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 of
## B. Voc. Solar Systems

and

## Syllabus of B. Voc. Program

**(Approved by Board of Studies, B. Voc. Program, PCCOE)**

## (Course 2021)

## Effective from Academic Year 2021-22

## Institute Vision

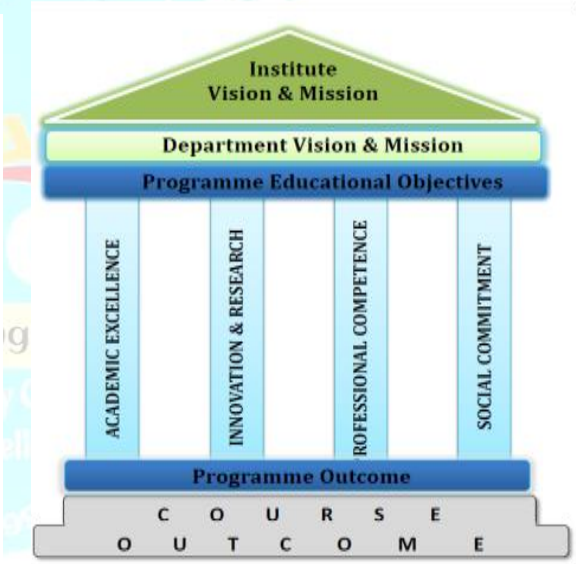
To Serve the Society, Industry and all the Stakeholders through the **Value-Added Quality Education.**

## Institute Mission

To serve the needs of society at large by establishing State-of-the-Art Engineering, Management and Research Institute and impart attitude, knowledge and skills with quality education to develop individuals and teams with ability to think and analyze right values and self-reliance.

## 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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# INDEX

# ABBREVIATIONS

| Abbreviations | Course Full Name |
|---|---|
| PCC | Professional Core Course |
| BSC | Basic Science Course |
| ECC | Engineering core/Science course |
| HSMC | Humanities, Social Sciences, and Management Course |
| INTR | Internship |
| PROJ | Project |

# CURRICULUM STRUCTURE
# STRUCTURE FOR I$^{ST}$ 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** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **C4.GE.01** | BSC | Applied Science | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C4.GV.01** | ECC | Engineering Drawing | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C4.GV.02** | ECC | Basic Electricity & Electronics | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S4.GV.03** | PCC | Professional Core Course I (Fundamentals of Solar Energy) | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C4.GP.01** | BSC | Applied Science Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **C4.VP.01** | ECC | Basic Electricity & Electronics Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S4.QP.01** | INTR | On Job Training (ELE/Q5901) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **12** | **36** | **48** | **30** | **80** | **120** | **200** | **-** | **-** | **300** | **700** |

## SEMESTER II

| B. Voc. Structure | | Sem-II | Teaching Scheme | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Type** | **Course Name** | **L** | **P** | **H** | **CR** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **C5.GE.01** | BSC | Applied Mathematics | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C5.GV.01** | ECC | IT Tools | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C5.GE.02** | HSMC | Language I | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S5.GV.02** | PCC | Professional Core Course II (Fundamentals of Solar Photovoltaic Energy systems) | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S5.VP.01** | PROJ | Mini Project | - | 6 | 6 | 3 | - | - | - | - | 100 | - | 100 |
| **S5.QP.01** | INTR | On Job Training (ELE/Q5902) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **12** | **36** | **48** | **30** | **80** | **120** | **200** | **-** | **100** | **200** | **700** |

**Abbreviation: L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE 1** – Internal Evaluation-1; **IE 2** – Internal Evaluation-II; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam; **PR** – Practical Exam.

# STRUCTURE FOR II$^{ND}$ 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** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **C6.GE.01** | HSMC | Language II (Soft Skill for Professionals) | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **C6.GE.02** | HSMC | Introduction to Entrepreneurship | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.GV.01** | PCC | Basics of Fluid Mechanics & Thermodynamics | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.GV.02** | PCC | Engineering Materials | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.VP.01** | PCC | Basics of Fluid Mechanics & Thermodynamics Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S6.VP.02** | PCC | Engineering Materials Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S6.QP.01** | INTR | On Job Training (ELE/Q7902) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **12** | **36** | **48** | **30** | **80** | **120** | **200** | **-** | **-** | **300** | **700** |

## SEMESTER-IV

| B. Voc. Structure | | Sem-IV | Teaching Scheme | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Type** | **Course Name** | **L** | **P** | **H** | **CR** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **C6.GE.03** | HSMC | Management and Entrepreneurship | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.GV.03** | PCC | Fundamental of Solar Energy-III | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.GV.04** | PCC | Metrology & Measuring Instruments (MMI) | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.GV.05** | PCC | Manufacturing Technology (MT) | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S6.VP.03** | PCC | Fundamental of Solar Energy-III Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S6.VP.04** | PCC | Metrology & Measuring Instruments & Manufacturing Tech. Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S6.QP.02** | INTR | On Job Training (ELE/Q7902) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **12** | **36** | **48** | **30** | **80** | **120** | **200** | **-** | **-** | **300** | **700** |

**Abbreviation: L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE 1** – Internal Evaluation-1; **IE 2**– Internal Evaluation-II; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam

# STRUCTURE FOR III$^{RD}$ 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** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **S7.GV.01** | PCC | Industrial Management | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.GV.02** | PCC | Solar Water Heater Plant | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.GV.03** | PCC | Solar PV Power Plant | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.GV.04** | PCC | Renewable Energy Sources and applications | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.VP.01** | PCC | Solar Water Heater Plant Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S7.VP.02** | PCC | Solar PV Power Plant Lab | - | 3 | 3 | 1.5 | - | - | - | - | - | 50 | 50 |
| **S7.QP.01** | INTR | On Job Training (ELE/Q9801) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **12** | **36** | **48** | **30** | **80** | **120** | **200** | **-** | **-** | **300** | **700** |

## SEMESTER-VI

| B. Voc. Structure Sem-VI | | | Teaching Scheme | | | | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Type** | **Course Name** | **L** | **P** | **H** | **CR** | **IE1** | **IE2** | **ETE** | **TW** | **OR** | **PR** | **Total** |
| **S7.GV.05** | PCC | Process Planning and Cost Estimation | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.GV.06** | PCC | Total Quality Management | 3 | - | 3 | 3 | 20 | 30 | 50 | - | - | - | 100 |
| **S7.VP.03** | PROJ | Project | - | 18 | 18 | 9 | - | - | - | 50 | 150 | - | 200 |
| **S7.QP.02** | INTR | On Job Training (ELE/Q9801) | - | 30 | 30 | 15 | - | - | - | - | - | 200 | 200 |
| | | **Total** | **6** | **48** | **54** | **30** | **40** | **60** | **100** | **50** | **150** | **200** | **600** |

**Abbreviation: L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE 1** – Internal Evaluation-1; **IE 2**– Internal Evaluation-II; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

## LIST OF QUALIFICATION PACKS (QP)

| Course code | QP code | Name of QP |
|---|---|---|
| **S4.QP.01** | **ELE/QP5901** | Solar Panel Installation Technician |
| **S5.QP.01** | **ELE/QP5902** | Solar PV System Installation Engineer |
| **S6.QP.01** | **ELE/QP7902** | Quality Manager |
| **S6.QP.02** | **ELE/QP7902** | Quality Manager |
| **S7.QP.01** | **ELE/QP9801** | Project Management |
| **S7.QP.02** | **ELE/QP9801** | Project Management |

# Course Syllabus
## Semester-I

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: I** | |
|---|---|---|---|---|---|---|
| **Course:** | **Applied Science** | | | | **Code: C4.GE.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| Unit | Description | Duration (36 Hrs) |
|---|---|---|
| 1 | **Water**<br>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. Alkalinity - its determination and numerical. Disadvantages of hard water in boilers,. Water softening techniques: Permutit and Ion exchange method. Water purification by reverse osmosis and electro-dialysis methods. | 6 |
| 2 | **Fuel and their Classification**<br>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. Petroleum and brief idea of refining into various factions and their characteristics and uses. Octane number and cetane number, knocking and anti-knocking agents. Synthesis reaction, properties, advantages and disadvantages of Biodiesel. Gaseous fuels- Gaseous fuels: Hydrogen gas as a future fuel, production by steam reforming of methane and coke, storage and transportation. . | 6 |
| 3 | **Corrosion**<br>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. | 6 |
| 4 | **Units and dimensions**<br>M.K.S. fundamentals & derived units, S.I. base units, supplementary units and derived units, Dimensions of various physical quantities, uses of dimensional analysis. | 6 |
| 5 | **Optics:** wave nature of light, reflection and refraction of a wave from a plane surface, total internal reflection, plane polarized light, Law of Malus | 6 |
| 6 | **Ultrasonics:** Productions of ultrasonic waves by magnetostriction and piezo-electric effect, application of ultrasonics in industry | 6 |

Text Books:

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

Reference books:

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

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: I** | |
|---|---|---|---|---|---|---|
| **Course:** | **Engineering drawing** | | | | **Code: C4.GV.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (36 Hrs)** |
|---|---|---|
| 1 | **Introduction**<br>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. | 6 |
| 2 | **Projection of Line and Planes**<br>Introduction, Projection of points – points on the different quadrants and on the reference planes. Projection of straight lines – 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- 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. | 6 |
| 3 | **Orthographic Projections**<br>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**<br>Introduction, Isometric scale, construction of Isometric view of simple objects from given orthographic. | 6 |
| 5 | **Development of Lateral Surfaces of Solids**<br>Introduction, Development of lateral surfaces of Cone, Cylinder, Pyramid and Prism. | 6 |
| 6 | **Freehand Sketching and introduction of AutoCAD software**<br>Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, screw thread forms, welded joints, riveted joints. | 6 |

