PPSU

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

B. TECH.
MECHANICAL ENGINEERING
(SUSTAINABLE ENERGY)

SYLLABUS BOOK

AY 2025-26

INSTITUTE VISION
To emerge as an Institute of Excellence by imparting value-based education aided with Research, Innovation and Entrepreneurial skills.

INSTITUTE MISSION	
1.	To impart the holistic engineering education of highest quality & prepare socially responsible professionals with entrepreneurial skills.
2.	To prepare value-aided engineering professionals to meet up global industry requirements by imparting cutting edge professional education.
3.	To inculcate the attitude of research and innovation among the stake holders through experiential and project-based teaching-learning pedagogy.
4.	To acquire global talent pool by providing world class amenities for teaching, learning & research.

Graduates will demonstrate ability to:

PEO No	PROGRAMME EDUCATIONAL OBJECTIVES
PEO 1	Solve real-world engineering problems, design and develop innovative and cost-effective solutions exhibiting engineering skills/fundamentals to cater needs of society.
PEO 2	Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting comprehensive competitiveness.
PEO 3	Exhibit professional ethics & values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader societal framework.

PO No	PROGRAMME OUTCOMES
PO 1	Engineering knowledge: Apply knowledge of engineering fundamentals, science, mathematics & engineering specialization for the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate and analyze complex engineering problems leading to substantial conclusions using basic principles of mathematics, science and engineering.
PO 3	Design/development of solutions: Develop solutions for complex engineering problems and design system components or processes meeting specified needs having due consideration for the safety and societal & environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge & methods like design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid & viable conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for prediction and modeling of complex engineering activities with an understanding of the limitations.
PO 6	The Engineer and The World: Apply cognitive learning by the contextual knowledge to assess societal, health, safety, legal and cultural issues and following responsibilities relevant to the professional engineering practice, understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge & skill needed for sustainable development.
PO 7	Ethics: Apply basic moral values & ethical principles and pledge to professional ethics/norms and responsibilities of the engineering practice.
PO 8	Individual and Collaborative Teamwork: Function effectively as an individual/as a team member or as a leader in diverse teams, and in multidisciplinary settings.
PO 9	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 10	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
PO 11	Life-long learning: Recognize the need, do necessary preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO No	PROGRAMME SPECIFIC OUTCOMES (PSO) MECHANICAL ENGINEERING (SUSTAINABLE ENERGY)
PSO 1	Graduates will apply advanced knowledge of mechanical engineering, thermodynamics, heat transfer, fluid mechanics, and renewable energy technologies to design, analyze, and operate efficient and sustainable energy systems.
PSO 2	Graduates will investigate real-world and socially relevant energy challenges by developing effective, energy-efficient solutions through the integration of modern tools, computational methods, and multidisciplinary engineering approaches.
PSO 3	Graduates will evolve as technically proficient professionals, researchers, and entrepreneurs in the sustainable energy domain, well-equipped to excel in competitive examinations and advance through higher academic and research pursuits.p

Credit Guidelines (General)			
Component	**Hour/Week**	**Credit**	**Total Hours/Semester**
Theory	1	1	15
Practical	2	1	30
Tutorial	1	1	15
Note: In specific cases; extra credits can be granted for specific/important subjects.			

CO-PO Mapping Guidelines		
Mapping Level	**% age Mapping**	**Indicator**
0 / -	0	No Mapping
1	0-33	Low Level (Slightly Mapped)
2	33-66	Medium Level (Moderately Mapped)
3	>66	High Level (Strongly Mapped)

Syllabus Book

B. Tech.
Mechanical Engineering (Sustainable Energy)

P P Savani University

School of Engineering

Effective From: 2025-26

Authored by: P P Savani University

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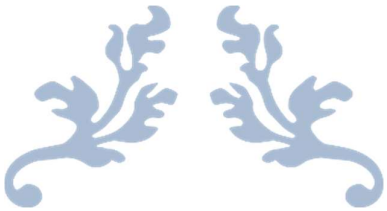
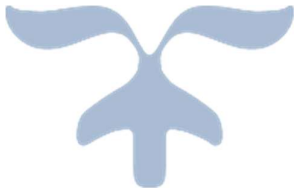


FIRST YEAR B. TECH.



P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

TEACHING & EXAMINATION SCHEME FOR FIRST YEAR B.TECH. (ALL PROGRAMME)AY: 2025-26

Sem	Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
1 OR 2	SESH1110	Calculus	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SEME1210	Basics of Mechanical Engineering	ME	3	0	2	5	5	40	60	0	0	40	60	200
	SEIT1210	Python for Engineers	CE	3	2	0	5	4	40	60	40	60	0	0	200
	SESH1130	Experimental Physics	SH	3	2	0	5	4	40	60	40	60	0	0	200
	CFLS2130	Intermediate Communicative English	CFLS	3	0	0	3	3	40	60	0	0	0	0	100
	SESH1120	Linear Algebra	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SECV1210	Basics of Civil Engineering	CV	3	0	2	5	5	40	60	0	0	40	60	200
	SECE1210	Programming with C Essentials	CE	3	2	0	5	4	40	60	40	60	0	0	200
	SEEC1210	Basics of Electrical and Electronics	EC	3	2	0	5	4	40	60	40	60	0	0	200
	SEME1220	Engineering Workshop	ME	0	2	0	2	2	0	0	100	0	0	0	100
	SECE1220	Digital Proficiency	CE	3	0	0	3	3	40	60	0	0	0	0	100
						Total	**48**	**44**							**1900**

Group 1	SESH1110	Calculus	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SEME1210	Basics of Mechanical Engineering	ME	3	0	2	5	5	40	60	0	0	40	60	200
	SEIT1210	Python for Engineers	CE	3	2	0	5	4	40	60	40	60	0	0	200
	SESH1130	Experimental Physics	SH	3	2	0	5	4	40	60	40	60	0	0	200
	CFLS2130	Intermediate Communicative English	CFLS	3	0	0	3	3	40	60	0	0	0	0	100
						Total	**23**	**21**							**900**
Group 2	SESH1120	Linear Algebra	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SECV1210	Basics of Civil Engineering	CV	3	0	2	5	5	40	60	0	0	40	60	200
	SECE1210	Programming with C Essentials	CE	3	2	0	5	4	40	60	40	60	0	0	200
	SEEC1210	Basics of Electrical and Electronics	EC	3	2	0	5	4	40	60	40	60	0	0	200
	SEME1220	Engineering Workshop	ME	0	2	0	2	2	0	0	100	0	0	0	100
	SECE1220	Digital Proficiency	CE	3	0	0	3	3	40	60	0	0	0	0	100
						Total	**25**	**23**							**1000**

