SEMESTER-VI

B. Voc. Structure		Sem-VI	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**T W**	**OR**	**PR**	**Tota**
VSS26110	MJ	Core Course X	2	-	2	**3**	**25**	**25**	**50**	-	-	-	100
VSS26111	MJ	Core Course XI	-	2	2	1	-	-	-	-	-	50	50
VSS26207	MI	Pr. Sp. course VII	2	-	2	2	20	20	40	-	-	-	80
VSS26607	SEC	Project II: Project	-	8	8	4	-	-	-	50	150	-	200
VSS26608	SEC	Internship VI: On Job Training	-	20	20	10	-	-	-	-	-	200	200
Total			**4**	**30**	**34**	**20**	**45**	**45**	**90**	**50**	**150**	**250**	**630**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits **FA–**Formative Assessment**, SA-**Summative Assessmen; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

Course Syllabus
Semester-I

Program:	**B. Voc. (Solar Systems)**				**Semester: I**	
Course:	**Fundamentals of Solar Energy**				**Code: VSS21101**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To understand the basic of solar energy appliances and can perform the maintenance of solar appliances independently

Course outcomes:

After learning the course, student will be able to

1. gain a solid understanding of the fundamental principles, and concept related with solar energy.
2. gain the knowledge of handling instruments for measuring solar radiation.
3. gain the knowledge of handling the liquid flat plate collector
4. design a simple conventional liquid flat plate collector
5. design a simple conventional solar air heater
6. gain the knowledge of handling concentric collector

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Introduction**: Energy Scenario in India, Potential of Solar Energy, Availability of solar radiation in India, Calculation of solar irradiance at surfaces. Properties of sunlight. Absorption by the atmosphere.	**8**
2	**Solar Radiation**: Instruments for measuring solar radiation and sun shine, solar radiation data, Solar energy geometry, Applications of solar energy.	**7**
3	**Liquid Flat Plate Collector** Construction of liquid flat plate collector, Performance analysis, transmissivity of the cover system, Overall lost coefficient, flat plate collector with plane reflector.	**8**
4	**Liquid Flat Plate Collector** Collector efficiency factor, collector heat removal factor, Effect of various parameters on performance, Simple numerical based on performance of Liquid flat plate collector.	**8**
5	**Solar Air Heater** Constructional detail of simple solar air heater, Performance analysis of conventional solar air heater, Other types of solar air heaters, applications of solar air heater	**7**
6	**Concentric Collectors** Constructional detail of a simple conventional concentric collector, Cylindrical parabolic collector, Compound parabolic collector, Paraboloid dish collector	**7**

Reference Books:

1. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, New York, Jui Sheng Hsieh, Solar Energy Engineering, Prentice-Hall, 2013.
2. Sukhatme S.P. and Panchal, Solar Energy, Tata McGraw Hills., 4th Edition, 2014.
3. Sushil-Kumar, T. B., *Building Construction*, 19th Ed. Delhi: Standard Pub. Distributors, 2003.

Program: B. Voc. (Solar Systems)					**Semester: I**	
Course: Engineering Drawing					**Course Code: VSS21201**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To develop imagination of physical objects to be represented on paper for engineering communication.
2. To develop the interpretation and manual drawing skills.
3. To develop the physical realization and manual drawing skill

Course Outcomes:

After learning the course, students will be able to

1. Understand the drawing sheets, dimensioning and tolerances
2. Understand and draw the projections of point and line on reference planes, inclined planes.
3. Understand the orthographic projections, first and third angle projections methods, draw orthographic views
4. Understand and draw the Isometric scale, construction of Isometric view of simple objects
5. Understand and draw the development of lateral surfaces of simple solids.
6. Understand and draw the free hand sketches of standard components of machine.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Introduction** Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances.	7
2	**Projection of Line and Planes** Introduction, Projection of points – points on the different quadrants and on the reference planes. Projection of straight lines (only first angle projection method) – Line on the reference planes - perpendicular to one plane and parallel to other plane – inclined to one plane and parallel to the other plane – parallel to both the planes –inclined to both the planes. Projection of planes (only first angle projection method) - Types of planes, Projection of planes perpendicular to both the reference planes, Perpendicular to one plane and parallel to other plane, Perpendicular to one plane and inclined to the other plane, Inclined to both planes.	8

3	**Orthographic Projections** Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic views by First angle method.	6
4	**Isometric View** Introduction, Isometric scale, construction of Isometric view of simple objects from given orthographic.	8
5	**Development of Lateral Surfaces of Solids** Introduction, Development of lateral surfaces of Cone, Cylinder, Pyramid and Prism.	8
6	**Freehand Sketching and introduction of AutoCAD software** Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, human heights, doors, windows	8

Text Books:

1. Bhatt N.D., and Panchal V.M., *Engineering Drawing, Charotar Publishing House*, 2010.
2. Agrawal B., and Agrawal C M "*Engineering drawing*", Tata McGraw Hill Education Private Limited., 2014.

Reference books:

1. Gill P.S., *Engineering drawing*, S.K. Kataria & Sons., 2016.
2. Gopalakrishnan.K.R., *Engineering Drawing*, (Vol.I and Vol.II), Dhanalakshmi publishers, 1970.
3. Venugopal. K, and Sreekanjana G., *Engineering Graphics*, New Age International Publishers. 2019.
4. Natarajan K. V., *A text book of Engineering Drawing Graphics*. Dhanalakshmi Publishers, 2008.

Program:	**B. Voc. (Solar Systems)**		**Semester: I**			
Course:	**Applied Science**		**Code: VSS21301**			
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

To develop an ability of understanding the phenomena with the help of science concepts and relate them to applications.

Course Outcomes:

After learning the course, students will be able to

1. Understand the quality of water, its softening techniques and quality of fuel and its different types.
2. Interpret the optical phenomena - reflection, refraction, polarization with wave nature of light.
3. Understand what is corrosion, its types and its consequences in environment.
4. Summarize production of ultrasonic waves and their applications.