**Text Books**

1. Bhatt N.D., and Panchal V.M., *Engineering Drawing*, Charotar Publishing House, 2010.
2. Agrawal Besant, 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:** | **Basics of Electrical & Electronics** | | | | **Code: C4.GV.02** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (36 Hrs)** |
|---|---|---|
| 1 | **Electromagnetism:** Flux, flux density, reluctance, MMF, permeability and field strength, their units and relationships; comparison of electric and magnetic circuit, Series magnetic circuit with air-gap, comparison of electric and magnetic circuit, force on current carrying conductor placed in magnetic field, Fleming's left-hand rule. Faradays laws of electromagnetic induction, Fleming's right-hand rule, statically and dynamically induced e.m.f, self and mutual inductance, coefficient of couplings. Energy stored in magnetic field. | **6** |
| 2 | **Single Phase AC Circuits:** Generation of single phase sinusoidal A.C. voltages, AC quantities, phasor representation, R-L-C series &, parallel circuit (No Numerical), impedance, admittance, concept of active, reactive, apparent power and power factor. **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. | 6 |
| 3 | **DC and AC machines**<br>**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.<br>**AC Machines:** Single phase transformers: Construction, operating principle, emf equation, voltage and current ratios. Losses, Efficiency and regulation, Auto-transformer. | 6 |
| 4 | **Network Theory:**<br>Kirchhoff's Current and Voltage Laws, Independent and dependent sources and their interconnection, power calculations, Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting. Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems. | 6 |
| 5 | **Electronic Devices and Circuits**<br>PN Junction diode: Structure, principle of operation, Photo diode, LED,<br>Bipolar Junction Transistors: structure, Principle of operation, Characteristics, Rectifiers and power supplies: Half wave and full wave rectifier, capacitor filter, Zener voltage regulator, Amplifiers and oscillators: Common emitter amplifier, feedback oscillators, RC phase shift oscillator, Analog Integrated Circuits: operational amplifiers (OPAMP), inverting and non-inverting amplifiers, comparator, Electronic Instrumentation: Digital multimeter, CRO, digital storage oscilloscope, function generator. | 6 |
| 6 | **Digital Electronics**<br>Number System & Logic Gates: Introduction to number system, weighted & non-weighted coding system, Conversion of number systems, Signed & unsigned numbers, Binary arithmetic, Binary subtraction using 2's complement, Introduction to logic gates, Boolean Laws. | 6 |

**Books:**

**Text Books**:


1. Nagrath I. J. and Kothari, *Theory and Problems of Basic Electrical Engineering*, PHI Learning Private Limited, 2016.
2. Husain Ashfaq, *Fundamentals of Electrical Engineering*, Dhanpat Rai & Co., 2010.
3. Mittal V. N. and Mittal Arvind, *Basic Electrical Engineering*, McGraw Hill., 2006.
4. Mehta V.K., *Basic Electrical Engineering*, S. Chand & Co. Pvt. Ltd. New Delhi, 2012.
5. Bell, D. A., *Electronic Devices and Circuits*, Oxford University Press, 2008.
6. Tomasy W., *Advanced Electronic Communication system*, PHI Publishers, 2003.
7. M. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India, 2004.


**Reference Books:**


8. Kulshreshta D.C., *Basic Electrical Engineering*, Tata McGraw Hill, 2009.
9. Theraja B.L. and Theraja A.K., *A textbook of Electrical Technology*, S. Chand & Co. Pvt. Ltd. New Delhi, 2007.
10. Hughes Edward, Hiley John, Ian McKenzie-Smith, and Keith Brown, *Electrical and Electronic Technology*, Pearson, 2016.
11. Neaman Donald, *Electronic Circuit Analysis and Design*, Tata McGraw Hill, 2006.
    Hayt William H., Kimmerly Jack E., and Durbin Steven M., *Engineering Circuit Analysis*, TataMcGraw Hill, 2012.

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: I** | |
|---|---|---|---|---|---|---|
| **Course:** | **Profession Core Course I (Fundamentals of Solar Energy)** | | | | **Code: S4.GV.03** | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

Detailed Syllabus:

| Unit | Description | Duration (36 Hrs) |
|---|---|---|
| 1 | **Solar radiation:** 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. solar radiation and Measurement-types of solar energy collectors | **6** |
| 2 | **Solar thermal systems:** Thermodynamic description of solar collectors. Types of solar collectors. Solar thermal systems for different applications in India and abroad. Storage of solar generated | **6** |
| 3 | **Solar Photovoltaic system:** The function of solar cells from semiconductor physics. Spectral sensitivity, Efficiency of solar cells and PV modules Different solar cell technologies and fabrication methods. Concepts for increasing efficiency based on loss analysis. Series connection of solar cells to modules. Module function and characteristics. Shading of cells and modules. | **6** |
| 4 | **Solar cell systems:** System components and their functions. Calculating output and dimensioning of solar cell systems. Analysis and computer simulation of a solar cell system. Concentrated sunlight and solar power (CSP). Properties of optical concentration systems. Solar cells in concentrated sunlight. Overview of the different components in a CSP system and their functions. Examples of CSP-systems globally | **6** |
| 5 | **Hybrid systems***:* Combinations of solar thermal and solar cell systems. Overview of different applications. District heating with solar thermal components. | **6** |
| 6 | **Applications of Solar Energy:** Solar water heater, Solar cookers, Solar Heating and Cooling of Buildings ,distillation, pumping, furnace, green house | **6** |

**Text Books**


1. Sukhatme S.P., and Nayak J.K., *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill, 2008.
2. Garg H.P., and Prakash J., *Solar Energy Fundamentals and Applications*, Tata McGraw-Hill, 2005.


**Reference books**


1. Duffie. J.A., and Beckman W.A., *Solar Engineering of Thermal Processes*, Wiley, 2006.
2. De Vos A., *Thermodynamics of Solar Energy Conversion*, Wiley-VCH, 2008.
3. Kalogirou S., *Solar Energy Engineering, Processes and Systems*, Elsevier, 2009.
4. Petela R., *Engineering Thermodynamics of Thermal Radiation for Solar Power*, McGraw-Hill Co., 2010.

| **Program:** B. Voc. (SOLAR SYSTEMS) | | | | **Semester:** I | | |
|---|---|---|---|---|---|---|
| **Course:** Applied Science Lab | | | | **Code: C4.GP.01** | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **3** | **3** | **1.5** | **-** | **50** | **-** | **50** |

**Guidelines:**

1. Total experiments to be conducted are four from Part A and four from Part B
2. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus:**

**Part A: Applied Chemistry (Any four)**

| **Expt.** | **Description** |
|---|---|
| 1 | Determination of total hardness of water sample by EDTA method (two water samples). |
| 2 | Determination of total alkalinity of the water sample.. |
| 3 | Determination of pH and conductance of different water sample solutions. |
| 4 | Proximate analysis of solid fuel. |
| 5 | Electrodepositon of Zinc (Zn) over Cu plates or Fe plates. |

**Part B: Applied Physics (Any four)**

| **Expt.** | Description |
|---|---|
| 1 | To determine least counts and take readings with given measuring instruments |
| 2 | To verify Snell's law of refraction |
| 3 | To verify law of Malus |
| 4 | To determine critical angle for given transparent medium |
| 5 | To determine velocity of ultrasonic waves in a given liquid |

Text Books:


1. Jain and Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Co.,2016.
2. Avadhanulu M.N., Kshirsagar P.G., *A text book of Engineering Physics*, S. Chand publication, 2015.
3. Virmani O.P., and A.K. Narula, *Applied Chemistry Theory and Practice*, New age International (P) Ltd., 1995.


Reference books:


1. Wiley Editorial, *Engineering Chemistry*, Wiley India, 2012.
2. Palanna O.G., *Engineering Chemistry*, Tata McGraw-Hill Education, 2009.
3. Gaur R.K., and S.L. Gupta, *Engineering Physics*, Dhanpat Rai Publications,2001.
4. Mendham J., Denny R.C., Barnes J.D., and Vogels Thomas M.J.K., *Text book of Qualitative Chemical Analysis*, Pearson Education ltd., 1989.

| **Program:** | B. Voc. (SOLAR SYSTEMS) | | | **Semester:** I | | |
|---|---|---|---|---|---|---|
| **Course:** | Basics of Electrical & Electronics Lab | | | **Code:** C4.VP.01 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **3** | **3** | **1.5** | **-** | **50** | **-** | **50** |

**Guidelines:**

1. Total experiments to be conducted are four from Part A and four from Part B
2. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus:**

| **Part A: Basic Electricity (Any four)** | |
|---|---|
| **Expt.** | **Description** |
| 1 | To study of various wiring accessories, earthing system and safety precautions while working with electrical systems |
| 2 | To measure steady state response of series RL and RC circuits on AC supply and observations of voltage and current waveforms. |
| 3 | To verify the relation between phase and line quantities in three phase balanced star and delta connections of load. |
| 4 | Perform speed control of DC Shunt Motor to plot characteristics. |
| 5 | To determine efficiency and regulation of single-phase transformer by direct loading test. |
| **Part B: Basic Electronics (Any four)** | |
| **Expt.** | Description |
| 1 | Verification of Kirchhoff's laws/Superposition Theorem/Thevenin's Theorem/Norton's Theorem |
| 2 | Testing & Measurements of various Electronic components. |
| 3 | Study of Cathode Ray Oscilloscope and measurement of different parameters using CRO/DSO. |
| 4 | Study of Multimeter for measurement of electronic components. |
| 5 | Study of Function generator. |

## Text Books:


1. Nagrath I. J., and Kothari, *Theory and problems of Basic Electrical Engineering*, PHI learning Pvt.Ltd., 2013.
2. Husain Ashfaq, *Fundamentals of Electrical Engineering*, Dhanpat Rai & Co., 2002.
3. Mittal V. N., and Mittal Arvind, *Basic Electrical Engineering*, McGrawHill. 2006.
4. Mehta V.K., *Basic Electrical Engineering*, S. Chand & Co. Pvt. Ltd., 2012.
5. Bell, D. A., *Electronic Devices and Circuits*, Oxford University Press, 2008.
6. Tomasy, W., *Advanced Electronic Communication system*, PHI Publishers, 2003.
7. M. Morris Mano, *Digital Logic and Computer Design*, Fourth edition, Prentice Hall of India, 2004.