P P Savani University
School of Engineering

Department of Science and Humanities

Course Code: SESH1110
Course Name: Calculus
Prerequisite Course/s: Algebra, Geometry, Trigonometry & Pre-Calculus till 12th Standard level

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	100	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To help learners to

- Summarize concept of calculus to enhance ability of analysing mathematical problems.
- Acquire knowledge and ability to work with differentiation and integration for applications of mathematical techniques in engineering.
- Develop the tool of convergence or divergence of any infinite series and power series for learning advanced Engineering Mathematics.
- Acquire knowledge of partial differentiation and ability to work with applications to advanced Engineering Mathematics.
- application of concavity of graph and find out points of inflection.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Calculus** Limits, Continuity, Types of Discontinuity, Successive Differentiation, Rolle's Theorem, LMVT, CMVT, Maxima and Minima.	09	20
2.	**Sequence and Series-I** Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence.	09	20
3.	**Sequence and Series-II** Power series, Taylor and Maclaurin series, Indeterminate forms and L'Hospital's Rule.	05	10
4.	**Partial Derivatives** Function of several variables, Partial differentiation, Applications, Chain rule, Linear approximations, Maxima and Minima, Euler's theorem, Lagrange multiplier.	11	30

5.	**Curve tracing** Tracing of Cartesian Curves, Polar Coordinates, Polar and Parametric Form of Standard Curves, Areas and Length in Polar co-ordinates	11	20
	TOTAL	45	100

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Calculus-1	04
2.	Calculus-2	04
3.	Calculus-3	02
4.	Sequence and Series-1	04
5.	Sequence and Series-2	02
6.	Sequence and Series-3	02
7.	Partial Derivatives-1	04
8.	Partial Derivatives-2	02
9.	Curve tracing-1	04
10.	Curve tracing-2	02
	TOTAL	30

Text Book:

Title	Author(s)	Publication
Thomas' Calculus	George B. Thomas, Maurice D. Weir and Joel Hass	Pearson
Elementary linear Algebra	Howard Anton and Chrish Rorres	Wiley

Reference Book:

Title	Author(s)	Publication
Advanced Engineering Mathematics	E Kreyszig	John Wiley and Sons
A textbook of Engineering Mathematics	N P Bali and Manish Goyal	Laxmi
Higher Engineering Mathematics	B S Grewal	Khanna
Engineering Mathematics	T Veerarajan	Tata Mc Graw Hill
Engineering Mathematics-1 (Calculus)	H. K. Dass and Dr. Rama Verma	S. Chand

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 50 marks
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

Course Outcome(s):

After the completion of the course, the student will be able to

SESH1110	CALCULUS
CO 1	Recall the concepts of limit, continuity and differentiability for analysing mathematical problems.
CO 2	Analyze the series for its convergence and divergence to solve real world problems.
CO 3	Evaluate various limit problems using L' Hospital's rule.
CO 4	Identify the ordinary differentials and partial differentials and solve the maximum and minimum value of function.
CO 5	Construct the graphs for function with intervals and identify more application for function.

Mapping of CO with PO

SESH1110	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	3	1	1							1
CO 2	3	2	1								1
CO 3	2	2	1								
CO 4	2	2	1	1							1
CO 5	2	2	1								1

Mapping of CO with PSO

SESH1110	PSO1	PSO2	PSO3
CO 1	3		
CO 2	1	1	
CO 3	1	2	
CO 4	3	2	
CO 5	1	1	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Calculus	1, 2, 3, 4, 5
2	Sequence and Series – I	1, 2, 3, 4, 6
3	Sequence and Series – II	1, 2, 3, 4, 6
4	Partial Derivatives	1, 2, 3, 4, 5
5	Curve tracing	1, 2, 3, 4, 5, 6

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1210
Course Name: Basics of Mechanical Engineering
Prerequisite Course(s): -- None

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- study the fundamentals of mechanical systems.
- study and appreciate significance of mechanical engineering in different fields of engineering.
- carry out simple land survey and recent trends in civil engineering.
- understand components of building, building terminology and construction materials.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Boiler:** Introduction, Fundamental Principles, Classification	07	15
2.	**Classification of Engineering Materials:** Classification of engineering material, composition of cast iron, mechanical properties and uses; Alloy steel and their applications; Stress-Strain diagram, Hooks law and modulus of elasticity. Tensile, shear and hardness.	10	20
3.	**Fluids:** Fluid properties, pressure, density and viscosity; pressure variation with depth, static and kinetic energy; Bernoulli's equation for incompressible fluids, viscous and turbulent flow and Metacentric height.	04	08
4.	**Measurement:** Temperature, pressure, velocity, flow, strain, force and torque measurement, concept of measurement error & uncertainty analysis, measurement by Vernier caliper, micrometer, dial gauges, slip gauges, sine-bar and combination set.	06	12

5.	**Basic Concepts of Thermodynamics:** Prime Movers - Meaning and Classification; the Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific Heat Capacity, Internal Energy, Specific Volume; Thermodynamic Systems, All Laws of Thermodynamics	04	09
6.	**Basics of I.C Engines:** Construction and Working of 2 Stroke & 4 Stroke Petrol andDiesel Engines, Difference Between 2-Stroke - 4 Stroke Engine & Petrol-Diesel Engine, Efficiency of I. C. Engines	08	18
7.	**Power Transmission Elements:** Construction and Applications of Couplings, Clutches and Brakes, Difference Between Clutch and Coupling, Types ofBelt Drive and Gear Drive	06	18
	TOTAL	45	100

List of Practical:

Sr. No.	Name of Practical	Hours
1.	To understand construction and working of various types of boilers	04
2.	To understand construction and working of mountings	04
3.	To understand construction and working of accessories	04
4.	To understand construction and working 2 –stroke & 4 –stroke Petrol Engines	04
5.	To understand construction and working 2 –stroke & 4 –stroke Diesel Engines	04
6.	To understand the types of hardness test	04
7.	To understand the stress-strain curve for ductile and brittle material	04
8.	To understand the basic concept of metacentric height	02
	TOTAL	30

Text Book(s):

Title	Author(s)	Publication
Elements of Mechanical Engineering	S. B. Mathur, S. Domkundwar	Dhanpat Rai & Sons Publications
Material Science	Narula	TMH
Basic Mechanical Engineering	Agrawal B & CM	TMH
Instrumentation and Measurement	Nakra and Chaudhary	TMH
Combustion Engines	Ganesan	TMH.