Detailed Syllabus:

Unit	**Description**	**Duration (30Hrs)**
1	**Water** Impurities in water, methods of their removal, hardness of water, its types and units. Chemical analysis of water by determination of hardness by EDTA method and its numericals. Disadvantages of hard water in boilers, Water softening techniques: Permutit Water purification by reverse osmosis **Fuel and their Classification** Definition, characteristics, classification into solid, liquid and gaseous fuel. Calorific value of fuels – GCV, NCV and their relation. Coal, its types and their properties, proximate analysis and ultimate analysis. Gaseous fuels- Gaseous fuels: Hydrogen gas as a future fuel, production by steam reforming of methane and coke, storage and transportation. .	8
2	**Optics:** Electromagnetic wave nature of light, electromagnetic spectrum, reflection and refraction of a wave from a plane surface, laws of reflection and refraction, total internal reflection, plane polarized light, Law of Malus.	8
3	**Corrosion** Theory of corrosion. Different types of corrosion: Pitting corrosion, concentration cell corrosion, stress corrosion and soil corrosion. Factors affecting corrosion: nature of metal and nature of environment. Prevention of corrosion by various methods using metallic and non- metallic coatings like – hot dipping, cladding, electroplating and cementation and powder coating.	7
4	**Vibrations &Ultrasonic waves:**	7

	Vibration as simple spring mass system, elementary and qualitative concept of free and forced vibrations, resonance Ultrasonic waves, properties of ultrasonic waves, Productions of ultrasonic waves by magnetostriction and piezo-electric effect,application of ultrasonic in industry	

Text Books:

1. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Co., sixteenth edition ,2016.
2. M. N. Avadhanulu ,P.G. Kshirsagar , A text book of Engineering Physics, S. Chand publication ,revised edition, 2015

Reference books:

1. Wiley Editorial, Engineering Chemistry, Wiley India, 2nd edition, 2012.
2. O.G. Palanna, Engineering Chemistry, Tata McGraw-Hill Education, 2009.
3. R. K. *Gaur*, S. L. *Gupta* , Engineering Physics, Dhanpat Rai Publications, 8th edition ,2001.

Program: B. Voc. (Solar Systems)					**Semester: I**	
Course: Writing Skills					**Code: Code: VSS21401**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce students to effective writing.
2. To expose students to various types of documents
3. To equip students with fundamental skills for effective written communication.

Course Outcomes: After learning the course students will;

1. Understand different writing styles such as descriptive and narrative writing.
2. Write summaries and persuasive letters
3. Write business emails and structured reports
4. Write job applications and resume/CV for job purposes

Detailed Syllabus:

Sr No	Description
1	**Introduction to Effective Writing Skills** Aspects and characteristics of writing skills. Importance of effective writing Skills.
2	**Effective Writing** Structure, Cohesion and Coherence, Grammar, Correctness, Completeness, Logic and other aspects of effective writing skills
3	**Write a descriptive paragraph:** Write a descriptive paragraph about a person, place, or object. Encourage them to use sensory details and vivid language to create a picture in the reader's mind**.**
4	**Write a personal narrative:** Write a personal narrative about a memorable event. Use descriptive language, dialogue, and reflection to make the story come alive.
5	**Write a summary and response:** Read an article or essay and write a summary of the main points, followed by a personal response that explains your thoughts and reactions to the piece.
6	**Writing instructions** Writing clear, concise and compete instructions
7	**Write a persuasive letter** Write a persuasive letter to a local or national government representative, expressing your opinions on a current issue or proposing a solution to a problem.
8	**Business email writing:** Write a business email on a given scenario. Write a formal email, using appropriate tone, format, and language.
9	**Report writing assignment:** Write a report on a given topic. Use clear prompt, a report outline, in a structured and professional format, using appropriate language and terminology.
10	**Job Application/ Cover Letter:** Write a job application in a professional format with all the necessary details.

Instructions:

- First lab activity is mandatory
- Any six assignments other than first lab activity to be conducted

Reference Books:

1. Seely, John. Oxford Guide to *Effective Writing and Speaking*. OUP 2nd edition, 2005
2. Goins, Jeff. *You Are a Writer* (So Start Acting Like One). Tribe Press
3. Brohaugh, William. *Write Tight: Say Exactly What You Mean with Precision and Power*.
4. Janzer. Anne. *The Writer's Process: Getting Your Brain in Gear*. Cuesta Park Consulting, 2016
5. King, Stephen. *On Writing: A Memoir of the Craft*. Scribner, 2010

Program: B. Voc. (Solar Systems)					**Semester: I**	
Course: Health and wellness I					**Code: Code: VSS21501**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals.
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice.

Course Outcomes: After learning the course students will be able to;

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Guideline:

Total: Any 5 experiments/assignments to be conducted

Detailed Syllabus:

Sr.No	Description
1	**Psychology of happiness:** What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions.
2	**Can we become happier?** Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities.
3	**Happiness Activities 1:** Expressing gratitude and positive thinking; Love and kindness; Avoiding overthinking and social comparison.
4	**Happiness Activities 2:** Identifying signature strengths; achieving happiness with “Flow”.
5	**Is happiness sufficient?** The concept of eudaimonic well-being; Self-determination and motivation.
6	**Meaning and purpose in life:** The concept of meaning in life and logo-therapy; Life goals., correlation with program specific case studies.

Reference Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life*: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, *Stress, Health and well-being:* Thriving in the 21st century, Wadsworth Publishing, 2013.
3. I. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program: **B. Voc. (**Solar Systems**)**				**Semester: I**		
Course: **On Job Training**				**Code: V**SS**21601**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. To expose students to the industry environment and enhance their technical skills while working in private/public enterprises, government agencies, research labs, or any other organized technical club.
2. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
3. To develop higher-order thinking skills to work with people of diverse backgrounds and cultures and work effectively within cross-disciplined environments.

Course Outcomes

After learning the course, students will be able to

1. To apply the theoretical knowledge in real-life applications with new perspectives to problem-solving.
2. To practice communication and teamwork skills while building a professional network of prospective employment.
3. To write technical reports and document the project outcomes along with enhancing the technical presentations skills

Guidelines:

Students will take on job training in the industry in the domain of Solar Systems as per the following job description and personal attributes.

Job Role: Solar PV System Installation Engineer

	Job Description
	The individual at work evaluates the installation site, designs the installation, plans and arranges for materials, and ensures smooth installation process. The individual also supervises the installation technicians' work
	Personal Attributes
	The individual must have: attention to detail, good eye sight, logical thinking, analytical ability and good interpersonal skills.

Course Syllabus
Semester-II

Program:	**B. Voc. (Solar Systems)**				**Semester: II**	
Course:	**Fundamentals of Solar Photovoltaic Energy systems**				**Code: VSS22102**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course-Objective:

To understand the basic of solar PV and can perform the maintenance of solar PV independently

Course Outcomes:

After learning the course, student will be able

1. To understand solar PV technology.
2. To understand PV specification and output.
3. To understand the effect of various parameter on the performance of PV system.
4. To know the system components of PV system.
5. To understand the various grid system.
6. To understand customer needs and suggesting the right solution.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	*Introduction : Basic of PV, Conversion of solar energy to electricity,* Voltage, current and power Electrical Circuits, Electrical Components	**8**
2	*Solar PV specifications and output:* measurement of the power output from a solar module, Solar PV Module Specifications, Standard Test Conditions, expected output from a 1KW solar PV system, Predicting Output, change of PV output when the condition is different from STC, Series and Parallel Connections, interpretation of connection specification of a solar PV module	**8**
3	*Solar PV output variation:* Sun path and tilt angle, direction and orientation of solar modules for attaining maximum output, PV Panel tilt angle, effect of tilt angle on a solar module, Effect of shading on solar modules	**7**
4	*Solar PV system components:* Basic working of a solar system, stand-alone system, PV system components, Working of DC and AC solar PV systems, How solar energy is converted to DC and AC electrical power using solar PV technology, Power Electronic convertors (DC-DC, DC-AC , MPPT)	**8**
5	**Solar PV system types**: Stand-alone System, Grid-tied System, Hybrid System, System Types and Components of DC off-grid system, Application of solar PV systems, Electric vehicle charging (PV to EV)	**7**
6	*Customer needs and solutions :* Understanding customer needs and suggesting the right solution, creating block diagram for a grid-tied system	**7**

Text Books:

1. Solanki C.S., *Solar Photovoltaics: Fundamentals, Technologies And Applications*, PHILearning private Ltd., 2018.
2. Rai G.D., *Non-conventional Sources of Energy*, Khanna Publishers,2012.