## Reference Books:


8. Kulshreshta D.C., *Basic Electrical Engineering*,Tata McGraw hill, 2009.
9. Theraja B.L., and Theraja A. K., *A textbook of Electrical Technology Vol I* S. Chand & Co. Pvt. Ltd., 2005.
10. Theraja B.L., and Theraja A. K., *A textbook of Electrical Technology Vol II*, S. Chand & Co. Pvt. Ltd., 2005.
11. Hughes Edward, Electrical Technology, and Neaman Donald, *Electronic Circuit Analysis and Design*, Tata McGraw Hill, 2006.
12. William H. Hayt, Jack E Kimmerly, and Durbin Steven M., *Engineering Circuit Analysis*, TataMcGraw Hill, 2012.

| **Program:** | B. Voc. (SOLAR SYSTEMS) | | | **Semester:** I | | |
|---|---|---|---|---|---|---|
| **Course:** | On Job Training (ELE/Q5901) | | | **Code:** S4.VP.01 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **30** | **30** | **15** | **-** | **-** | **200** | **200** |

**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 Description** |
|---|---|
| 1 | The individual at work checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation. |

| | **Personal Attributes** |
|---|---|
| 1 | The individual must have: ability to work in standing position for long hours, good physical strength to handle solar panels and willingness to work in outdoor settings at varied locations such as roof tops, fields, urban or rural. |

# Course Syllabus
## Semester-II

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: II** | |
|---|---|---|---|---|---|---|
| **Course:** | **Applied Mathematics** | | | | **Code: C5.GE.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (36 Hrs)** |
|---|---|---|
| 1 | **Linear Algebra:**<br>Determinants: Definition and expansion of determinants of order 2 and 3, Cramer's rule to solve simultaneous equations in 2 and 3 unknowns<br>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. | **6** |
| 2 | **Calculus I:**<br>Limits: Definition of Limit, Limits of algebraic, trigonometric, exponential and logarithmic functions with simple examples<br>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. | 6 |
| 3 | **Calculus II:**<br>Integration: Definition of integration as anti-derivative. Integration of standard function, Rules of integration.<br>Definite Integrals: Definition of definite integral, Properties of definite integral with simple problems | 6 |
| 4 | **Differential Equations:**<br>Definition of differential equation, order and degree of differential equation. Formation of differential equation, Solution of differential equations of first order and first degree such as variable separable type, Homogeneous Differential equations | 6 |
| 5 | **Vectors and Three-Dimensional Geometry:**<br>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. | 6 |
| 6 | **Statistics and Probability:**<br>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.<br>Probability: Random Experiments and Events, Definition of probability, Addition and multiplication theorems of probability. | 6 |

**Text Books:**


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


**Reference Books:**


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

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: II** | |
|---|---|---|---|---|---|---|
| **Course:** | **Language I** | | | | **Code: C5.GE.02** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| Unit | Description | Duration (36 Hrs) |
|---|---|---|
| 1 | **Listening Skills** – Importance of Listening, Hearing v/s Listening, Types of Listening, Techniques to improve listening skills, Receiving messages / Instructions | 4 |
| 2 | **Reading Skills** – Importance and Types of Reading, Techniques of effective Reading, Types of Reading Comprehensions. | 4 |
| 3 | **Grammar & Vocabulary**<br>Grammar - Articles, Prepositions, Tenses, Subject-Verb Agreement, Types of Sentences, Common errors of grammar.<br>Vocabulary – Synonyms, Antonyms, Words often confused, Collocations, Prepositional Phrases, General and Professional English words | 10 |
| 4 | **Speaking Skills**– Accuracy v/s Fluency, Proper Pronunciation, Pace and Tone, Self introductions, Narrating incidents, Making Enquiries, Agreeing/Disagreeing, Group Discussions. | 6 |
| 5 | **Writing Skills**<br>Coherence and Cohesion in writing, Stages of writing, Writing instructions, Describing Objects, Letter writings, Reports writing | 6 |
| 6 | **Communication Skills**<br>Importance of Effective Communication, 7C Principles of Communication, Types of Communication, Barriers to Communication, How to remove the barriers | 6 |

Text Books:

1. Wren & martin, and Rao Prasada N. D. V., *English Grammar and Composition*, S. Chand and Co. Pvt. Ltd, 2017.

Reference Books:

1. Salaria R.S., and Kumar Kul Bhushun , *Effective Communication Skills*, Khanna book publishing co. (P)Ltd, 2020.
2. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication, 2016.
3. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
4. V. Bhatia, *Business Communication*, Khanna book publishing co. (P)Ltd, 2013.

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: II** | |
|---|---|---|---|---|---|---|
| **Course:** | **IT Tools** | | | | **Code: C5.GV.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (36 Hrs)** |
|---|---|---|
| 1 | **Introduction to Computer :** Evolution of Computers & its applications, Basics of Hardware and Software, Central Processing Unit, Input devices, Output devices, Computer Memory & storage, Application Software, Systems Software, Utility Software, Open source and Proprietary Software, Mobile Apps | **6** |
| 2 | **duction to Internet and WWW :** Basic of Computer Networks, Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Network Topology, Concept of Internet & WWW, Applications of Internet, Website Address and URL, Introduction to IP Addresses, Internet Protocol, Modes of Connecting Internet (Hotspot, Wi-Fi, LAN Cable, Broadband, USB Tethering), Identifying and uses of IP/MAC/IMEI of various devices, Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox, Opera etc.), Surfing the web, Search Engines, | 6 |
| 3 | **Word Processing :**Word Processing Basics, Creating a New Document, Opening and Closing Documents, Save and Save As, Using The Help, Page Setup, Page Layout, Borders, Watermark, Print Preview, Printing of Documents, Saving a Document as PDF file, Text Selection, Cut, Copy and Paste, Font, Color, Style and Size selection, Alignment of Text, Undo & Redo, AutoCorrect, Spelling & Grammar, Find and Replace, Formatting the Text, Creating and using user-defined Styles, Paragraph Indentation, Bullets and Numbering, Change case, Header & Footer, Insert & Draw Table, Changing cell width and height, Alignment of Text in cell, Delete / Insertion of Row, Column and Merging & Splitting of Cells, Border and Shading. | 6 |
| 4 | **Spreadsheet :**Elements of Spread Sheet, Creating of Spread Sheet, Concept of Cell Address [Row and Column] and selecting a Cell, Entering Data [text, number, date] in Cells, Page Setup, Printing of Sheet, Saving Spreadsheet, Opening and Closing, Modifying / Editing Cell Content, Formatting Cell (Font, Alignment, Style ), Cut, Copy, Paste & Paste Special, Changing Cell Height and Width, Inserting and Deleting Rows, Column, AutoFill, Sorting & Filtering, Freezing panes, Formulas, Functions and Charts, Using Formulas for Numbers (Addition, Subtraction, Multiplication & Division), AutoSum, Functions (Sum, Count, MAX, MIN, AVERAGE), sort, Filter, Pivot table Charts (Bar, Column, Pie, Line). | 6 |
| 5 | **Presentation :**Creation of Presentation, Creating a Presentation Using a Template, Creating a Blank Presentation, Inserting & Editing Text on Slides, Inserting and Deleting Slides in a Presentation, Saving a Presentation, Inserting Table, Adding ClipArt Pictures, Inserting Other Objects, Resizing and Scaling an Object, Creating & using Master Slide, Presentation of Slides, Choosing a Set Up for Presentation, Running a Slide Show, Transition and Slide Timings, Automating a Slide Show, Working with Color and Line Style, Adding Video and Sound, Adding Headers, Footers and Notes, Printing Slides and Handouts. | 6 |
| 6 | **E-mail and Social Networking :**Structure of E-mail, Using E-mails, Opening Email account, Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, replying to an E-mail message, Forwarding an E-mail message, Searching emails, Attaching files with email, Email Signature, Social Networking & e-Commerce, Facebook, Twitter, LinkedIn, Instagram, Instant Messaging (WhatsApp, Facebook Messenger, Telegram), Introduction to Blogs. | 6 |

**Text Books:**


1. Bittu Kumar, *Mastering MS Office: Concise Handbook with screenshots*, V&S Publishers, 2017.
2. Orchids, *Microsoft Office 2007*, MS Office Series, 2018
3. Jain Satish, 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.
   Peter Norton, *Introduction to Computers*, Tata Mcgraw Hill Publication, 2005.

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | | **Semester: II** | |
|---|---|---|---|---|---|---|
| **Course:** | **Professional core course II** (Fundamentals of Solar Photovoltaic Energy systems) | | | | **Code: S5.GV.02** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (Hrs)** |
|---|---|---|
| 1 | Introduction : Conversion of solar energy to electricity, Voltage, current and power Electrical Circuits, Electrical Components | 6 |
| 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 | 6 |
| 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 | 6 |
| 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) | 6 |
| 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) | 6 |
| 6 | Customer needs and solutions : Understanding customer needs and suggesting the right solution, creating block diagram for a grid-tied system | 6 |

**Text Books**


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


**Reference Books**


1. Naganagouda H., *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:** Mini Project | | | | **Code:** S5.VP.01 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **6** | **6** | **3** | **-** | **-** | **100** | **100** |

**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. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

**Detailed Syllabus:**

| **Task** | **Description** |
|---|---|
| 1 | 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).<br><br>**The application fields (Thrust areas) are as follows:**<br>Agricultural, Health and Hygiene, refrigeration and air conditioning, Smart Cities, green buildings, Energy, Transportation, automobile, Robotics, etc. |

| **Program:** | **B. Voc. (SOLAR SYSTEMS)** | | | **Semester:** II | | |
|---|---|---|---|---|---|---|
| **Course:** | On Job Training (ELE/Q5902) | | | **Code:** S5.QP.01 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **30** | **30** | **15** | **-** | **-** | **200** | **200** |

**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 Description** |
|---|---|
| 1 | 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:** |
|---|---|
| 1 | 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: | Soft Skills for Professionals | | | | Code: C6.GE.01 | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| 3 | 3 | 3 | 20 | 30 | 50 | 100 |

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Introduction to Soft Skills:** What are Soft Skills, Importance of Soft Skills, Soft Skills v/s Hard Skills, Ways to Develop Soft Skills, Traits of a Pleasant Personality | **8** |
| 2 | **Language Skills:** Interactive Nature of Communication, Importance of Context, Formal and Informal, Language Functions, Introducing - Making Requests - Asking for / Giving Permission, Giving Instructions and Directions, Agreeing / Disagreeing, Seeking and Giving Advice, Conversational Manners | **8** |
| 3 | **Communication Skills:** Oral and Written Communication, Body Language, Basics of Email Writing, Attending and Coordinating Meetings, Telephonic Conversational Skills, Business Expressions, Public Speaking Skills | **8** |
| 4 | **Self Management:** Importance of Self Grooming, Dress Sense, Self Awareness, Developing Right Attitude, Developing Assertiveness, Being Fit, Work Scheduling, Punctuality, Time Management, Stress Management | **7** |
| 5 | **People Skills:** Creating Positive Impression, People-Networking Skills, Building Trust And Rapport With People, Interpersonal Skills, Presentation Skills | **7** |
| 6 | **Work Skills:** Listening as a Team, Contributing as a Team, Process of Problem-Solving, Work Ethics, Professionalism, Taking Initiatives | **7** |