Reference Book(s):

Title	Author(s)	Publication
Thermal Engineering	R. K. Rajput	Laxmi Publications
Basic Mechanical Engineering	T.S. Rajan	Wiley Eastern Ltd., 1996.

Web Material Link(s):

- http://nptel.ac.in/course.php
- http://nptel.ac.in/courses/105107157/
- http://nptel.ac.in/courses/105101087/
- http://nptel.ac.in/courses/105107121/
- http://nptel.ac.in/courses/105104100/

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Tutorial

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 40 marks.
- External Practical viva consists of 60 marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME1210	BASICS OF MECHANICAL ENGINEERING
CO 1	Understand the concept of Boiler, Material types and its application.
CO 2	Understand the Fluid properties and measurement process.
CO 3	Understand the concept of basic thermodynamics
CO 4	Comprehend the importance of mechanical engineering equipments like IC engine and power transmission elements.
CO 5	Analyze mechanical properties of materials and apply concepts of stress–strain relationships and elasticity in engineering problems.

Mapping of CO with PO

SEME1210	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	3	1	3	2	2					2
CO 2	2	3	1	3	2	2					2
CO 3	1	3	1	3	2	2					2
CO 4	1	3	1	3	2	2					2
CO 5	1	3	1	1	2	2					2

Mapping of CO with PSO

SEME1210	PSO1	PSO2	PSO3
CO 1	1	1	1
CO 2	1	2	1
CO 3	1	2	1
CO 4	1	1	1
CO 5	2	3	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Boiler	1, 2, 3
2	Classification of Engineering Materials	1, 2
3	Fluids	1, 2
4	Measurement	1, 2
5	Basics Concept of Thermodynamics	1, 2, 3
6	Basics of I.C. Engines	1, 2

7	Power Transmission Elements	1, 2

P P Savani University
School of Engineering
Department of Computer Engineering

Course Code: SEIT1210
Course Name: Python for Engineers
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- Understand the basic object-oriented programming.
- Identify an appropriate approach to solve computational problems.
- Develop logic building and problem-solving skills.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Python** History, Features of Python, Applications of Python, Working with Python, Input and Output Functions in Python, Variable, Assignment, Types, Basic Operators, Expressions and Types of Data Int, Float, Complex, String, List, Tuple, Set, Dictionary and its Methods, Type Conversions, Comments, Input Processing and output.	04	07
2.	**Decision Structures in Python** Conditional Blocks Using if, Else and Else If, Simple for Loops in Python, For Loop Using Ranges, String, List and Dictionaries Use of While Loops in Python, Loop Manipulation Using Pass, Continue, Break and Else	04	07
3.	**Array and Strings in Python** Arrays, Basic Strings, Accessing Strings, Basic Operations, String Slicing, Testing, Searching and Manipulating Strings, Function and Methods.	03	08
4.	**Dictionary, List, Tuples and Sets** Dictionaries, Accessing Values in Dictionaries, Working with Dictionaries, Properties, Functions and Methods. Sets, Accessing Values in Set, Working with Set Properties, Functions and Methods, Tuple, Accessing Tuples, Operations, Working, Functions and Methods. List, Accessing List, Operations, Working With Lists, Function and methods, two-dimensional lists.	05	10
5.	**Functions, Modules and Packages in Python** Introduction to Functions, defining a Function, Calling a Function, Types of Functions, Function Arguments, Anonymous Functions, Global and Local Variables, Importing Module, Math Module, Random Module, Introduction to Packages: Numpy, Pandas, Matplotlib.	07	14
6.	**Python Object Oriented Programming** OOP Concept of Class, Object and Instances, Constructor, Class, Attributes, Methods, Using Properties to Control Attribute Access, and Destructors, Inheritance, Overloading Operators. Objects in Python:	08	16

	Creating Python Classes, Modules and Packages, Inheritance in Python, Polymorphism in Python.		
7.	**Files & Regular Expression in Python** Introduction to File Input and Output, Writing Data to a File, Reading Data from a File, Additional File Methods, Using Loops to Process Files, Processing Records, RE Module, Basic Patterns, Regular Expression Syntax, Regular Expression Object, Search Object, Findall method, Split method, Sub Method.	05	15
8.	**Exception Handling in Python** Handling IO Exceptions, Working with Directories, Metadata, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Throwing Mechanism, Catching Mechanism	05	09
9.	**Building Desktop Application** Exploring the Tkinter Library in Python, Creating basic Desktop application using Tkinter	04	14
	TOTAL	**45**	**100**

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Introduction to Python (Introduction to IDLE, different data types, Input Output in Python, Operators, Operator precedence).	04
2.	Manipulation of Strings.	04
3.	Implementation of Dictionaries, Sets in Python.	03
4.	Implementation of Tuples and Lists in Python.	03
5.	Working with decision structures in Python	04
6.	Working with functions and modules in Python	02
7.	Working with Object-oriented paradigms in Python	04
8.	Implementation of file handling in Python.	02
9.	Exception handling in Python	02
10.	Building desktop application of your own calculator in Python.	02
	TOTAL	**30**

Text Book(s):

Title	Author/s	Publication
Python approach Programming: A modular	Sheetal Taneja, Naveen Kumar	Pearson

Reference Book(s):

Title	Author(s)	Publication
Think Python: How to Think Like a Computer Scientist	Allen Downey	Green Tea Press
Python Cookbook	David Ascher, Alex Martelli Oreilly	O Reilly Media

Web Material Link(s):

- https://www.tutorialspoint.com/python/
- https://www.w3schools.com/python/
- https://onlinecourses.nptel.ac.in/noc20_cs83/preview

Course Evaluation:
Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical:
- Continuous Evaluation consists of practical performance which should be evaluated out of 10 for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva-voce consists of 30 marks during End Semester Exam.