Reference Books:

1. NaganagoudaH.,*Solar Power Hand Book*, PHI School Books, 2014.
2. Solanki Chetan Singh, *Renewable Energy Technologies; A Practical Guide for Beginners*, PHI School Books 2008.
3.Kothari D.P., and Signal K.C., *Renewable Energy Sources and Emerging Technologies*, PHI, 2011.

Program:	**B. Voc. (Solar Systems)**				**Semester: II**	
Course:	**Basics of Electrical & Electronics**				**Code: VSS22202**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To build strong conceptual understanding and fundamentals of basic electrical circuit, single phase and polyphase AC systems.
2. To impart basic knowledge for conceptual understanding of DC and AC machines
3. To acquire the basic knowledge of digital and analog electronics.
4. Familiarize students with various electrical measuring instruments and drives used in electrical and electronics engineering

Course Outcomes: After learning the course, students will be able to

1. Understand fundamental concepts of electrical engineering, DC circuits and work power and energy.
2. Apply the knowledge of single phase and three phase circuits to determine unknown electrical quantities.
3. Demonstrate the constructional features and operational details of DC and AC machines
4. Understand the concept of a number system and logic gates to implement any logic function.
5. Understand the characteristics and applications of Zener diodes, PN junction diode, LED and Photo diode.
6. Describe the different types of electrical drives and instruments used for voltage, current, and power measurements in various industrial applications.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Elementary Concepts:** Concept of Potential difference. Current and resistance. Series and parallel circuits, Voltage and current dividers, Power and energy calculations, Ohm's law, Kirchhoff's Law, SI units of work Power and Energy, Conversion of energy from one form to another (Electricity bill verification as an activity)	7
2	**Single phase and poly phase A. C. circuits:** Generation of single phase sinusoidal A.C. voltages, AC quantities, phasor representation, Pure R, Pure L, and Pure C circuits, impedance, admittance, concept of active, reactive, apparent power and power factor. **(Verification of power factor for RL and RC circuit on multisim)** Polyphase A.C. Circuits: Introduction to 3 phase supply and its necessity, balance three phase system, relation between line and phase quantities (with phasor diagram), power in three phase circuits for star and delta connection **(Verification of line and phase values for star and delta on simulation platform)**	7

3	**DC and AC machines** **DC Machines:** Construction, working principle of D.C. generator, emf equation of DC generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, Back emf (Numerical), Industrial applications. **(Demonstration of machine parts)** **AC Machines:** Single phase transformers: Construction, operating principle, emf equation, voltage and current ratios. Losses, Efficiency and regulation, Autotransformer. **(Understating of direct loading test on single phase transformer)**	8
4	**Fundamentals of Digital Electronics: Number System:** Introduction to number system, Conversion of number systems, Binary Code, 1's complement and 2's complement, Introduction to Digital Electronics: Basic logic Gates, Boolean Postulates/laws, De-Morgan Theorems. **(Verification of logic gates on digital trainer kit)**	7
5	**Basics of Semiconductor:** The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED, Photodiode **(Demonstration of above devices on Virtual labs)**	8
6	**Measuring instrument and drives:** Measurement of Voltage, Current, and Power, Study of Energy meters, Use of CT and PT for measurement of power /energy in single phase and three phase Drives: Advantages of electrical and electronic drives, individual and group drive, selection of drives depending on load characteristics. **(Case study on selection of drive)**	8

Text Books:

1. I. J. Nagrath and Kothari (PHI learning Pvt.Ltd). "*Theory and problems of Basic Electrical Engineering*, Eastern Economy Edition.

2. Ashfaq Husain. "*Fundamentals of Electrical Engineering*", 4 th Edition, Dhanpat Rai & Co.),

3. V. N. Mittal and Arvind Mittal,. "*Basic Electrical Engineering*", 2 nd Edition, McGrawHill.

4. V.K. Mehta. "*Basic Electrical Engineering*", 1 st Revised Edition ,S. Chand & Co. Pvt. Ltd. NewDelhi.

5. R.P. Jain, Modern Digital Electronics, Prentice Hall of India,New Delhi 4 th edition

Reference Books:

1. D. C. Kulshreshta . "*Basic Electrical Engineering" ,1 st Edition ,Tata McGraw hill.*

2. B. L. Theraja and A. K. Theraja S. *A textbook of Electrical Technology Vol I S. Chand &*

amp; Co. Pvt. Ltd. New Delhi,1 st Edition.

3. B. L. Theraja and A. K. Theraj . *A textbook of Electrical Technology Vol II , S. Chand & amp; Co. Pvt. Ltd. New Delhi,1 st Edition*

4. Edward Hughes. *"Electrical Technology", 10 th Edition* ,Pearson.Ltd..

5. A. K. Sawhney Publisher*: Dhanpat Rai Publications,"* A Course in Electrical and Electronic Measurements and Instrumentation.

6. R. L. Boylestad & Louis Nashlesky *Electronic Devices Circuit Theory*, Pearson Education.

Program:	**B. Voc. (Solar Systems)**				**Semester: II**	
Course:	**Applied Mathematics**				**Code: VSS22302**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives: This course aims at enabling students,

1. To familiarize with concepts and techniques in Elementary Calculus and Matrices.
2. To get acquainted with statistic and probability techniques.