**Text Book**

1. Prashant Sharma, *Soft Skills - Personality Development for Life Success*, BPB Publications, 2018.

**Reference books:**

1. Jay, *Effective Presentation*, Pearson, 2009.
2. Mishra, and C. Muralikrishna, *Communication Skills for Engineers*, Pearson, 2011.
3. Gopalaswamy Ramesh, *The Ace of Soft Skills: Attitude, Communication and Etiquette For Success*, Pearson Education, 2010.
4. Mitra Barun K., *Personality Development & Soft Skills*, Oxford University Press, 2012.
5. Mishra Rajiv K., and Rupa & Co., *Personality Development the Complete Manager –Life Skills for Success*, ICFAI University, 2004.

| Program: | B. Voc. (Solar Systems) | | | Semester: III | | |
|---|---|---|---|---|---|---|
| Course: | General foundation course – I<br>( Introduction to Entrepreneurship ) | | | Code: C6.GE.02 | | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| 3 | 3 | 3 | 20 | 30 | 50 | 100 |

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **The Entrepreneur:**<br>Why to become entrepreneur ,Types of Entrepreneur , Concept of Social Enterprise and Social Entrepreneurship**,** Social Entrepreneurs, Rural Entrepreneurship, Family Business Entrepreneurship**,** The entrepreneurial decision process,<br>**Case Study of Entrepreneurship in different Sectors** | **8** |
| 2 | **Skills for Successful Entrepreneurs:**<br>Communication Skills, Creativity and Problem solving, Innovation, Negotiation Skills, Risk management<br>**Case Study of Successful Entrepreneurs- Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India** | **8** |
| 3 | **Inter Personal Relationship and Understanding Individual Behavior**<br>Importance of maintaining good inter personal relationship with related people in business, Need for leadership in the enterprise development, Characteristics of a good leader, Various styles of Leadership, Definition Personality, importance of personality in Performance, Ego State, Johari window- Transactional Analysis | 8 |
| 4 | **Business Opportunity Identification**<br>Concept of Business Opportunity, What is a business idea, How to generate Business Ideas? Business Opportunities Identification Process, Business Value Chain, different sections of the business value chain for potential opportunities. | 7 |
| 5 | **Business Organizations and Business Laws:**<br>Types of Business Organizations -Sole Proprietorship, Joint Hindu Family Business, Partnership, Limited Liability Partnership (LLP), Corporate Governance, Franchising, Business Laws in India to start Business | 7 |
| 6 | **Government Initiatives:** Role of Government in promoting Entrepreneurship in India, Start up India, Atmanirbhar Bharat, Make in India Assistance to an Entrepreneur, Industrial Park , Special Economic Zone , MSME Act , MSME policy in India, Financial assistance to MSME, Various Government schemes - PMEGP, CGTMSE, PMKVY, Mudra loan, Case studies of Start ups, Role of Institutional Support | 7 |

Reference Books:


1. S.S. Khanna, *Entrepreneurial Development*, S. Chand Publication, 2011
2. Poornima M., *Entrepreneurship Development, and small business management*, Charantimath, Pearson Publication, 2018.
3. Arya Kumar, *Entrepreneurship*, Pearson Publication, 2012.
4. Kavita Singh, *Organizational Behavior*, Vikas Publishing House, 2015.

| **Program:** | **B. Voc. (Solar System)** | | | | **Semester: III** | |
|---|---|---|---|---|---|---|
| **Course:** | **PCC III: Basics of Fluid Mechanics & Thermodynamics** | | | | **Code: S6.GV.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Properties of Fluid**<br>Pressure, Density, Specific Weight, Specific Gravity, Viscosity, Newton's law of viscosity, Surface Tension, Capillarity, Compressibility, Vapour pressure, Cavitation. Numerical on pressure, density, SP. Weight, viscosity, surface tension , capillarity & compressibility. | 8 |
| 2 | **Basic Fundamental of Fluid Mechanics**<br>Introduction to fluid & Non fluids, Pascal's Law, Hydrostatic law, Buoyancy & floatation, Classification of fluids & regimes of flow, Continuity equation, Bernoulli's equation, Simple numerical on continuity equation & Bernoullis equation. | 8 |
| 3 | **Measuring Instruments**<br>Bourdon tube pressure gauge, Piezometer, U tube manometer, Double u tube manometer, Differential manometer, Inverted U tube differential manometer, Viscometer, Pitot tube, types of temperature sensors & Pressure sensors | 8 |
| 4 | **Law of thermodynamics**<br>Zeroth Law, First law for closed systems and open systems, Second law statements: Kelvin Plank and Clausius statement. PMMI and PMMII, | 7 |
| 5 | **Applications:**<br>Applications of first law for steam turbine, refrigeration compressor, throttling device, heat exchanger etc.<br>Application of second law to heat engine, refrigeration cycle and heat pump<br>Introduction to Reciprocating air compressor, measurement of calorific value of fuel | 7 |
| 6 | **Psychometric**<br>Psychometric properties, Psychometric chart, Psychometric process | 7 |

Text Books:


1. Bansal R.K., *Fluid Mechanics*, Laxmi Publication (P) Ltd., 2018.
2. Modi P. N., and Seth S. M., *Hydraulics and Fluid Mechanics*, Standard Book House, 2019.
3. S.K. Som, and Biswas G., *Introduction to Fluid Mechanics and Fluid Machines*, TATA McGraw –Hill, 2008.
4. Nag P.K., *Engineering Thermodynamics*, Tata McGraw Hill Publications, 2103.
5. Mahesh M. Rathore, *Thermal Engineering*, Tata McGraw-Hill, 2010.


**Reference Books:**


1. Potter Merle C., Wiggert David C., and Ramadan Bassem, *Mechanics of Fluids,* Cengage Learning, 2016.
2. Kundu, Cohen, and Dowling, *Fluid Mechanics*, Elsevier India, 2015.
3. Munson, Young, and Okiishi, *Fundamentals of Fluid Mechanics,* Wiley, 2021.
4. Cengel, and Cimbla, *Fluid Mechanics*, TATA McGraw –Hill, 2017.
5. White F.M., *Fluid Mechanics*, TATA McGraw-Hill, 2016.
6. Fox Robert W., McDonald Alan T., and Mitchell John W., *Introduction to Fluid Mechanics,* John Wiley, 2020.
7. Cengel Y., and Boles, *Thermodynamics an engineer's approach,* Tata McGraw-Hill, 2019.

| **Program:** | **B. Voc. (Solar System)** | | | | **Semester: III** | |
|---|---|---|---|---|---|---|
| **Course:** | **PCC IV: Engineering Materials** | | | | **Code: S6.GV.02** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE 1** | **IE 2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **50** | **100** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (45 Hrs)** |
|---|---|---|
| 1 | **Introduction of Engineering Materials:** Classifications of Engineering materials, Metallic Materials, Ceramic Material, Polymers, Composite and Nano-materials. | **8** |
| 2 | **Mechanical Behavior**<br>Mechanical Properties of engineering material, Tensile, compression, flexural, Hardness, toughness, Mechanism of elastic & plastic deformation (slip and twinning), Theory of dislocation. | **8** |
| 3 | **Ferrous and non-ferrous metal**<br>Definition, classification, properties and applications of Iron and Steel-Cast Iron, Stainless Steel, Tool Steel, Copper, Aluminium, Lead, Tin, Zinc, Nickel, Magnesium. | **8** |
| 4 | **Heat treatment**<br>Time Temperature Transformation diagrams, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalizing, Hardening & Tempering, quenching media. | **7** |
| 5 | **Non Destructive testing**<br>Difference between destructive and non-destructive testing, Ultrasonic testing NDT, Magnetic particle inspection NDT, Acoustic emission NDT, Dye penetrant NDT, Radiography NDT, Eddy Current NDT. | **7** |
| 6 | **Applications and processing of materials and their property**<br>Metal alloys, ceramics, polymers, composites, Electrical property, Thermal property, Magnetic property, Nanomaterials. | **7** |

Text Books:

1. Kodgire V. D., *Material Science and Engineering*, Everest publishing house, 2017.
2. Callister W. D., *Introduction to Material Science and Engineering*, John Wiley, 2018.

Reference books:

1. Dieter George E., *Mechanical Metallurgy*, McGraw-Hill, 2017.
2. Smith Charles O., *The Science of Engineering Material*, Prentice Hall, 1977

| **Program:** | **B. Voc. (Solar System)** | | | **Semester: III** | | |
|---|---|---|---|---|---|---|
| **Course:** | **PCC III Lab: Basics of Fluid Mechanics & Thermodynamics Lab** | | | **Code: S6.VP.01** | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practicals** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **-** | **2** | **1.5** | **-** | **50** | **-** | **50** |

**Guidelines:**

1. Total experiments to be conducted are four from Part A and four from Part B
2. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus:**

| **Expt.** | **Description** |
|---|---|
| | **Part A Fluid Mechanics** |
| 1 | Determination of pressure using manometers (minimum two) |
| 2 | Determination of fluid viscosity and its variation with temperature. |
| 3 | Determination of Metacentric height of floating object. |
| 4 | Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus. |
| 5 | Verification of modified Bernoulli's equation |
| | **Part B Thermodynamics** |
| 6 | Determination of Calorific value of solid fuel using Bomb Calorimeter |
| 7 | Application of first law to open systems using day to day examples |
| 8 | Application of first law to open systems |
| 9 | Trial on reciprocating air compressor to determine volumetric efficiency |
| 10 | Study of psychometric process. |

Text Books:


1. Bansal R.K., *Fluid Mechanics*, Laxmi Publication (P) Ltd., 2018.
2. Modi P. N., and Seth S. M, *Hydraulics and Fluid Mechanics*, Standard Book House, 2019.
3. Som S.K. and Biswas G., *Introduction to Fluid Mechanics and Fluid Machines*, TATAMcGraw –Hill, 2011.