Course Outcome(s):
After completion of the course, the students will be able to

SEIT1210	**PYTHON FOR ENGINEERS**
CO 1	Interpret the fundamental python syntax, semantics and fluent in the use of python control flow statements.
CO 2	Determine the methods to create and manipulate python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
CO 3	Articulate the object-oriented programming concepts such as encapsulation, inheritance and polymorphism as used in python.
CO 4	Identify the commonly used operations involving file systems and regular expressions.
CO 5	Design object-oriented and GUI-based Python applications.

Mapping of CO with PO

SEIT1210	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	2	2			2				1		1
CO 2	3	3	1		3				1		2
CO 3	2	3	2		2				1		2
CO 4	2	2	1	1	3				1		2
CO 5	2	2	3	1	3	1		1	2	1	2

Mapping of CO with PSO

SEIT1210	PSO1	PSO2	PSO3
CO 1	2		2
CO 2	2		2
CO 3	2		2
CO 4	2		2
CO 5	2		2

Level of Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1.	Introduction to Python	1,2,4
2.	Decision Structures in Python	1,2,3
3.	Array and Strings in Python	1,2,3

4.	Dictionary, List, Tuples and Sets	2,3,4
5.	Functions, Modules and Packages in Python	2,3,4
6.	Python Object Oriented Programming	3,4,6
7.	Files & Regular Expression in Python	3,4.6
8.	Exception Handling in Python	3,4,5
9.	Building Desktop Application	2,3,4

P P Savani University
School of Engineering

Department of Science and Humanities

Course Code: SESH1130
Course Name: Experimental Physics
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- Prepare students for career in engineering where physics principles can be applied for the advancement of technology.
- Think in core concept of engineering application by studying various topics involved in branch specific application.

Course Content:

Module No.	Content	Hours	Weightage in %
1	**QUANTUM PHYSICS** (Prerequisites: Dual nature of radiation, Photoelectric effect Matter waves, wave nature of particles, de-Broglie relation, Davisson-Germer experiment). Introduction; De Broglie hypothesis of matter waves; Properties of matter waves; Phase velocity and group velocity and their relation; Heisenberg uncertainty principle; non-existence of electron in nucleus; Wave function; Physical interpretation of wave function; Schrodinger's time dependent wave equation; time independent wave equation; Quantum Computing (overview).	07	16
2	**Acoustic and Ultrasonic** (Prerequisites: Sound, propagation of sound, concept of frequency and wave length).Acoustic – Introduction, Classification and Characterization of Sound, Sabine's formula for reverberation (without derivation), Absorption Coefficients, Sound Absorbing Materials, factors affecting the acoustics of buildings and remedies, Sound Insulation. Ultrasonic – Introduction, Properties of Ultrasonic, Generation of Ultrasonic sound: Piezoelectric & Magnetostriction effect, Applications of Ultrasonic.	07	16

3	**LASER AND FIBRE OPTICS** (Prerequisites: Absorption, recombination, Valance and conduction bands, refractive index of a material, Snell's law)LASER – Introduction, Characteristics, Absorption, Spontaneous and stimulated emission; metastable state, population inversion, Pumping mechanism, components of LASER; Nd:YAG Laser, Applications of LASER.**FIBRE OPTICS** – Introduction, Optical Fiber construction, working principle and types, Numerical Aperture, Acceptance angle and Attenuation, Fiber optic communication system, Applications of Optical Fiber.	08	18

4	**NANOSCIENCE AND NANOTECHNOLOGY** (Prerequisites: Nano scale and structures, general purpose of nano technology, method of formation of nano structure, fullerenes, carbon nanotubes). Nanomaterials : Properties (Physical, Mechanical, Optical, Electrical, Magnetic); Surface to Volume Ratio; Synthesis of Nanomaterials: Bottom up and Top down technique; Methods to synthesize nanomaterials: PVD & Sol-gel, Applications.	06	14
5	**SUPERCONDUCTORS AND SUPERCAPACITORS** (Prerequisites: Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical resistivity and conductivity temperature dependence of resistance). Superconductors: Introduction, Critical temperature, Properties of superconductors, Type of superconductors: Type I and Type II and high Tc superconductors, Applications: Magnets, Josephson effect, SQUID, Maglev, other. Supercapacitors: Principle, construction, materials and applications, comparison with capacitor and batteries : Energy density, Power density.	08	18
6	**SEMICONDUCTOR PHYSICS AND TECHNOLOGY** (Prerequisites: Intrinsic and extrinsic semiconductors, Energy bands in conductors, semiconductors and insulators, Semiconductor diode, I-V characteristics in forward and reverse bias) Direct & indirect band gap semiconductor; Fermi level; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; mobility, current density; Hall Effect; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Applications of semiconductors: LED, Zener diode, Photovoltaic cell.	09	18
	TOTAL	45	100

List of Practical:

Sr. No	Name of Practical	Hours
1.	To understand some basic aspects of the graph drawing.	04
2.	To understand some basic aspects of error analysis.	02
3.	To verify ohm's law using ammeter and voltmeter	02
4.	To study the series and parallel connections of resistors.	04
5.	To study the series and parallel connections of capacitors.	04
6.	To study the I-V characteristic of LED and dynamic resistance of a given LED.	02
7.	To study the I-V characteristic of ZENER diode and measurement of dynamic resistance.	02