Course Outcomes: After learning the course, students will be able to

1. Understand concepts of determinants and matrices and apply to solve simultaneous linear equation system.
2. Solve differentiation and integration of different types of functions.
3. Understand the concepts related to algebra of vectors.
4. Apply statistic and probability techniques on different types of numerical data.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1.	**Linear Algebra:** Determinants: Definition and expansion of determinants of order 2 and 3, Cramer's rule to solve simultaneous equations in 2 and 3 unknowns Matrices: Definition of a matrix of order m X n and types of matrices, Algebra of matrices, Transpose of a matrix, Minor, cofactor of an element of a matrix, Adjoint of matrix and inverse of matrix by Adjoint method, Solution of simultaneous equations containing 2 and 3 unknowns by matrix inversion method.	7
2.	**Calculus:** **Differentiation:** Definition of derivatives, notations, Derivatives of standard functions, Rules of differentiation, Differentiation of Trigonometric, Exponential and Logarithmic function, Application of Derivatives: Geometrical meaning of derivative, tangent and normal, Maxima and minima. **Integration:** Definition of integration as anti-derivative. Integration of standard function, Rules of integration.	8
3.	**Vectors and Three-Dimensional Geometry:** Introduction to Three-Dimensional Geometry, Vectors: Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) Dot (Scalar) product with properties, Vector (Cross) product with properties.	7
4.	**Statistics and Probability:** Measures of central tendency (mean, medium & mode) for ungrouped and grouped frequency distribution, Measures of Dispersion: range, mean deviation, standard deviation, Variance and coefficient of variation. Probability: Random Experiments and Events, Definition of probability, Addition and multiplication theorems of probability.	8

	Total	**30**

Text Books:

1. J.K. Tyagi, S. K. Tyagi, Applied Mathematics-I, Khanna Publishing House, 1st Edition, 2012
2. Reena Garg, Engineering Mathematics,, Khanna Publishing House. 1st Edition, 2021

Reference Books:

1. H. K. Dass, Applied Mathematics for Polytechnics, CBS Publishers, India, 11th Edition, 2019
2. Dr. P. K. Shrivastava, Applied Mathematics – I,, Vayu Education of India, 2016
3. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. I, S. Chand Publication, 2018
4. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. II, S. Chand Publication, 9th Edition, 2019

Program: B. Voc. (Solar Systems)					**Semester: II**	
Course: Soft Skills					**Code: VSS22402**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**2**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce students to four skills of language
2. To expose students to public speaking
3. To equip students with fundamental skills for expressing thoughts in effective manner

Course Outcomes:

After learning the course students will be able

1. Understand the importance of listening and reading skills
2. Write well developed paragraphs and instructions
3. Develop skills required for public speaking
4. Present themselves effectively in different contexts

Detailed Syllabus:

Sr No	Description
1	**Introduction to Soft Skills with special reference to language skills** Importance, need of soft skills, Soft Skills V/s hard skills
2	**Listening Skills** Importance, Types and techniques for effective listening. Assignment: Listen and summarize the content.
3	**Reading Skills** Tips for effective reading, Types of reading. Assignment: Read the given article/text and summarize in your own words
4	**Speaking Skills 1 – Self Introductions** Tips for effective public speaking **Assignment: Self introductions and describing job profiles.**
5	**Speaking Skills 2 – Group Discussions** **Assignment: Dos and Don'ts of a Group Discussion**
6	**Speaking Skills 3 – Presentations** Assignment: Presenting ideas and thoughts before an audience.
7	**Communication Skills** Types of communication and barriers to communication. Assignment: Role play
8	**Time Management** Time Management prioritizing, urgency and importance, categorizing tasks as high, medium, or low priority, Developing a structured daily, weekly, or monthly schedule to manage time efficiently

	Assignment: Create a visual schedule or checklist for daily tasks, including schoolwork, chores, and free time.
9	**Problem-Solving Skills** Basics of problem solving, critical thinking, brainstorm ideas and try different approaches to find solutions, Steps in problem solving.
Instructions: 1. First lab activity is mandatory 2. Any six assignments other than first lab activity to be conducted	
Reference Books: 1. Rao Prasad N D V, English Grammar and Composition, S. Chand and Co. Pvt. Ltd, 2017. 2. Salaria R.S., and Kumar K.B., Effective Communication Skills, Khanna book publishing co. (P)Ltd, 2020. 3. Patil Z.N., Walke B., Thorat A., and Merchant Z., English For Practical Purposes, Macmillan Publication,2016. 4. Mishra S., and Muralikrishna C., Communication Skills for Engineers, Pearson India Publication,2011. 5. Bhatia V., Business Communication, Khanna book publishing co. (P)Ltd, 2013.	

Program: B. Voc. (Solar Systems)					**Semester: II**	
Course: IT Tools					**Code: VSS22502**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objectives:

1. To understand use of computer-based system in communication and fundamentals of Internet
2. To learn and understand MS office world using simple tools.

Course Outcomes: After learning the course, students will be able to

1. Demonstrate the computer components and how they are used for communication and networking.
2. Comprehend the use of MS office and Internet Communication

Guideline:

Total : 6 experiments/assignments to be conducted

Detailed Syllabus:

Sr No	Description
1	Study of Basic Computer fundamentals.
2	Demonstrate and Study of different types of computer networks and internet.
3	Create and manage professional documents using MS word.
4	Create and manage data using MS excel.
5	Create and manage presentation using power point.
6	Study of Internet Communication: Email, Social Media, etc.

Text Books:

1. Kumar B., *Mastering MS Office: Concise Handbook with screenshots*, V&S Publishers, 2017.
2. Orchids, *Microsoft Office 2007*, MS Office Series, 2018
3. Jain S., Kartika Geeta, *Microsoft Office 2010 Training Guide*, BPB Publications 2015.
4. Kurose James F., and Ross Keith W., *A Computer Networking: A top-down approach featuring the internet*, Pearson Publication, 2017.
5. Thareja Reema, *Fundamentals of Computers*, Oxford University Press, 2019.

Reference Books:

1. Ed Tittel, and Muthukumaran B., *Computer Networking*, Schaum's Outlines, TATA Mcgraw Hill Publications, 2006.
2. Peter Norton, *Introduction to Computers*, Tata Mcgraw Hill Publication, 2005.

Program: **B. Voc. (**Solar Systems**)**					**Semester: II**	
Course: **On Job Training**				**Code: V**SS**22602**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

4. To expose students to the industry environment and enhance their technical skills while working in private/public enterprises, government agencies, research labs, or any other organized technical club.
5. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
6. To develop higher-order thinking skills to work with people of diverse backgrounds and cultures and work effectively within cross-disciplined environments.

Course Outcomes

After learning the course, students will be able to

4. To apply the theoretical knowledge in real-life applications with new perspectives to problem-solving.
5. To practice communication and teamwork skills while building a professional network of prospective employment.
6. To write technical reports and document the project outcomes along with enhancing the technical presentations skills

Guidelines:

Students will take on job training in the industry in the domain of Solar Systems as per the following job description and personal attributes.

Job Role: Solar PV System Installation Engineer

	Job Description
	The individual at work evaluates the installation site, designs the installation, plans and arranges for materials, and ensures smooth installation process. The individual also supervises the installation technicians' work
	Personal Attributes
	The individual must have: attention to detail, good eye sight, logical thinking, analytical ability and good interpersonal skills.