**Reference Books:**


1. Potter Merle C., and Wiggert David C., and Ramadan Bassem, *Mechanics of Fluids, Cengage Learning, 2016.*
2. Kundu, Cohen, and Dowling, *Fluid Mechanics*, Elsevier India, 2012.
3. Munson, Young, and Okiishi, *Fundamentals of Fluid Mechanics*, Wiley India, 2020.
4. Cenge, and Cimbla, *Fluid Mechanics*, TATA McGraw –Hill, 2010.
5. White F.M., *Fluid Mechanics*, TATA McGraw-Hill, 2011.
6. Fox Robert W., McDonald Alan T., and Mitchell John W., *Introduction to Fluid Mechanics*, John Wiley, 2015.

| Program: | B. Voc. (Solar System) | | | | Semester: III | |
|---|---|---|---|---|---|---|
| Course: | PCC IV Lab: Engineering Materials Laboratory | | | | Code: S6.VP.02 | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Practicals | Hours | Credit | TW | PR | OR | Total |
| - | 2 | 1.5 | - | 50 | - | 50 |

**Guidelines:**

1. Total: 8 experiments/assignments to be conducted.

**Detailed Syllabus:**

**List of Practical's**

**Conduct any 8 Experiments from the following list**

1. Tension test for ductile material using extensometer on Universal Testing Machine. (Discussion on Stress-strain diagram for ductile and brittle materials, factor of safety).
2. Compression test for Brittle material on Universal Testing Machine.
3. Shear test of ductile material on Universal Testing Machine.
4. Experimental verification of flexural formula in bending by 3 point bending method.
5. Experimental verification of torsional formula.
6. Impact testing of materials
7. Non-destructive testing of materials: Dye penetrant, magnaflux, Ultrasonic, Eddy current.
8. Heat treatment: Annealing, Normalizing, Hardening and Tempering.
9. Specimen preparation for microscopic study.
10. Microstructure observation and analysis of ferrous and non-ferrous materials.
11. Hardness test: Brinell, Vickers. Rockwell, etc.
12. Jominy End Quench test

**Text Books:**

1. Kodgire V.D., *Material Science and Engineering*, Everest publishing house, 2017.
2. Callister W. D., *Introduction to Material Science and Engineering*, John Wiley, 2018.

**Reference books:**

1. Dieter George E., *Mechanical Metallurgy*, McGraw-Hill, 2017.
2. Smith Charles O., *The Science of Engineering Material*, Prentice Hall, 1977.

| Program: | B. Voc. (Solar Systems) | | | Semester: III | | |
|---|---|---|---|---|---|---|
| Course: | On Job Training (ELE/Q7902) | | | Code: S6.QP.01 | | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Practical | Hours | Credit | TW | PR | OR | Total |
| 30 | 30 | 15 | - | - | 200 | 200 |

**Guidelines:**
Students will take on job training in the industry in the domain of Refrigeration and air conditioning as per the following job description and personal attributes.

| | Job Description |
|---|---|
| 1 | A Quality Manager - Electronics is responsible for managing quality in all organisational 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 organisation to ensure it remains competitive in the market. |

| | Personal Attributes |
|---|---|
| 1 | The individual in this job role must possess strong leadership, management, analytical and problem solving abilities. The person must be adept at using various computer applications for efficient data and record management. The individual must have good communication skills, attention to detail and a strong sense of quality in all the activities. |

# Course Syllabus
## Semester-IV

| Program: | B. Voc. (Solar Systems) | Semester: IV |
|---|---|---|
| Course: | General foundation course – II<br>Management and Entrepreneurship | Code: C6.GE.03 |

| Teaching Scheme | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| 3 | 3 | 3 | 20 | 30 | 50 | 100 |

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Management:**<br>Meaning, Definition, Need and Process of Management, Managerial levels/Hierarchy: Top Level, Middle Level, Lower Level, Five Functions of Management: Planning, Organizing, Staffing, Directing, Controlling, Managerial Skills: Technical Skill, Human Skill, Conceptual Skill | 8 |
| 2 | **Marketing Management:**<br>Definition & Functions of Marketing- Scope of Marketing, Core concepts of marketing:- Need, Want, Demand, Customer Value, Exchange, Customer Satisfaction, Customer Delight, Customer loyalty, Company orientation towards market place, Segmentation, Target Marketing & Positioning, | 8 |
| 3 | **Marketing Mix:**<br>Marketing Mix, 7P's - Product, Price, Place, Promotion, People, Process, Physical evidence. Product Life Cycle | 8 |
| 4 | **Startup opportunities**<br>Meaning of Startup,The Rise of The startup Economy, Startup Policy, Startup opportunities, Registration and Legal Process of Startups, The Startup Ecosystem -Entrepreneurship in India. | 7 |
| **5** | **Market Survey and Research:**<br>What is a market survey?, Process of conducting a market survey, Primary and secondary sources of information, Market survey tools, Preparation of schedule, Techniques of data collection, Questionnaire | 7 |
| 6 | **Business Plan**<br>The Business plan as an entrepreneurial tool, Elements of Business Plan, Market Analysis, Technical Analysis, Financial Analysis, Economic Analysis, SWOT analysis, Internal and External Environment Analysis | 7 |

Reference Books:


1. Khanka S.S., *Entrepreneurial Development*, S.Chand Publication, 2013.
2. Charantimath Poornima M., *Entrepreneurship Development and small business management*, Pearson Publication, 2018.
3. Kumar Arya, *Entrepreneurship*, Pearson Publication, 2012.
4. Singh Kavita, *Organizational Behaviour*, Vikas Publishing House, 2015.
   Kotler Philip, Keller K., Koshy Abraham, and Mithileshwar Jha, *Marketing Management: A South Asian Perspective*, Pearson Education, 2013.

| **Program: B. Voc. (Solar Systems)** | | | | | **Semester: IV** | |
|---|---|---|---|---|---|---|
| **Course: PCC V : Fundamental of Solar Energy-III** | | | | | **Code: S6.GV.03** | |
| **Teaching Scheme** | | | | **Evaluation Scheme** | | |
| **Lecture** | **Practical** | **Tutorial** | **Credit** | **IE** | **ETE** | **Total** |
| 3 | - | - | 3 | 30 | 70 | 100 |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (36Hrs.)** |
|---|---|---|
| 1 | **Various applications of solar energy:** Solar thermal application- water heating, air heating, refrigeration and air conditioning, desalination, drying, cooking, principle of photovoltaic conversion of solar energy. | **8** |
| 2 | **Photovoltaic Cell**: Types of solar cells, domestic lighting, street lighting, water pumping, solar thermal electric power plant, solar PV power plant, solar power generation: thermal and electricity, battery charger. | **8** |
| 3 | **Solar Water Heating Systems:** Different collector used for water heating application, water circulation system- force and natural (Thermo-syphon) system, integral collector storage system, simple design of solar flat plate collector(FPC) for water heating system, IS standard for design of flat plate collectors, heat losses and heat gain in FPC. | **8** |
| 4 | **Solar Air Heating System:** Different collector used for air heating system, air circulation system- natural and force, simple design of solar air heater (SAH) for drying system for drying, heat losses, heat gain, efficiency of SAH, drying performance. | **7** |
| 5 | **Scale formation:** Scale formation, sources of scale formation, different techniques of removing scale formation, water softening plant, elements of water softening plant. | **7** |
| 6 | **Commercial Solar water heater and Solar air heaters:** Different solar water heater available in the market, different air heaters available in the market, New technology in the water heater and air heaters. | **7** |
| | **Total Hrs.** | **45** |

**Text Book**

1.Sukhatme S.P., and J. K. Nayak, *Solar Energy- Principles of thermal collection and storage*, Tata McGraw Hills., 2008.
2.C.S. Solanki, *Solar Photovotaics – Fundamentals, Technologies and Applications*, PHI Learning, 2015.

**Reference Book**

1. Duffie, J.A., and Beckman, W.A. *Solar Energy Thermal Process*, John Wiley and Sons, New York, 2013.
2.Jui Sheng Hsieh, *Solar Energy Engineering*, Prentice-Hall, 2013.
3**.** Boxwell Michael, *The Solar Electricity Handbook*, Code Green Publishing, 2009.
4**.** Green Martin A., *Solar Cells Operating Principles, Technology, and System Applications* Prentice-Hall, 2008.

| **Program: B. Voc. (Solar Systems)** | | | | **Semester :** | |
|---|---|---|---|---|---|
| **Course: Metrology and Measuring Instruments (MMI)** | | | | **Code: S6.GV.04** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | |
| **Lecture** | **Hours** | **Credit** | **IE** | **ETE** | **Total** |
| **3** | **3** | **3** | **50** | **50** | **100** |

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Fundamentals of Metrology**<br>Introduction to Engineering Metrology, Measurement Standard, Types and sources of errors, Accuracy and Precision, Geometric Form Measurement: Geometric Form Measurement: Straightness, Flatness, Roundness, Straight edge, use of spirit level, autocollimator, testing of flatness of surface plate, Limit Gauges. | 8 |
| 2 | **Comparators, Thread and Gear Metrology**<br>Comparators: Mechanical, Pneumatic, Optical, Electrical, Calibration of dial gauge indicator, Thread form Measurement: Thread form errors, Best Wire Size, Measurement of Pitch, Depth and Angle of Thread, Floating Carriage Micrometer, Gear Metrology: Introduction, Gear tooth Vernier, Gear Rolling Tester, Profile Projector | 8 |
| 3 | **Advances in metrology and Surface Roughness Measurement**<br>Surface Roughness Measurement: Introduction to Surface roughness, Surface roughness measuring instrument: TalySurf. Coordinate Measuring Machine (CMM) and Machine Vision Systems | 8 |
| 4 | **Fundamentals of instrumentation**<br>Basic functional elements of measurement system and instrumentation need of measurement, Methods and applications of measurements, Errors in measurement, Storage and display devices, digital voltmeter and ammeter, power & energy measurement | 7 |
| 5 | **Position and Temperature Measurement**<br>Classification of sensor/transducers, Position sensors: Potentiometer, LVDT and RVDT, Proximity sensors: Optical, Inductive, Capacitive, Temperature sensor: RTD, Thermocouples and Infrared thermometer | 7 |
| 6 | **Miscellaneous Measurement**<br>Selection of sensor/transducers, Force Measuring Sensors: Piezoelectric, strain gauges, Level Sensors: Capacitive, Optical, Conductive, Measurement of speed/velocity: Stroboscope, Contact and Non-contact type of tachometers | 7 |

**Reference books:**

1. Narayana K.L., *Engineering Metrology*, Scitech Publications Pvt. Ltd., 2013.
2. Gupta I.C., *Engineering Metrology*, Dhanpatrai Publications, 2019.
3. Farago Francis T., Curtis Mark A., *Handbook of dimensional measurement*, Industrial Press Inc. 2007.
4. ASTME, *Handbook of Industrial Metrology*, Prentice Hall of India Ltd, 2018.
5. Kulkarni V. A., and Bewoor A. K., *Quality Control*, John Wiley Publication, 2009.
6. Wordsworth Harrison M., and Godfrey Stefeen, *Modern Methods for Quality control and Improvement*, Willy Publication, 2016.
7. Davim J. Paulo, *Mechatronics*, Wiley publication, 2011.
8. Histand, *Introduction to Mechatronics*, Mc Graw Hill, 2012.