8.	To determine the Numerical Aperture and acceptance angle of an optical fiber	04
9.	To determine wavelength of laser using diffraction grating.	04
10.	To determine the velocity of ultrasonic waves in a given liquid and also to determine the compressibility of the liquid.	02
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Concept of the Modern Physics	A. Beiser	Tata McGraw-Hill Education
Basic electrical engineering	Kothari and Nagrath	Tata McGraw-Hill Education
Quantum Mechanics	P.M. Mathew, K. Venkatesan	Tata McGraw-Hill Education
Waves and Acoustics	Pradipkumar Chakrabarti Satyabrata Chawdhary	New Central Book Agency
Lasers and Nonlinear Optics	G.D. Baruah	Pragati Prakashan
Engineering Physics	G Vijayakumari	Vikas Publishing house PVT LTD
Basic Electronics for Scientists and Engineers	Dennis L. Eggleston	Cambridge University Press

Web Material Link(s):

- http:/nptel.ac.in/course.php

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of Performance and regular manual writing, checking of the practical throughout the semester of 20 marks.
- Internal viva or practical performance consist of 20 Marks.
- Practical performance/test of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SESH1130	EXPERIMENTAL PHYSICS
CO 1	Understand the framework of quantum mechanics and apply the knowledge of basic quantum mechanics to construct one dimensional Schrodinger's wave equation.
CO 2	Classify the phenomenon of acoustics and ultrasonic in various engineering field and apply it for various engineering and medical fields.
CO 3	Describe the laser and articulate the idea of optical fiber communications and apply the concepts of lasers and optical fiber communications in every possible sector.
CO 4	Interpret the concept of Nanotechnology and understand the synthesis and applications of Nano-materials from technological prospect. Discover the types and properties of

	Superconductors. Relate the behavior of superconductors at high temperatures
CO 5	Distinguish pure, impure semiconductors and characteristics of semiconductor devices. Thus, will be able to use basic concepts to analyze and design a wide range of semiconductor devices.

Mapping of CO with PO

SESH1130	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2	1	2	1	0	0	0	0	1	2
CO 2	2	3	2	3	2	1	1	0	1	1	2
CO 3	2	2	2	2	2	0	1	0	1	2	2
CO 4	3	2	2	2	1	1	2	1	1	1	3
CO 5	2	2	3	2	2	1	1	0	1	1	2

Mapping of CO with PSO

SESH1130	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2		1	1
CO 3		2	2
CO 4	2	1	3
CO 5	1		2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Quantum Physics	2
2	Acoustic and Ultrasonic	3
3	Laser and Fibre Optics	2,3
4	Nanoscience and Nanotechnology	2,3,6
5	Superconductors and Supercapacitors	1, 2,3
6	Semiconductor Physics and Technology	1,6

P P Savani University
School of Engineering
Department of Science & Humanities

Course Code: SESH1120
Course Name: Linear Algebra
Prerequisite Course/s: -- Algebra, Geometry, Trigonometry &Pre-Calculus till 12th Standard level

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	100	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Analyses and solve system of linear equations and understand characteristics of Matrices.
- Learn about and work with vector space, linear transformation and inner product space.
- Apply concepts of linear algebra for solving science and engineering problems.
- Introduce the concept of improper integral and Beta-Gamma Function.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Matrix Algebra** Elementary Row and Column operations, Inverse of matrix, Rank of matrix, System of Linear Equations, Characteristic Equation, Eigen values and Eigen vector, Diagonalization, Cayley Hamilton Theorem.	12	30
2.	**Vector Space** Concept of vector space, Subspace, Linear Combination, Linear Dependence and Independence, Span, Basis and Dimension, RowSpace, Column Space and Null Space, Rank and Nullity.	11	20
3.	**Linear Transformation** Introduction of Linear Transformation, Kernal and Range, Rank and Nullity, Inverse of Linear Transformation, Rank Nullity Theorem, Composition of Linear Maps.	09	20
4.	**Inner Product Space** Inner Product, Angle and Orthogonality, Orthogonal projection, Gram-Schmidt process and QR Decomposition, least square decomposition.	08	20
5.	**Beta and Gamma function** Improper Integrals, Convergence, Properties of Beta and Gamma Function, Duplication Formula (without proof)	05	10
	TOTAL	45	100

List of Tutorial:

Sr. No.	Name of Tutorial	Hours
1.	Matrix Algebra-1	04

2.	Matrix Algebra-2	02
3.	Vector Space-1	04
4.	Vector Space-2	02
5.	Linear Transformation-1	04
6.	Linear Transformation-2	02
7.	Inner Product Space-1	04
8.	Inner Product Space-2	02
9.	Beta and Gamma function-1	04
10.	Beta and Gamma function-2	02
	TOTAL	30

Text Book(s):

Title	**Author/s**	**Publication**
Thomas' Calculus	George B. Thomas, Maurice D. Weir and Joel Hass	Pearson
Elementary Linear Algebra	Howard Anton and Chrish Rorres	Wiley

Reference Book(s):

Title	**Author(s)**	**Publication**
Advanced Engineering Mathematics	E Kreyszig	John Wiley & Sons
A textbook of Engineering Mathematics	N P Bali and Manish Goyal	Laxmi
Higher Engineering Mathematics	B S Grewal	Khanna
Engineering Mathematics for First Year	T Veerarajan	Tata Mc Graw Hill
Engineering Mathematics-1 (Calculus)	H. K. Dass and Dr. Rama Verma	S. Chand

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous evaluation consists of performance of tutorial which will be evaluated out of 10 Marks for each tutorial and average of the same will be converted to 50 marks.
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SESH1120	**LINEAR ALGEBRA & CALCULUS**
CO 1	Evaluate linear system using matrices and the knowledge of eigenvalues and eigenvectors for matrix diagonalization
CO 2	Determine the basis and dimension of vector spaces and subspaces.
CO 3	Discuss the matrix representation of a linear transformation given bases of the relevant vector space.
CO 4	Apply vectors, inner products, and linear transformations to real world situations.

CO 5	Classify gamma, beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering.