Course Syllabus
Semester-III

Program: B. Voc. (Solar Systems)					**Semester: III**	
Course: Fundamental of Solar Energy II					**Code: VSS23103**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	SA	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To understand the basic of solar energy appliances and perform the maintenance independently

Course outcomes:

After learning the course, students will be able to

1. Understand the various solar thermal energy storages.
2. Analyze the performance of solar pond.
3. Understand the various indirect form of solar energy
4. Determine the economic aspect of solar appliances

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1	**Solar Thermal Energy Storage** Introduction of solar thermal energy storages, Types of solar energy storages, Sensible heat storage, Latent heat storages, Thermochemical solar energy storages	8
2	**Solar Pond** Introduction of Solar Pond, Principle of working of solar pond, Performance analysis of solar pond, Other solar pond concept	7
3	**Indirect Solar Energy Utilization:** Introduction of Wind Energy, Energy from biomass, Wave energy, Ocean thermal energy conversion	7
4	**Economics Analysis** Introduction of economics analysis, Initial and annual cost, Present worth calculation, Payback period	8

Text Books:

1. Sukhatme S.P. and Panchal, *Solar Energy*, Tata McGraw Hills., 4th Edition, 2016
2. Garg H.P., and Prakash J., *Solar Energy Fundamentals and Applications*, Tata Graw Hill, 2005

Reference Books:

1. Duffie, J.A., and Beckman, W.A. *Solar Energy Thermal Process*, John Wiley and Sons, New York, Jui Sheng Hsieh, *Solar Energy Engineering*, Prentice-Hall, 2013.
2. G D Rai, *Non-conventional energy sources*, Khanna Publication, 2012

Program: B. Voc. (Solar Systems)						**Semester: III**
Course: Fundamental of Solar Energy II Lab						**Code: VSS23104**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**_**	**_**	**50**	**50**

Course Objectives:

1. To understand the basic of solar energy appliances and perform the maintenance independently

Course outcomes:

After learning the course, students will be able to

1. Understand the various solar thermal energy storages.
2. Analyze the performance of solar pond.
3. Understand the various indirect form of solar energy
4. Determine the economic aspect of solar appliances

Detailed Syllabus:

Assignment No.	**Description**
1	Determine the Solar Energy Storage in an indirect Solar Drying trays filled with Phase Change Materials.
2	Study of Solar Energy Storage in sensible heating
3	Study of Solar Pond System.
4	Case study of payback period of Solar PV cell plant
5	Industrial visit to wind mill/ biogas plant

Text Books:

1. Sukhatme S.P. and Panchal, *Solar Energy*, Tata McGraw Hills., 4th Edition, 2016
2. Garg H.P., and Prakash J., *Solar Energy Fundamentals and Applications*, Tata Graw Hill, 2005

Reference Books:

3. Duffie, J.A., and Beckman, W.A. *Solar Energy Thermal Process*, John Wiley and Sons, New York, Jui Sheng Hsieh, *Solar Energy Engineering*, Prentice-Hall, 2013.
4. G D Rai, *Non-conventional energy sources*, Khanna Publication, 2012

Program:	**B. Voc. (Solar Systems)**				**Semester: III**	
Course:	**Design and Development of solar Liquid Flat Plate Collector**				**Code: VSS23203**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	SA	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To understand the basic of solar water heating technology

Course outcomes: After learning the course, students will be able to

1. Understand the selection of solar water heater
2. Understand the types of solar water heater
3. Determine the cost and pay-back period of solar water heater
4. Differentiate the various industrial solar water heater

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Principles, classifications and selection of solar water heater:** Mechanism of solar water heating technology, types of solar water heater with inbuilt storage, Working principle of solar water heater, Performance analysis of Liquid flat Plate collector, cost, safety, and environmental factor of solar water heating	8
2	**Components** Types of glazing and material selection, Transmissivity of glazing, Solar radiation absorbing materials and their selection, Piping, insulating material, Water container materials.	7
3	**Cost and limitation** Aspects and limitation of Solar water heater, construction and principle of solar water heater, Economics of solar dryer and key elements of solar water heater	7
4	**Separate Collector and storage:** Natural circulation type system, Forced circulation or pumped system, Industrial Solar water heater.	8
	Total	**30**

Text Books:

1. Sukhatme S.P. and Panchal, *Solar Energy*, Tata McGraw Hills., 4th Edition, 2016
2. G D Rai, *Non-conventional energy sources*, Khanna Publication, 2012

Reference Books:

Hand book on *Industrial drying* by Arun Mujumdar, 4th addition, Routledge Publication, 2015

Program: B. Voc. (Solar Systems)					**Semester: III**	
Course: Design and Development of solar Liquid Flat Plate Collector Lab					**Code: VSS23204**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To understand the basic of solar water heating technology

Course Outcomes:

After learning the course, students will be able to

1. Determine the heat gain and efficiency of solar liquid flat plate collector
2. Analysis of working and principle of various liquid FPC
3. Analyze the current status of Liquid FPC in the market

Detailed Syllabus:

Assignment No.	Description
1	To determine the Heat gain and Efficiency of Solar water collector
2	Comparative analysis of various flat plate collector
3	Case study of Solar Water Heating system
4	Market Survey of Solar water heaters
5	Industrial Visit of Solar liquid flat plate collector manufacturer.

Text Books:

1. Sukhatme S.P. and Panchal, *Solar Energy*, Tata McGraw Hills., 4th Edition, 2016
2. G D Rai, *Non-conventional energy sources*, Khanna Publication, 2012

Reference Books:

Hand book on *Industrial drying* by Arun Mujumdar, 4th addition, Routledge Publication, 2015

Program: B. Voc. (Solar Systems)					**Semester: III**	
Course: IT Tools II					**Code: VSS23303**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To develop advanced skills in using word processing and spreadsheet software for complex tasks and automation.
2. To introduce students to digital multimedia tools for image, audio, video editing, and screen casting.

Course outcomes:

After learning the course, students will be able to

1. Use word processors to Create and manage long documents with tables of contents, indexing, cross-references, and footnotes.
2. Utilize advanced spreadsheet features like VLOOKUP, nested functions, data validation, scenarios, and basic macros/VBA.
3. Perform basic image editing, audio/video editing, screen recording, and use online multimedia tools.
4. Collaborate effectively using cloud storage, file sharing, online office suites, and project management tools.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1	**Advanced Word Processing** Working with long documents (Table of contents, indexing, cross-references, footnotes), Using mail merge for bulk emails/letters, collaborating on documents (Track changes, comments), Protecting and securing documents	8
2	**Advanced Spreadsheet Features** Advanced functions (VLOOKUP, IF, Nested IFs, etc.), Data validation and data entry forms, Scenarios and goal seek analysis, Introduction to macros and VBA	8
3	**Digital Multimedia** Image editing basics, Audio/video editing introduction, Screen recording and screencasting, Online multimedia tools	8
4	**Collaboration and Cloud Tools** Cloud storage (Google Drive, OneDrive), File sharing and collaboration, Online office suites, Introduction to project management tools, AI-based Automation (Zapier, Co-Pilot)	6

Text Books:

1. Shelly Cashman Series. 2019. *Office 365 & Office 2019 Introductory*, 1st Edition, Cengage Learning, Boston.
2. Jennifer Duffy. 2018. *Multimedia Foundations: Core Concepts for Digital Design*, 2nd Edition, Focal Press, Burlington.