**Text Books:**

1.Jain R.K., *Engineering Metrology*, Khanna Publication, 2005.
2. I. C. Gupta, *Engineering Metrology*, Dhanpath Rai, 2019.
3. Bewoor A. K., and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication, 2009.
4. M. Mahajan , *Metrology*, 2012.

5. Rajput R.K., *Mechatronics*, Nirali Publication, 2022.

| **Program:** | **B. Voc. (Solar Systems)** | | **Semester :** | | | **IV** |
|---|---|---|---|---|---|---|
| **Course:** | **PCC VII : Manufacturing Technology** | | **Code :** | | | **S6.GV.05** |
| **Teaching Scheme:** | | | **Evaluation Scheme:** | | | |
| **Lecture** | **Hours** | **Credit** | **IE1** | **IE2** | **ETE** | **Total** |
| 03 | 03 | 03 | 20 | 30 | 50 | 100 |

**Detailed Syllabus**

| **Unit** | **Description** | **Duration ( 45 Hrs)** |
|---|---|---|
| 1 | **Introduction to the Manufacturing Technology:** Introduction and Classification of manufacturing processes, selection of manufacturing processes, introduction to materials commonly used for industrial applications, safety practices followed in the workshop. | **8** |
| 2 | **Introduction to the various Instruments and tools used in workshop practices:** Marking & Measuring tools, striking tools, cutting tools, holding tools, Miscellaneous Tools- Wrenches, keys, Spanners, pliers, Screw drivers their specifications, special tools. | **8** |
| 3 | **Introduction to Casting and Plastic molding process:** Sand casting, Investment casting, plastic molding etc. Demonstration of sand-casting process for manufacturing cast product. | **8** |
| 4 | **Introduction to Joining processes:** Gas welding, flame welding, brazing, soldering, mechanical fastening and adhesive bonding. Introduction to various terminologies like, joining tools, selection of materials, safety measures. Use of soldering tool for joining components on printed circuit board (PCB). | **77** |
| 5 | **Introduction to Advanced Manufacturing Processes:** Demonstration of VMC machining, CNC machining, 3D Printing etc. | **7** |
| 6 | **Introduction to Metal Forming processes:** Introduction to sheet metal forming processes and tools. Demonstration of Cutting, Shearing and Blanking, Straightening, Bending and Seaming, Punching and Piercing, Burring, Stamping. | **7** |

Text Books:

1. Rajput R.K., *Manufacturing Technology*, Firewall Media, 2007.
2. Sharma P.C., *Production Technology*, S. Chand, 1999.

Reference books:

1. Rao P. N., *Manufacturing Technology*, Tata McGraw-Hill Education, 2013.
2. Kalpakjian, Manufacturing *Engineering and Technology*, Pearson, 2009.

**E-sources:**

- **www.nptel.ac.in**

| **Program: B. Voc (Solar System)** | | | | **Semester:** IV | | | |
|---|---|---|---|---|---|---|---|
| **Course: PCC V LAB : Fundamental of Solar Energy-III** | | | | **Code: S**6.VP.03 | | | |
| **Teaching Scheme** | | | | **Evaluation Scheme** | | | |
| **Lecture** | **Practical** | **Tutorial** | **Credit** | **TW** | **OR** | **PR** | **Total** |
| | 3 | - | 1.5 | - | - | 50 | 50 |

**List of Experiments: (any 8)**

| **Sr. No.** | **Description** |
|---|---|
| 1 | Study the various applications of solar Energy |
| 2 | Identifying and measuring the parameters of a solar PV Module in the field |
| 3 | Series and Parallel connection of PV Modules |
| 4 | Visit to Photovoltaic cell manufacturing industry |
| 5 | Determine the power produce in kW in small Photovoltaic power plant |
| 6 | Solar cell simulation using PC1D simulator |
| 7 | Dismantle of the Flat plate collector for air heating system |
| 8 | Assemble of the Flat plate collector for air heating system |
| 9 | Dismantle of the Flat plate collector for water heating system |
| 10 | Assemble of the Flat plate collector for water heating system |

**Text Book**

1.Sukhatme S.P., and Nayak J.K., *Solar Energy- Principles of thermal collection and storage*, Tata McGraw Hills., 2008.

2. Solanki C.S., *Solar Photovotaics – Fundamentals, Technologies and Applications*, PHI Learning, 2015.

**3.** Solanki C.S., *PV Lab Training Manual*, NCPRE, IIT Bombay, 2012.

**Reference Book**

1. Duffie J.A., and Beckman, W.A. *Solar Energy Thermal Process*, John Wiley and Sons, New York, 2012.

2. Hsieh Jui Sheng, *Solar Energy Engineering*, Prentice-Hall, 2013.

3. Boxwell Michael, *The Solar Electricity Handbook*, Code Green Publishing, 2009.

4. Green Martin A., *Solar Cells Operating Principles, Technology, and System Applications*, Prentice-Hall, 2008.

| **Program:** | **B. VoC (Solar Systems)** | **Semester :** | **IV** |
|---|---|---|---|
| **Course:** | **PCC VI&VII LAB :** Metrology & Measuring Instruments & Manufacturing Tech. Lab | **Code :** | S6.VP.04 |

| **Teaching Scheme:** | | | **Evaluation Scheme:** | | | |
|---|---|---|---|---|---|---|
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| 03 | 03 | 1.5 | -- | 50 | -- | 50 |

**Guidelines:**

1. Total experiments to be conducted are four from Part A and four from Part B
2. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus**

| | |
|---|---|
| | Part A Metrology & Measurement Instruments |
| 1 | To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers. |
| 2 | To measure the pitch, angle and form of thread of a screw on Profile Projector. |
| 3 | Calibration of dial mechanical dial gauge indicator |
| 4 | Speed measurement of mechanical system/application using non-contact and contact type tachometer and its comparison. |
| 5 | To measure temperature using any temperature sensor/transducer. |
| | **Part B Manufacturing Technology** |
| 6 | Introduction to safety measures. |
| 7 | Demonstration of Manufacturing processes (Machining: Turning, Drilling, Milling and grinding using one simple machine component and sheet metal operations): Working, operation and types |
| 8 | Demonstration of soldering and brazing operations on different materials. |
| 9 | Demonstration of Advanced Manufacturing processes (CNC Machining, Additive manufacturing using one simple machine component) |
| 10 | Joining – 1 Job involving MIG welding or Arc welding or Gas welding. |

**Reference Books:**


1. Choudhari Hajara, and Bose S.K., *Elements of workshop Technology Vol. I & II*, Asian Publishing House, 2010.
2. Raghuvanshi B.S., *Workshop Technology. Vol. 1 & 2*, Dhanpat Rai & Co. (P) Ltd, 2017.
3. Rao P. N., *Manufacturing Technology Volume I & II*, McGraw Hill Education Private Limited, 2017.
4. Narayana K.L., Engineering Metrology, New Age International (P) Limited, Publishers, 2006.
5. Gupta I.C., *Engineering Metrology*, Dhanpatrai Publications, 2018.
6. Farago Francis T., Curtis Mark A., *Handbook of dimensional measurement*, Publisher Industrial Press, 2013.
7. ASTME, *Handbook of Industrial Metrology*, Prentice Hall of India Ltd., 2004.

| Program: | B. Voc. (Solar Systems) | | | Semester: IV | | |
|---|---|---|---|---|---|---|
| Course: | On Job Training (ELE/Q7902) | | | Code: S6.QP.02 | | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Practical | Hours | Credit | TW | PR | OR | Total |
| 30 | 30 | 15 | - | - | 200 | 200 |

**Guidelines:**

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

| | Job Description |
|---|---|
| 1. | A Quality Manager 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. |

| | Personal Attributes |
|---|---|
| 1. | The individual in this job role must possess strong leadership, management, analytical and problem solving abilities. The person must be adept at using various computer applications for efficient data and record management. The individual must have good communication skills, attention to detail and a strong sense of quality in all the activities. |

# Course Syllabus
## Semester-V

| Program: | B. Voc. (Solar Systems) | | | | Semester: V | |
|---|---|---|---|---|---|---|
| **Course:** | **Industrial Management** | | | | **Code: S7.GV.01** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Lecture** | **Hours** | **Credit** | **IE1** | **IE2** | **ETE** | **Total** |
| **3** | **3** | **3** | **20** | **30** | **70** | **100** |

**Objectives:**

1. To understand the different sector of Industrial Engineering.
2. To have the knowledge of wages and incentive policies.

**Course Outcome: After learning this course students will able to**

3. Understand the concept of Industrial engineering.
4. Describe the Private and Public sector concept.
5. Identify the functions of organization in a Industry.
6. Understand the different wages and incentives policies.
7. Understand the labour and tax laws of organization.
8. Study the different material management skills in industry.