Mapping of CO with PO

SESH1120	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	3	1	1							3
CO 2	3	2	1								2
CO 3	2	2	1								3
CO 4	2	2	1	1							1
CO 5	2	1	1								1

Mapping of CO with PSO

SESH1120	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	1	1	
CO 3	2	2	
CO 4	2	2	
CO 5			

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Matrix Algebra	1, 2, 3, 4, 5, 6
2	Vector Space	1, 2, 3, 4, 6
3	Linear Transformation	1, 2, 3, 4, 6
4	Inner Product Space	1, 2, 3, 4, 5, 6
5	Beta and Gamma Function	1, 2, 3, 4, 5

P P Savani University
School of Engineering
Department of Civil Engineering

Course Code: SECV1210
Course Name: Basics of Civil Engineering
Prerequisite Course/s: -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	02	5	40	60	00	00	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective of the Course:
To help learners to

- Understand components of building, building terminology and construction materials.
- Understand building layout plan.
- Understand latest trends in civil engineering.
- Understand importance of various construction equipment.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**CIVIL ENGINEERING**: **AN OVERVIEW** Introduction, Branches, Scope, Impact, Role of Civil Engineer, Unit of measurement, Unit conversion (Length, Area, Volume).	04	10
2.	**INTRODUCTION TO CIVIL ENGINEERING MATERIALS:** List of materials, Details (types, properties, uses) of materials: Cement, Aggregate, Brick, Steel, Concrete, Stone, Soil, Mortar, Timber, Plastic, Epoxy, Flyash, Steel slag, Copper slag, Bitumen, Optical fiber, Pipe, Wire, Cable, Smart material, Basic hand fill tests.	08	20
3.	**BUILDING CONSTRUCTION:** Types of building, Components of building, Type of foundation and importance, Types of brick bonds, Principle of planning, Typical building layout, Symbols used in electrical layout, Symbols used for water supply, plumbing and sanitation. Nominal dimensions for door, window and furniture	10	20
4.	**INTRODUCTION TO TOWN PLANNING:** 5Principles of town planning, Necessity of town planning, Origin of town, Growth of town, Land use, Principles and objects of zoning, Advantages of zoning, Low cost housing, Prevention of slum, FSI.	04	10
5.	**INTRODUCTION TO SURVEYING AND LEVELLING:** Introduction: Fundamental principles, Classification. Linear measurement: Instruments used, Chaining on plane ground, Offset, Ranging. Angular measurement: Compass-Instrument used, Meridian, Bearing, Local attraction. Levelling: Instrument used, Terminology, Types of leveling, Methods of leveling. Modern tools: Introduction to theodolite, Total Station, GPS.	10	20

6.	**CONSTRUCTION EQUIPMENT:** Types of equipment- Functions, Uses. Hauling equipment-Truck, Dumper, Trailer. Hoisting equipment- Pulley, Crane, Jack, Winch, Sheave block, Fork truck. Pneumatic equipment-Compressor. Conveying equipment- package, screw, flight/scrap, bucket, belt conveyor. Drill, Tractor, Ripper, Rim pull, Dredger, Drag line, Power shovel, JCB, Hoe.	04	10
7.	**RECENT TRENDS IN CIVIL ENGINEERING:** Mass Transportation, Rapid Transportation, Smart City, Sky scarper, Dams, Rain Water harvesting, Batch mix plant, Ready Mix Concrete plant, Green building, Earth quake resisting building.	05	10
	TOTAL	45	100

List of Tutorial :

Sr. No	Name of Tutorial	Hours
1.	Unit conversation Exercise.	02
2.	Chart preparation of various materials.	02
3.	Different types of brick bonds.	04
4.	Layout of residential building.	02
5.	Introduction Linear and angular measurements	02
6.	Introduction to Theodolite	04
7.	Introduction to Dumpy level.	02
8.	Introduction to total station.	04
9.	Videos showing working of construction equipment.	04
10.	Presentation on various topics as in module 7 about recent trends.	04
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Elements of civil engineering	Anurag A. Kandya	Charotar Publication
Basic Civil Engineering	S. Ramamrutham	Dhanpatrai Publication

Reference Book(s):

Title	Author/s	Publication
Elements of civil engineering	Dr. R. K. Jain and Dr. P. P. Lodha	McGraw Hill Education
Basics of civil engineering	S.S. Bhavikatti	New age international Publishers

Web Material Links:

- http://nptel.ac.in/courses/105107122/
- http://nptel.ac.in/courses/105107157/
- http://nptel.ac.in/courses/105101087/
- http://nptel.ac.in/courses/105104100/

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 15 marks and 1 hour of duration.
- Submission of assignment which consists of solving 20 numerical and it carried 10 marks of evaluation.
- End semester examination will consist of 60 marks exam.

Tutorial:

- Continuous Evaluation consists of performance of tutorial which should be evaluated out of 10 marks for each practical and average of the same will be converted to 40 marks.
- External Practical viva consists of 60 marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SECV1210	BASICS OF CIVIL ENGINEERING
CO 1	Explain the fundamental concepts of civil engineering, including its branches, scope, roles, and basic unit conversions.
CO 2	Identify and describe the properties, types, and applications of common civil engineering materials such as cement, concrete, steel, and aggregates.
CO 3	Illustrate and apply principles of building construction, including components, foundations, brick bonds, and building planning/layout.
CO 4	Demonstrate basic knowledge and applications of surveying and levelling techniques, including modern instruments like total station and GPS.
CO 5	Explain concepts of town planning, construction equipment, and recent trends in civil engineering such as smart cities, green buildings, and sustainable practices.