Reference Books:

1. Joan Lambert and Joyce Cox. *2013. Microsoft Word 2013 Step by Step*, Microsoft Press, Redmond.
2. Curtis Frye. 2013. *Microsoft Excel 2013 Step by Step*, Microsoft Press, Redmond.

3. David W. Beskeen, et al. 2015. *Microsoft Office 2016 Illustrated Introductory*, First Course, Cengage Learning, Boston.
4. Katherine Murray. 2018. *Modern Desktop Environments for Virtual, Cloud, and Mobile Users*, Pearson Education, London.

Program:	**B. Voc. (**Solar Systems**)**				**Semester: III**	
Course:	**Business Communication - I**				**Code: VSS23403**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce learners to the basics of Business Communication & enhance their professional competence.
2. To instruct learners on techniques of personal branding through emotional & social skills

Course Outcomes:

After learning the course students will be able to;

1. Apply knowledge of fundamentals of communication in given situations
2. Communicate effectively using non-verbal codes
3. Write professional letters
4. Demonstrate business negotiations and social skills.

Detailed Syllabus:

Assignment No.	**Description**
1	**Art of Business Communication** Introduction to the art of Business Communication, Role and importance in professional and personal life, Ice-breaking activities for various scenarios, Professional Greetings, Making & Responding to Requests.
2	**Introduction to Business Communication** Types of Communication, Principles and Barriers to Communication, Overcoming Barriers to communication **Assignment:** Explain different types of communication. Provide examples of barriers to communication from your own experiences and suggest ways to overcome it.
3	**Talking about opinions and perceptions** Get recognized in the crowd: Introducing self in business environment Understand purpose of introduction, tailor self-introduction for gaining attention, find out USP (individuality, skills etc) and emphasize, assertive and expressive, Express opinions confidently in business environment, Speak with purpose, use persuasive communication.
4	**Non-Verbal communication & Body Language** Importance of Non-Verbal Communication, Non Verbal Codes, Kinesics, Haptics, Proxemics, Chronemics, Para-language, Artifacts **Assignment:** Case Study of the role of body language in a given situation
5	**Business Correspondence** Art of writing Business Letters (Understand different formats, writing with

	purpose, difference between day-to-day language and formal language) Write a professional resume or CV. Use a professional format. Highlight skills, experiences, and qualifications relevant to the target job or industry. **Assignment:** Developing formal business letters for different purposes
6	**Mock Business Meetings** Self- Grooming, Art of persuasion, Techniques of Short Speech & Effective Delivery of Extempore & Debate.
7	**Professional Etiquette and Networking** Understanding and practicing professional etiquette in various business settings, Building and maintaining professional relationships through networking.
8	**Negotiation Simulation:** Negotiation exercise, practicing persuasive communication, active listening, and conflict resolution skills. **Assignment:** Compose a pitch /oral presentation on the given topic and submit the write-up of the same. (Evaluation will be based on both oral and written content.)
9	**Emotional & Social Skills** Situational Conversations & Rapport Building through Role Play, Emotional Intelligence: Testing and Improving EI **Assignment:** Provide step by step solutions in the form of practical examples for the given case studies.

Instructions:

- All assignments are suggestive however, course teacher may devise another assignment to evaluate students
- First lab activity is mandatory

Reference Books:

1. Rao Prasad N D V, *English Grammar and Composition*, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., *Effective Communication Skills*, Khanna book publishing co. (P) Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication, 2016.
4. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
5. Bhatia V., *Business Communication*, Khanna book publishing co. (P) Ltd, 2013.

Program:	**B. Voc. (**Solar Systems**)**				**Semester: III**	
Course:	**Health and Wellness II**				**Code: VSS23503**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals.
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice.

Course Outcomes:

After learning the course students will be able to;

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Detailed Syllabus:

Assignment No.	**Description**
1	Positive psychology: what do you understand by positive psychology? What are benefits of positive psychology.
2	Identifying strengths: what do you understand by strengths? Classification of strengths, developmental assests. Identifying your personal strengths
3	Living well at every stage: what is resilience? positive youth development, Life tasks of adulthood.
4	Self-efficacy: Definition, the neurobiology of self-efficacy, self-efficacy's influence in life arenas.
5	Mnemonics: method of loci, peg word system, key word method, Recall of Name, Recall of words.
6	Optimism: learned optimism -Seligman, primary prevention, primary enhancement.

Instructions:

- Any 5 practical assignments to be conducted.

References Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life: Adjustment in the 21st Century*, Wadsworth Publishing, 2007
2. R. Harington, *Stress, Health and well-being: Thriving in the 21st century*, Wadsworth Publishing, 2013.
3. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program:	**B. Voc. (Solar Systems)**			**Semester: III**		
Course:	**Internship III: On Job Training** (ELE/Q7902)			**Code: VSS23603**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Guidelines: Students will take on internship in the industry/research lab in the domain of Solar energy (Solar thermal and Solar PV) as per the following job description and personal attributes.

Job Description

A Quality Manager - Solar is responsible for managing quality in all organizational operations. It starts from ensuring the quality of components received from the supplier to the quality of final output, including the quality of the production process. The individual also recruits, trains and manages a team of quality inspectors and supervisors, apart from driving quality initiatives in the organization to ensure it remains competitive in the market.

Course Syllabus
Semester-IV

Program:	**B. Voc. (Solar Systems)**				**Semester: IV**	
Course:	**Fundamental of Solar Energy III**				**Code: VSS24105**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. Understand electrical circuit basics, PV module types, and series/parallel connections.
2. Learn about solar battery types, charge controllers, and inverters, including their selection and maintenance.
3. Gain knowledge of electrical component functionality and testing procedures.
4. Familiarize with safety measures, performance monitoring, and guidelines for solar plant installation.

Course outcomes:

After learning the course, students will be able to

1. Identify and use electrical components and measurement instruments for PV systems.
2. Select, size, an Analyzing solar battery characteristics, charging processes, and safety precautions.
3. Select, size, and evaluate charge controllers and inverters for efficient solar energy conversion.
4. Understand of Function of electrical components and Testing.
5. Understand safety measures, monitoring and regulatory standards for safe and efficient solar PV system operation.
6. Understand and developed Solar PV based system