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Introduction:** Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis. | 7 |
| 2 | **Private sector:** Privet sector enterprise, merits and demerits of private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments. | 8 |
| 3 | **Public sector:** Public sector enterprise, merits and demerits of public sector industry and private sector industry. Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments. | 8 |
| 4 | **Wages & incentives:** Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman. | 8 |
| 5 | **Labour, industrial & tax laws**: M.K.S. fundamentals & derived units, S.I. base units, supplementary units and derived units, Dimensions of various physical quantities, uses of dimensional analysis. | 7 |
| 6 | **Material management:** Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards | 7 |

Text Books:

Reference books:

4. Industrial Engineering & Management, S.C. Sharma, Khanna Publishing House

| **Program:** | **B. Voc. (Solar Systems)** | | **Semester:** | | | **V** |
|---|---|---|---|---|---|---|
| **Course:** | **PCC VII:** Solar Water Heater Plant | | **Code:** | | | **S7.GV.02** |
| **Teaching Scheme:** | | | **Evaluation Scheme:** | | | |
| **Lecture** | **Hours** | **Credit** | **IE1** | **IE2** | **ETE** | **Total** |
| 03 | 03 | 03 | 20 | 30 | 50 | 100 |

**Prior Knowledge of**

1. Heat transfer analysis
2. Fundamentals of solar engineering

**Courser Objectives:**

1. To establish an understanding of the fundamental concepts of the solar water heating system
2. To make the students conversant about the water heat storage and insulating materials
3. To develop the skills to evaluate and understand the load calculations of the water heating system
4.To develop the competency to predicts the life and payback load of the solar water heating system

**Courser Outcomes:**

1.Understand the various types of the water heaters
2.Analyze the water heating system and evaluate the load on water heating system
3.Understand the various hot water storage system
4.Select the appropriate insulating materials for the water heaters
5.Evaluate the payback period and the reliability of the water heaters

**Detailed Syllabus**

| **Unit** | **Description** | **Duration ( 45 Hrs)** |
|---|---|---|
| 1 | **Introduction to solar water heaters**<br>Energy demand and renewable energy, Energy related environmental problems, Various types of solar water heaters, Description of Flat-Plate Collectors, Concentrating Collectors, Concentration Ratio, Basic Flat-Plate, Installation of simple solar water heater | 08 |
| 2 | **Load calculation**<br>Examples of Time-Dependent Loads, Hot-Water Loads, temperature, number of people, area required etc, Space Heating Loads, Degree-Days, Balance Temperature, Building Loss Coefficients, Building Energy Storage Capacity, Swimming Pool Heating Loads, | 07 |
| 3 | **Hot water storage**<br>Energy Storage in Solar Process Systems, Water Storage, water softening plant, Stratification in Storage Tanks, Packed-Bed Storage, Introduction to Phase Change Energy Storage, Chemical Energy Storage, Seasonal Storage | 08 |
| 4 | **Insulating Materials**<br>Various types of insulating materials, thermal conductive critical radius of insulation, types of insulation, cost of insulations, Density, thermal conductivity and specific heat of the various insulating materials, industrial insulating materials, criteria for the selection of the insulating materials. | 07 |
| 5 | **Performance Analysis**<br>Energy Balance Equation, Collector Overall Heat Loss Coefficient, Measurements of Collector Performance, Input-output water temperature, Thermal Performance of Concentrating Collectors, efficiency, life, Effects of Dust and Shading, | 08 |
| 6 | **Maintenance and economics of solar water heater plant:**<br>Reliability of water plant, leakages, blockages, rusting, scaling, valve damages, control valve, Costs of Solar Process Systems, Uncertainties in Economic Analyses, | 07 |

| | | |
|---|---|---|
| | Payback period | |

**Text Books**

1. Sukhatme S.P., and Nayak J.K., *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill, 2008.
2. Garg H.P., and Prakash J., *Solar Energy Fundamentals and Applications*, Tata McGraw-Hill, 2005.

**Reference books**

1. Duffie. J.A., and Beckman W.A., *Solar Engineering of Thermal Processes*, Wiley, Fourth edition, 2006.
2. Soteris A. Kalogirou, Solar Energy Engineering Processes and Systems, Second edition, 2014.
1. De Vos A., *Thermodynamics of Solar Energy Conversion*, Wiley-VCH, 2008.
2. Kalogirou S., *Solar Energy Engineering, Processes and Systems*, Elsevier, 2009.
3. Petela R., *Engineering Thermodynamics of Thermal Radiation for Solar Power*, McGraw-Hill Co., 2010.

**E-sources:**

- www.nptel.ac.in

| **Program:** | **B. Voc. (Solar Systems)** | | **Semester :** | | | **V** |
|---|---|---|---|---|---|---|
| **Course:** | **PCC VII :** Solar PV Power Plant | | **Code :** | | | **S7.GV.03** |
| **Teaching Scheme:** | | | **Evaluation Scheme:** | | | |
| **Lecture** | **Hours** | **Credit** | **IE1** | **IE2** | **ETE** | **Total** |
| 03 | 03 | 03 | 20 | 30 | 50 | 100 |

**Objectives:**

Following concepts to be taught to the students,

1. Demonstrate significance of PV technologies and their utilization
2. Expose them to conceptualize PV power plant, its economics and maintenance.

**Course Outcomes:**

After learning the course, the learners will be able to

1. Understand types of PV power plant and net metering system.
2. Estimate the internal parameters for site selection and shadow analysis.
3. Understand types of electric energy storage system and their performance characteristics.
4. Understand types of inverter, their selection, and circuitry arrangement.
5. Estimate the performance and yield of PV plant.
6. Analyze the economics of PV power plant and assess the maintenance requirement.

**Detailed Syllabus**

| **Unit** | **Description** | **Duration ( 45 Hrs)** |
|---|---|---|
| 1 | **Types of Solar Power Plant**<br>Installation of PV Plant on grid/ Off grid, light arresting, earthing (Grid Connected solar Power Plant, Grid interactive solar power plant, Net Metering Solar Power Plant, Off-Grid / Hybrid solar power plant, Schemes of solar power plant) | **08** |
| 2 | **Site Selection and shadow analysis**<br>(Site survey and plant load assessment, PV module structure interrow spacing calculation, Pitch analysis, Selection of PV module tilt angle, Near shading object calculation,) | **08** |
| 3 | **Electricity storage System:**<br>Types of battery storage system, sizing, performance characteristics | **07** |
| 4 | **Inverter and circuit details**<br>(Types of solar inverter, Selection of string /central / off grid inverter, Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects) | **08** |
| 5 | **Performance of PV plant, IV characterization**<br>(Connection of PV Module (Series and Parallel Circuit), Power characteristics of a Solar Cell, Fill factor and Equivalent Solar cell Circuit, STC and NOCT, Losses in a Grid-Connected PV System, Calculating the Energy Yield for a PV Grid-Connected System, Specific Yield, Performance Ratio | **08** |
| 6 | **Economics and Maintenance of PV plant:** Simple Payback, Life Cycle Costing, System Maintenance, Troubleshooting | **06** |

Text Books:

1. M.A. Greaen "Solar Cells — Operating Principles, Technology, and System Applications", Prentice Hall, Inc. New Jersey, 1983
2. Solanki C.S., *Solar Photovoltaics: Fundamentals, Technologies And Applications*, PHI Learning private Ltd., 2018.
3. Rai G.D., Non-conventional Sources of Energy, Khanna Publishers, 2012.

Reference books:

1. Solar Electricity Handbook; Michale Boxwell; 2017 edition
2. Naganagouda H., *Solar Power Hand Book*, PHI School Books, 2014.
3. Solanki Chetan Singh, *Renewable Energy Technologies; A Practical Guide for Beginners*, PHI School Books 2008.
4. Kothari D.P., and Signal K.C., Renewable Energy Sources and Emerging Technologies, PHI, 2011.

**E-sources:**

- www.nptel.ac.in 2. https://onlinecourses.nptel.ac.in/noc22_ee71/preview

| **Program:** | **B. Voc. (Solar Systems)** | | **Semester :** | | | **V** |
|---|---|---|---|---|---|---|
| **Course:** | **Renewable Energy Sources and applications** | | **Code :** | | | **S7.GV.04** |
| **Teaching Scheme:** | | | **Evaluation Scheme:** | | | |
| **Lecture** | **Hours** | **Credit** | **IE1** | **IE2** | **ETE** | **Total** |
| 03 | 03 | 03 | 20 | 30 | 50 | 100 |

**Detailed Syllabus**

**Objectives:**

1. Following concepts to be taught to the students,
2. Demonstrate significance of analysis of solar, wind, biomass, and ocean energy technologies and their utilization
3. Expose them to conceptualize renewable energy appliances and equipment.
4. Develop a research insight about renewable technologies.

**Course Outcomes:**

After learning the course, the learners will be able to

1. Estimate the potential of solar and wind energy resources.
2. Demonstrate understanding of the fundamentals of energy conversion from biomass.
3. Demonstrate understanding of energy conversion technologies from Biomass.
4. Demonstrate understanding of the fundamentals of energy conversion from geothermal energy.
5. Demonstrate understanding of the fundamentals of energy conversion from Tidal energy.
6. Demonstrate understanding of the fundamentals of energy conversion from ocean wave energy and OTEC system

| **Unit** | **Description** | **Duration ( 45 Hrs)** |
|---|---|---|
| 1 | **Wind energy** History and types of wind machines, Terminology, Dimensional analysis, Principles of Aerodynamics of a wind turbine blade, Maximum rotor efficiency (Betz Limit), Power output from practical wind turbine generators, wind data analysis and site selection considerations | **08** |
| 2 | **Energy from biomass -** Sources of biomass Different species, Conversion of biomass into fuels Energy through fermentation Pyrolysis, gasification and combustion Aerobic and anaerobic bio-conversion, Properties of biomass | **08** |
| 3 | **Biogas plants:** Types of plants Design and operation Properties and Characteristics of biogas. Biogas / Producer Gas Technology, Engines - Constructional, Operational & Performance aspects | **08** |
| 4 | **Geothermal Energy:** Availability of Geothermal Energy-size and Distribution, Recovery of Geothermal Energy, Various Types of Systems to use Geothermal Energy, Direct heat applications, Power Generation. | **08** |
| 5 | **Ocean Energy 1** **Tidal Energy:** Introduction, Origin, and Nature of Tidal Energy, Advantages of Tidal Energy, Limitations of Tidal Energy, Tidal Energy Plant, Energy Potential Estimation, Ocean Tidal Energy Conversion Schemes. | **07** |
| 6 | **Ocean Energy 2** Ocean Wave energy, Different technology of Ocean Wave energy conversion, Ocean Thermal Energy Conversion System (OTEC), Types of OTEC | **06** |

| | | |
|---|---|---|
| | **Total** | **45** |

**Text Books:**


1. V.V. N. Kishore, Editor, Renewable Energy Engineering and Technology, A knowledge Compendium, The Energy and Resources Institute, New Delhi, 2008
2. S.P. Sukhatme and J K Nayak, Solar Energy, IV edition, Tata McGraw Hill, New Delhi, 2017.
3. S.P. Sukhatme, Solar Energy Principles of thermal collection and storage, II edition, Tata McGraw Hill, New Delhi, 1996.
4. G.L. Johnson ,Wind Energy Systems ,Prentice Hall, 1985


**Reference books:**


1. J.A.Duffie and W.A.Beckman, Solar engineering of Thermal processes, IV edition, John Wiley, New York, 2013.
2. D.Y.Goswami, F.Kreith and J.F.Kreider, Principles of Solar Engineering, 4th Edition, Taylor and Francis, Philadelphia, 2023.
3. D.D.Hall and R.P.Grover, Biomass Regenerable Energy, John Wiley, New York,1987.
4. Mukund R Patel, Wind and Solar Power Systems, CRC Press, 1999.
5. J F Manwell, J.G.McGowan, A.L.Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley and Sons, May 2002.
6. R D Begamudre, Energy Conversion Systems, New Age International (P) Ltd., Publishers, New Delhi ,2000.