Mapping of CO with PO

SECV1210	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2	2	3	2	3		2		3	
CO 2	3	3	3		2		2	3	3		3
CO 3	3	2	2	2	3	3		2	2	1	
CO 4	3	3		3		2	3		2	3	
CO 5	3		3	2	2	1	2	3			

Mapping of CO with PSO

SECV1210	PSO1	PSO2	PSO3
CO 1	1	1	1
CO 2	1	2	1
CO 3	1	2	1
CO 4	2	2	1
CO 5	2	2	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Civil engineering: An overview	1, 2, 3
2	Introduction to civil engineering materials	1, 2
3	Building construction	1, 2
4	Introduction to surveying and levelling	1, 2
5	Introduction to town planning	1, 2, 3
6	Construction equipment	1, 2
7	Recent trends in civil engineering	1, 2,4

P P Savani University
School of Engineering
Department of Computer Engineering

Course Code: SECE1210
Course Name: Programming with C Essentials
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	4	40	60	40	60	0	0	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the basic components of a computer system.
- identify an appropriate approach to computational problems.
- develop logic building and problem-solving skills.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Computers Programming:** Introduction to programs, its significance, classification of programming language, Selection of a programming language, Flow Charts and Algorithms.	04	10
2.	**Introduction to Constants, Variables and Data Types:** Features of C Language, the Structure of C Program, Types of Errors, Debugging, Tracing the Execution of the Program, Watching Variables Values in Memory. Character Set, C Tokens, Keyword and Identifiers, Constants and Variables, Data Types - Declaration and Initialization, User Define Type Declarations - Typedef, Enum, Basic Input, and Output Operations, Symbolic Constants, Overflow and Underflow of Data.	07	15
3.	**Operators, Expressions, and Managing I/O Operations:** Introduction to Operators and its Types, Evaluation of Expressions, Precedence of Arithmetic Operators, Type Conversions in Expressions, Operator Precedence and Associatively. Introduction to Reading a Character, Writing a Character, Formatted Input and Output.	05	10
4.	**Conditional Statements:** Decision Making & Branching: Decision Making with If and If - else Statements, Nesting of If-else Statements, The Switch and go-to statements, Ternary (?:) Operator. Looping: The while Statement, The Break Statement & The Do. While loop, The FOR loop, Jump within loops - Programs.	06	15
5.	**Arrays:**	06	15

	Introduction, One-dimensional Arrays, Two-dimensional Arrays, Concept of Multidimensional Arrays.		
6.	**Strings:** Declaring and Initializing String Variables, Arithmetic Operations on Characters, Putting Strings Together, Comparison of Two Strings, String Handling Functions.	05	12
7.	**User-Defined Functions:** Concepts of User-defined Functions, Prototypes, function Definition, Parameters, Parameter Passing, Calling a Function, Recursive Function.	06	13
8.	**Pointers:** Introduction to Pointers, Declaration and initialization of pointers, Pointer to pointer, pointer and array, pointer to array, array to pointer, function returning pointer.	06	10
	TOTAL	45	100

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Draw Flow Chart and write algorithm for at least five problems.	02
2.	Introduction to C programming environment, compiler, Linker, loader, and editor.	02
3.	Write programs to implement basic elements of C programming (different input functions, different output functions, different data types, and different operators)	04
4.	Write programs to implement control structures (if statement, if-else statement, nested if-else statement, switch statement, break statement, goto statement)	04
5.	Write programs to implement looping constructs (for loop, while loop, do-while and nested for loop)	04
6.	Write programs to implement arrays. (1-D array, and 2-D array)	04
7.	Write programs to implement strings. (input, output, different string inbuilt functions)	02
8.	Write programs to implement user-defined functions. (function with/without return type, function with/without argument, function and array)	04
9.	Write programs to implement recursive function.	02
10.	Write programs to implement pointers.	02
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Programming in ANSI C	E. Balagurusamy	Tata McGraw Hill
Introduction to Computer Science	ITL Education Solutions Limited	Pearson Education

Reference Book(s):

Title	Author(s)	Publication
Programming in C	Ashok Kamthane	Pearson
Let Us C	Yashavant P. Kanetkar	Tata McGraw Hill
Introduction to C Programming	ReemaThareja	Oxford Higher Education
Programming with C	Byron Gottfried	Tata McGraw Hill

Web Material Link(s):

- http://www.digimat.in/nptel/courses/video/106104128/L01.html
- https://www.youtube.com/watch?v=3QiItmIWmOM

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of practical performance which should be evaluated out of 10 for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva-voce consists of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the students will be able to

SECE1210	**PROGRAMMING WITH C ESSENTIALS**
CO 1	Observe and interpret the concepts for data representation, algorithms and coding methods in computer system.
CO 2	Immediately analyze the syntax and semantics of the "c" language and apply in program.
CO 3	Manage the less memory usage while developing the program.
CO 4	Classify the types of errors occur while running the program.
CO 5	Develop and utilize user-defined functions, arrays, strings and pointers in C for efficient data manipulation and code modularity.

Mapping of CO with PO

SECE1210	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	3	2	1							1	
CO 2	3	3	2	1	2					1	
CO 3	2	3	2	1	2		2				2
CO 4	2	3	1	2	1			2			
CO 5	3	3	3	2	3	2	2	2	1	1	2

Mapping of CO with PSO

SECE1210	PSO1	PSO2	PSO3
CO 1	3		
CO 2	1	1	
CO 3	1	2	
CO 4	2	1	
CO 5	2	2	

Level of Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1.	Introduction to Computers Programming:	1,2
2.	Introduction to C, Constants, Variables and Data Types	1,2,3
3.	Operators, Expressions, and Managing I/O	3,4

	Operations	
4.	Conditional Statements	2,3,4
5.	Arrays	2,3,5
6.	Strings	2,3
7.	User-Defined Functions	2,3,4,6
8.	Pointers	2,3,4,5

P P Savani University
School of Engineering

Department of Electronics & Communication Engineering

Course Code: SEEC1210
Course Name: Basics of Electrical and Electronics
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- Understand fundamental concepts of electrical related to Voltage, Current etc. and principles of circuit analysis.
- Explore electrical components, learn measurement and instrumentation along with elementary understanding of electronics.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Fundamental of Electrical Engineering:** Electrical circuit elements, resistor, capacitor, inductor, voltage and current sources, Ohm's law. Series and parallel combinations of resistors and capacitors, Kirchoff's current and voltage laws. Analysis of circuits by Node voltage method and mesh current method. Analysis of circuits using source transformation, Thevenin and Norton equivalent models. Notion of linearity, superposition theorem, maximum power transfer theorem, Milman's theorem.	12	28
2.	**Circuit Analysis and Power Concepts:** Transient analysis of electrical circuits, cylco-stationary analysis of RLC circuits. Notion of power in DC and AC circuits and concepts of real and reactive power in AC circuits, power factor, polyphase circuits, star- delta conversion.	11	24
3.	**Semiconductor Devices:** Basic concepts of semiconductor devices, PN junction diode, characteristics and its application as rectifier circuits (half-wave and full-wave rectifiers), types of diodes, BJT, JFET, MOSFET.	12	26
4.	**Digital Electronics:** Number systems, logic gates, Boolean algebra, De-Morgan's theorem, combinational and sequential circuits, half adder & full adder, flip flops.	10	22
	TOTAL	45	100