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Electrical and Electronic Circuits and Measurement Instruments:** Size of a solar panel unit, Various power rating of a SPV, Resistance, inductance, and capacitance, Semiconductors: Transistors, Diodes, and MOSFETs. Transformers, Basic knowledge about tools and tackles required for PV plant installation, voltmeter, amp meter, Multi meter, tong tester, AC/DC side testing, Temperature Sensors, monitoring of incoming and outgoing power at junction box & inverter level, Clamp meter for measuring current.	8
2	**Solar Battery:** Typical values of battery voltage, module current & voltage. Current flow in batteries & impact of shorting of terminals. Charging process & precautions to be taken while charging a battery, Types of Solar battery i.e. lead acid battery, Li-ion battery, SMF battery and their characteristics. Battery types based on discharge rates, such as C-5, C-10, and C-20. Battery parameters, including depth of discharge (DOD), state of charge (SOC), cycle life.	8
3	**Charge Controller and Inverter** **Charge Controller**: Introduction, Types of Charge Controllers, Functionality and Operation, Selection and Sizing: Installation and Wiring: Monitoring and Maintenance, Regulatory Compliance and Standards **Inverter:** Introduction, importance of Inverter, inverter technical	8

	specifications and selection, types of Inverter and their feature, compression of inverters, solar inverters, Installation and Wiring: Monitoring and Maintenance, Regulatory Compliance and Standards.	
4	**Function of electrical components and Testing:** Junction box, Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Moulded Case Circuit Breaker (MCCB), Type of maintenance: Preventive, Periodic, Regular maintenance for solar PV system. String Testing- Pre-checks, Short Circuit Test- Work Method, Inverter Testing- Work Method, Check list preparation, Pre -requirement of installation of sub-station equipment, Basics and erection of transformers, pole erection and stringing	7
5	**Guideline for PV installation** Safety measurement in solar plant, performance and monitoring system, ways to maximize energy, solar cell utility – scale system performance, types and importance of safety equipment, general safety guidelines for O&M, Applying the Local Electric Code, Government rules and regulation for the installation of PV based system	7
6	**Various Solar PV based system** Solar Water Pump, solar traffic light, solar fertilizer sprayer. Solar lighting system: Solar Lantern, street light, home light, Charge controller, Storage battery, Inverter, Luminars, Maintenance of solar lighting system, types and advantages of solar outdoor lighting Comparative study of Conventional lighting system & solar lighting system	7
	Total	**45**

Text Books:

1. *Renewable Energy Technologies; A Practical Guide for Beginners*, Chetan Singh Solanki, PHI School Books (2008)
2. *Renewable Energy Sources and Emerging Technologies*, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)

Reference Books:

1. *Renewable energy; power for a sustainable future*; oxford; Stephen peake; oxford university press- 2017
2. *Renewable energy systems*; Devid M, Buchla, Thomas E kissell, Thomas, L Floyd; Pearson India Education Services Pvt. Ltd. 2017
3. *Fundamentals of Renewable Energy Systems Paperback* – D.Mukherjee, New Age International Publisher; First edition (2011)
4. *Solar Power Hand Book*, Dr. H. Naganagouda(2014)

Program:	B. Voc. (Solar Systems)				Semester: IV	
Course:	Fundamental of Solar Energy III Lab				Code: VCM24106	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	PR	Total
2	2	1	-	-	50	50

Objectives:

1. Develop practical skills in using electrical instruments (Ammeter, Voltmeter, Wattmeter) for measuring voltage, current, and power in circuits.
2. Acquire proficiency in soldering and desoldering techniques for safe component connection and disconnection.
3. Enhance knowledge and understanding of electronic components through identification, labeling, and hands-on practice, including interpretation of measurement results and assessment of safety in earth resistance measurement.

Course Outcomes:

After learning the course, students will be able to

1. Able to use instruments like Ammeter, Voltmeter, and Wattmeter for precise electrical measurements.
2. Develop proficiency in safe component connection and disconnection through soldering and desoldering techniques.
3. Understand the electronic components through hands-on identification and labeling exercises.
4. Acquire the Skills in measuring earth resistance with an Earth Megger and interpreting results safely.
5. Understand insight into industrial processes by visiting a solar panel manufacturer or solar plant.
6. Understand process of installation of solar PV systems effectively,
7. Develop the ability to visually inspect and differentiate solar battery types and capacities.

Detailed Syllabus:

Assignment No.	Description
1	**Electrical Parameter Measurement:** Hands-on utilization of instruments such as Ammeter, Voltmeter, and Wattmeter for measuring electrical parameters. Conducting exercises to measure voltage, current, and power in circuits.
2	**Soldering and Desoldering:** Practical exercises for safely connecting and disconnecting components through soldering and desoldering techniques.
3	**Component Identification:** Identification and labeling of components including resistors, inductors, capacitors, transistors, diodes, photo diodes, MOSFETs, and small transformers.
4	**Earth Resistance Measurement:** Demonstration of utilizing an Earth Megger for measuring earth resistance in grounding systems. Interpretation of measurement results and assessment of safety.

5	**Industrial Visit:** Visiting a solar panel manufacturer or solar plant for hands-on experience and understanding of industrial processes.
6	**Solar PV System Installation**: Connecting the junction box to a charge controller, the charge controller to a battery, and the battery to a standalone inverter. Executing inverter to household connection for practical application.
7	**Battery Capacity Identification:** Hands-on activities to visually inspect and identify the capacity of solar batteries. Practical exercises to differentiate between different types of batteries (e.g., C-5, C-10, C-20) through visual inspection

Text Books:

1. Sukhatme S.P. and Panchal, *Solar Energy*, Tata McGraw Hills., 4th Edition, 2016
2. G D Rai, *Non-conventional energy sources*, Khanna Publication, 2012

Reference Books:

1. Hand book on *Industrial drying* by Arun Mujumdar, 4th addition, Routledge Publication, 2015

Program:	**B. Voc. (Solar Systems)**				**Semester: - IV**	
Course:	**Design and Development of Solar Air Heater**				**Code: VSS24205**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To understand the basic of solar Drying Technology

Course outcomes:

After learning the course, students will be able to

2. Understand the selection of dryers.
3. Understand the types of indirect dryers
4. Determine the cost and pay-back period of solar dryers.
   Differentiate the various industrial dryers.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Principles, classifications and selection of dryers** Mechanism of drying, classification and selection of drying, temperature and pressure of operation, effect of energy, cost, safety, and environmental factor of dryer selection	8
2	**Indirect Drying** Types of indirect dryers, classification and selection criteria, Batch tray dryers, indirect contact rotary dryers, rotating batch vacuum dryer, agitated dryer	7
3	**Solar Drying** Aspects and limitation of solar drying, construction and principle of solar drying, Economics of solar dryer and key elements of solar dryers	7
4	**Drying in Industrial Sector** Drying of food stuffs, Drying of fish and sea foods, grain drying, drying of foods and vegetables, drying of herbal medicines and tea	8
	Total	**30**

Text Books:

1. Sukhatme S.P. and Panchal, Solar Energy, Tata McGraw Hills., 4th Edition, 2016
2. G D Rai, Non-conventional energy sources, Khanna Publication, 2012

Reference Books:

1.Hand book on Industrial drying by Arun Mujumdar, 4th addition, Routledge Publication, 2015

Program:	**B. Voc. (**Solar Systems**)**				**Semester: IV**	
Course:	**Business Communication - II**				**Code: VSS24404**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objectives:

1. To introduce learners to the basics of Business Communication & enhance their professional competence.
2. To instruct learners on techniques of personal branding through emotional & social skills.