**E-sources:**

- https://nptel.ac.in/courses/103103206

| **Program:** | **B. Voc. (Solar System)** | | | **Semester:** V | | |
|---|---|---|---|---|---|---|
| **Course:** | **Solar water heater plant lab** | | | **Code:** S7.VP.01 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **3** | **3** | **1.5** | **-** | **50** | **-** | **50** |

**Courser Objectives:**

1. To establish an understanding of the fundamental concepts of the solar water heating system
2. To make the students conversant about the water heat storage and insulating materials
3. To develop the skills to evaluate and understand the load calculations of the water heating system
4. To develop the competency to predicts the life and payback load of the solar water heating system

**Courser Outcomes:**

1. Understand the various types of the water heaters
2. Analyze the water heating system and evaluate the load on water heating system
3. Understand the various hot water storage system
4. Select the appropriate insulating materials for the water heaters

Evaluate the payback period and the reliability of the water heaters

**Guidelines:**

3. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus:**

1. Study of IS standard for solar water heater.
2. Study various types of solar water heater and any one case study solar water heater.
3. Study of pipe fittings–elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings
4. Study of water riser in solar water heating system.
5. Study of insulating materials.
6. Case study of Vacuum tube solar water heater
7. Study of water softening plant
8. Checking points for the maintenance of solar water heater

**Text Books**


1. Sukhatme S.P., and Nayak J.K., *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill, 2008
2. Solar Energy Hand book
3. ISHARE Hand book

| **Program:** | **B. Voc. (Solar System)** | | | **Semester:** V | | |
|---|---|---|---|---|---|---|
| **Course:** | Solar PV Power Plant **lab** | | | **Code S7.VP.02** | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **3** | **3** | **1.5** | **-** | **50** | **-** | **50** |

**Objectives:**

Following concepts to be taught to the students,

1. Demonstrate significance of PV technologies and their utilization
2. Expose them to conceptualize PV power plant, its economics and maintenance.

**Course Outcomes:**

After learning the course, the learners will be able to

1. Understand types of PV power plant and net metering system.
2. Estimate the internal parameters for site selection and shadow analysis.
3. Understand types of electric energy storage system and their performance characteristics.
4. Understand types of inverter, their selection, and circuitry arrangement.
5. Estimate the performance and yield of PV plant.
6. Analyze the economics of PV power plant and assess the maintenance requirement.

**Guidelines:**

1. Total : 8 experiments/assignments to be conducted

**Detailed Syllabus:**

1. To study the load requirement of PV panel
2. To study bus bar system of the PV panel
3. To study earthling and light arresting of solar PV panel
4. To study DC-AC inverter
5. To study the on grid and off grid system
6. To study the external supply of electricity to the PV plant
7. To study the overall installation of the PV plant.
8. Checking points for maintenance of PV solar panel
9. Trial on PV panel for performance analysis

| **Program:** | **B. Voc. (Solar System)** | | | **Semester:** V | | |
|---|---|---|---|---|---|---|
| **Course:** | On Job Training (ELE/Q9801) | | | **Code: S7.QP.01** | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **PR** | **OR** | **Total** |
| **30** | **30** | **15** | **-** | **-** | **200** | **200** |

**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 Description** |
|---|---|
| **1.** | A Project Manager – Solar system is responsible for planning, overseeing and leading projects from ideation to completion. This includes liaison with the project stakeholders and third-party vendors to ensure timely and successful delivery of projects. The individual may be responsible for managing multiple projects according to the size of the organization |

| | **Personal Attributes** |
|---|---|
| **1.** | The individual must have managerial, organisational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives. |

# Course Syllabus
## Semester-VI

| Program: | B. Voc. (Solar System) | | | | Semester: VI | |
|---|---|---|---|---|---|---|
| Course: | Process Planning and Cost Estimation | | | | Code: S7.GV.05 | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| 3 | 3 | 3 | 20 | 30 | 50 | 100 |

**Course Objective**

To introduce the process planning concepts to make cost estimation for various products after process planning.

**Course Outcome:**

**After learning this course students will able to**

1. Select the process, equipment and tools for various industrial products.
2. Prepare process planning activity chart.
3. Calculate the machining time for various machining operations.
4. Explain the concept of cost estimation.
5. Compute the job order cost for different type of shop floor.
6. Estimate time requirement for execution of project.

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 2. | **Introduction to Process Planning**<br>Process Planning—Definition, Purpose of Process Planning, Concept of Process Planning, Objectives of Process Planning, Scope of Process Planning, and Information required to do Process Planning, Preparing Operation Planning Sheet | **8** |
| 3. | **Process Planning activities**<br>Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity, | 8 |
| **3.** | **Resource Management**<br>Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery | 6 |
| **4.** | **Introduction to Cost Estimation**<br>Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference Between Cost Estimating and Cost Accounting, | 8 |
| **5.** | **Cost Elements**<br>Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating | 8 |
| 6 | **Assembly & Installation Time Calculation**<br>Time calculation: Study of RAC requirement, design of RAC System, Selection of RAC components & material, Fabrication of ducts and distribution system, installation of RAC System, Testing of RAC System. | 7 |

**Text Books:**

1. M.Adithian and B.S. Pabla, Estimation and Costing, Konark publishers Pvt. Ltd., 1989.

2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, Prentice Hall Pvt. Ltd.., 2005

**Reference Books:**

1. Namua Singh, System Approach to computer integrated Design and Manufacturing, John Wiley

& Sons,Inc.,1996.

3. Joseph G Monks, Operation Management, Theory & Problems, McGraw Hill Book Company, 1987.

4. T.R.Banga and S.C.Sharma, Estimations and Costing, Khanna Publishers,1988.

5. G.B.S.Narang and V.Kumar, Production and Costing, Khanna Publishers, 1995.

| Program: | B. Voc. (Solar System) | | | Semester: VI | | |
|---|---|---|---|---|---|---|
| Course: | Total Quality Management | | | Code: S7.GV.06 | | |
| Teaching Scheme | | | Evaluation Scheme | | | |
| Lecture | Hours | Credit | IE 1 | IE 2 | ETE | Total |
| 3 | 3 | 3 | 20 | 30 | 50 | 100 |

**Objectives:**

1. To understand the different tools and techniques in TQM.
2. To have the knowledge of JIT, Lean manufacturing and TPM.

**Course Outcome:**

**After learning this course students will able to**

1. Understand the basic concept of TQM.
2. Explain the Continuous process improvement of the organization.
3. Describe the quality tools used in TQM.
4. Understand the concept of JIT
5. Understand the concept of TPM.
6. Reduce the wastes in in industry through Lean manufacturing.

**Detailed Syllabus:**

| Unit | Description | Duration (45 Hrs) |
|---|---|---|
| 1 | **Introduction, Basic concepts of total quality management** Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy | 7 |
| 2 | **Continuous process improvement** Input /output process Model, Juran trilogy, PDCA Cycle, 5 –'S' Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes | 7 |
| 3 | **Management planning tools & Bench marking** Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking | 9 |
| 4 | **Just in time (JIT)** JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems | 7 |
| 5 | **Total productive maintenance (TPM)** Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation. | 8 |
| 6 | **Lean Manufacturing** Concept & definition of Waste, Various types of waste, Kaizen & 3M, Waste reduction, Poka Yoke & Examples, Quality Gurus. | 7 |

**Text Books**:

1. Er. V. MohanavelEr. S. Suresh Kumar, "Total Quality Management" Research Publication House, Dehli, ISBN: 978-93-86138-70-5, Vol. 1, 2017
2. Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla, "Total Quality Management (TQM)", 1st Edition, ISBN: 9781003053156, 2020.

**Reference Books:**

1. Besterfield D.H., et al. Total quality management. N.Y. Pearson Education Publ; 2003.
2. Evans J.R., Lindsay W.M. The management and control of quality. Mason, OH: Thomson South Western Publication; 2005.

| **Program:** | **B. Voc. (Solar System)** | | | | **Semester: VI** | |
|---|---|---|---|---|---|---|
| **Course:** | **Project** | | | | **Code: S7.VP.03** | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **OR** | **PR** | **Total** |
| **18** | **18** | **9** | **50** | **150** | **-** | **200** |

**Detailed Syllabus:**

| **Unit** | **Description** | **Duration (18 Hrs)** |
|---|---|---|
| **1** | On the basis of learning in the vocational degree, a project to be taken up by the student strengthening his/ her vocational skills | **18** |

| **Program:** | **B. Voc. (Solar System)** | | | **Semester:** VI | | |
|---|---|---|---|---|---|---|
| **Course:** | On Job Training (ELE/Q9801) | | | **Code:** S7.QP.02 | | |
| **Teaching Scheme** | | | **Evaluation Scheme** | | | |
| **Practical** | **Hours** | **Credit** | **TW** | **OR** | **PR** | **Total** |
| **30** | **30** | **15** | **-** | **-** | **200** | **200** |

**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 Description** |
|---|---|
| **1.** | A Project Manager – Solar System is responsible for planning, overseeing and leading projects from ideation to completion. This includes liaison with the project stakeholders and third-party vendors to ensure timely and successful delivery of projects. The individual may be responsible for managing multiple projects according to the size of the organization |
| | |
| | Personal Attributes |
| **1.** | The individual must have managerial, organizational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives. |