Course Outcomes:

After learning the course students will be able to;

1. Demonstrate the skills of handling customer and clients
2. Use digital tools effectively to present or communicate as per situation
3. Appear confidently for business meetings and interviews
4. Write professional drafts and proposals.

Detailed Syllabus:

Assignment No.	**Description**
1	**Interpersonal Communication Skills** Developing active listening and empathy skills in business interactions, Managing conflict and difficult conversations in the workplace
2	**Handling Customer Inquiries and Complaints** Strategies for responding to customer inquiries promptly and courteously, Techniques for addressing customer complaints effectively to maintain customer satisfaction Assignment: Develop a comprehensive response plan for handling customer inquiries and complaints, focusing on promptness, courtesy, and satisfaction maintenance.
3	**Digital and Visual Communication Tools** Utilizing digital tools and platforms for effective business communication. Assignment: Create a visually engaging presentation or document using digital tools, demonstrating effective communication techniques to enhance impact.
4	**Social Networking** Content: What is Social networking; networking through social media platforms like LinkedIn, Indeed, for professional purposes. Assignment: Create and launch a full-fledged LinkedIn profile with all relevant details. Submit printouts of LinkedIn Bio, Qualifications and Other important sections.

5	**Interview Skills** Researching the company and role, practicing responses to common questions, and preparing questions to ask the interviewer. Assignment: Develop a set of interview questions tailored to a specific job role, considering both traditional and behavioral-based questions.
6	**Business Storytelling** Crafting compelling stories and using storytelling techniques for business communication.
7	**Understanding Business Documents** Introduction to common business documents (e.g., invoices, receipts).
8	**Business Plan: Writing & Presentation** Content: Elevator pitch, Business plan proposal, presenting a business proposal Assignment: Create a basic business plan proposal and present it in the form of an Elevator pitch.
9	**Advanced Business Writing Skills** Techniques for writing business documents, such as proposals, executive summaries, and business plans, Incorporating data and research into written communication effectively Assignment: Create proposal for business purpose in a professional format.

Instructions:

- All assignments are suggestive however; course teacher may devise other assignments to evaluate students.
- Any five assignments are mandatory.

Reference Books:

1. Rao Prasad N D V, *English Grammar and Composition*, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., *Effective Communication Skills*, Khanna book publishing co. (P) Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication, 2016.
4. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
5. Bhatia V., *Business Communication*, Khanna book publishing co. (P) Ltd, 2013.

Program:	**B. Voc. (Solar Systems)**				**Semester: IV**	
Course:	**Environmental Science**				**Code: VSS24504**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

To study components of the environment, their function, quality, issues related to the environment, the effect of quality degradation on human beings, and their solutions.

Course Outcomes:

After learning the course, students will be able to

1. Measure atmospheric metrological parameters and interpret the results.
2. Determine water quality parameters and interpret the results.
3. Distinguish different component of the environment and their function and sustainable development.

Detailed Syllabus:

Assignment No.	**Description**
	Any Five experiments from assignments 1 to 9.
1	**Experiment Name –** Measurement and interpretation of metrological parameters of the atmosphere. **Content** Use a weather sensor or weather station to measure metrological parameters such as temperature, wind direction, wind speed, humidity, rainfall, air pressure, solar radiation, etc**.**
2	**Experiment Name –** Determine the water quality of a given location using a water monitoring kit. **Content** Determine the water quality, such as pH, Temperature, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Turbidity, etc., of a given location using a water monitoring kit. Compare results with BIS standards.
3	**Experiment Name –** Determine total hardness of water sample. **Content** Determine total hardness of various types of water samples. Compare results with standards and write observations/conclusions.
4	**Experiment Name –** Prepare water audit report of the college/house/locality/colony/ industry. **Content** Prepare a water audit report of the college/house/locality/colony/ industry for water quantity and quality with observations and recommendations.
5	**Experiment Name –** Visit a Water Treatment Plant (WTP) or Sewage Treatment Plant (STP). **Content** Study various unit's operations and processes of water and wastewater treatment.

6	**Experiment Name –** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan. **Content** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan with schematic diagrams and photographs.
7	**Experiment Name –** Determine the noise level to find out its direct exposure to communities. **Content** Determine noise level using a sound level meter or noise dosimeter at various locations. Compare the results with standards and write observations/conclusions.
8	**Experiment Name –** Propose a model for pollutant removal. **Content** Propose a model for the treatment or removal of any type of contaminant or pollutant from water/ wastewater/air/soil. Demonstrate the mechanism of working and its application.
9	**Assignment Name –** Calculate environmental footprint. **Content** Calculate environmental footprint such as water footprint/ carbon footprint/ energy footprint, etc.

Text Books:

1. *Water Supply Engineering*, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. *Environmental Science: A Practical Manual* Author: G. Swarajya Lakshmi ISBN: 9788178002286

Reference Books:

1. *Standard Methods for examination of water and wastewater*, Mary Franson, American Public Health Association.
2. *IS 10500:2012* Drinking water specifications.
3. *IS 3025: 2013*, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.
4. *Water Supply and Sanitary Engineering*, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).

Program: B. Voc. (Solar Systems)				**Semester: IV**		
Course: Mini Project				**Code: VCM24604**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
4	**4**	**2**	**-**	**50**	**-**	**50**

Course Objectives:

1.

Course outcomes:

After learning the course, students will be able to

1.

Guidelines to the Students:

1. **Group Size:** The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.
2. **Selection and approval of Topic:** Topic should be related to real life application/Thrust areas in the above application fields but not limited to.

OR

The investigation of practical problem in manufacture and / or testing/ installation of solar photovoltaic modules

Note: The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal/external guides. Projectreport must be submitted in the prescribed format only. No variation in the format will be accepted

Detailed Syllabus:

A Project based learning approach will be followed for this course and hence the experiments will be a small project built by the students for **Utilization of solar photovoltaic module** in any of the following application fields (Thrust areas).

The application fields (Thrust areas) are as follows:

Agricultural, Health and Hygiene, refrigeration and air conditioning, Smart Cities, green buildings, Energy, Transportation, automobile, Robotics, etc.

Program:	**B. Voc. (Solar Systems)**			**Semester: IV**		
Course:	**Internship III: On Job Training** (ELE/Q7902)			**Code: VSS24605**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1.

Course Outcomes: After learning the course, students will be able to

1.

Guidelines: Students will take on internship in the industry/research lab in the domain of Solar energy (Solar thermal and Solar PV) as per the following job description and personal attributes.

Job Description

A Quality Manager - Solar is responsible for managing quality in all organizational operations. It starts from ensuring the quality of components received from the supplier to the quality of final output, including the quality of the production process. The individual also recruits, trains and manages a team of quality inspectors and supervisors, apart from driving quality initiatives in the organization to ensure it remains competitive in the market.