List of Practical:

Sr. No.	Name of Practical	Hours
1.	To understand the electronic measuring devices and electronic components.	02
2.	To verify the Ohm's Law.	02
3.	To verify the Kirchoff's current and Kirchoff's voltage law.	02
4.	To verify the Norton's and Thevenin's theorem.	04
5.	To verify the delta and star connection.	04
6.	To study I-V characteristics of p-n junction diode.	02
7.	To study the cathode ray oscilloscope and to understand how to take measurement, time period and frequency.	02
8.	To study the half wave and full wave rectifier.	04
9.	To verify transistor as a switch & amplifier.	04
10.	To verify all the logic gates using bread board.	04
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Basic electrical engineering	T.N. Nagsarkar and M.S. Sukhija	Oxford University Press, 3rd edition.
Basic electrical engineering	D.P. Kothari and I.J. Nagrath	Tata McGraw-Hill Education, 2010
Fundamentals of Electrical Engineering	L. S. Bobrow	Oxford University Press, 2011
Electronic Principles	Albert Malvino & David J. Bates	McGraw-Hill Education, 7th edition.
Electronic Devices and Circuits	David A. Bell	Oxford University Press, 5th edition

Web Material Link(s):

- https://archive.nptel.ac.in/courses/108/105/108105112/
- https://archive.nptel.ac.in/courses/108/101/108101091/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of Performance and regular manual writing, checking of the practical throughout the semester consists 20 Marks.
- Internal viva or practical performance consist of 20 Marks.
- Practical performance/test of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEEC1210	BASICS OF ELECTRICAL AND ELECTRONICS
CO 1	Apply fundamental electrical laws (Ohm's Law, KCL, KVL) to analyze basic electrical

	circuits with resistors, capacitors, inductors, and sources.
CO 2	Analyze and solve electrical circuits using network theorems such as Thevenin's, Norton's, Superposition, and apply node and mesh analysis techniques.
CO 3	Evaluate the performance of AC and DC circuits by analyzing power components, power factor, transient and steady-state behavior of RLC circuits.
CO 4	Explain the working principles and applications of semiconductor devices including PN junction diode, rectifiers, BJT, JFET, and MOSFET.
CO5	Design and analyze basic digital circuits using number systems, logic gates, Boolean algebra, combinational and sequential circuits.

Mapping of CO with PO

SEEC1210	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	3	3	2	1	2					1	
CO 2	3	3	3	2	2					1	
CO 3	3	3	2	2	2					1	
CO 4	3	2	2	2	2					1	
CO 5	3	3	3	2	3				1	2	1

Mapping of CO with PSO

SEEC1210	PSO1	PSO2	PSO3
CO 1	3	2	1
CO 2	3	2	2
CO 3	3	2	2
CO 4	3	2	2
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Fundamental of Electrical Engineering	1,2, 3, 4
2	Circuit Analysis and Power Concepts	2,3,4
3	Semiconductor Devices	2,3
4	Digital Electronics	3,4,5

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1220
Course Name: Engineering Workshop
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
-	02	-	02	-	-	100	-	-	-	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- learn about the safety measures required to be taken while using working in workshop.
- learn about how to select the appropriate tools required for specific operation.
- learn about different manufacturing technique for production out of the given raw material.
- understand applications of machine tools, hand tools, power tools and welding process.

List of Practical:

Sr. No	Name of Practical	Hours
1.	Introduction and Demonstration of Safety Norms. Different Measuring Instruments.	02
2.	To Perform a Job of Fitting Shop.	06
3.	To Perform a Job of Carpentry Shop.	06
4.	To Perform a Job of Sheet Metal Shop.	06
5.	To Perform a Job of Black Smithy Shop.	04
6.	Introduction and Demonstration of Grinding & Hacksaw Cutting Machine.	02
7.	Introduction and Demonstration of Plumbing Shop & Welding Process.	04
	TOTAL	30

Text Book(s):

Title	Author(s)	Publication
Elements of Workshop Technology Vol. I	Hajra Chaudhary S. K.	Media promoters & Publishers
Workshop Technology Vol. I and II	Raghuvanshi B.S.	Dhanpat Rai & Sons

Reference Book(s):

Title	Author(s)	Publication
Workshop Technology Vol. I	W.A.J. Chapman	Edward Donald Publication
Workshop Practices	H S Bawa	Tata McGraw-Hill
Basic Machine Shop Practice Vol. I, II	Tejwani V. K.	Tata McGraw-Hill

Web Material Link(s):
- http://nptel.ac.in/course.php

Course Evaluation:
Practical:

- Continuous Evaluation Consist of Performance of Practical which will be evaluated out of 10 for each practical and average of the same will be converted to 50 Marks.
- Internal Viva consists of 50 Marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME1220	ENGINEERING WORKSHOP
CO 1	Understand the various measuring instruments.
CO 2	Understand the safety norms required in the workshop.
CO 3	Understand the application of various tools required for different operations.
CO 4	Remember the process of manufacture from a given raw material.
CO 5	Explain various manufacturing processes in machine shop.

Mapping of CO with PO

SEME1220	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2					2			2		1
CO 2						3		3	3		1
CO 3	2					2			1		1
CO 4	2								3		2
CO 5	2								3		2

Mapping of CO with PSO

SEME1220	PSO1	PSO2	PSO3
CO 1	2	3	2
CO 2			
CO 3	2	3	2
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Practical No	Content	RBT Level
1	Introduction and Demonstration of Safety Norms. Different Measuring	1, 2, 4
2	Instruments.	1, 2, 3
3	To Perform a Job of Fitting Shop.	1, 2, 3
4	To Perform a Job of Carpentry Shop.	2, 3, 4
5	To Perform a Job of Sheet Metal Shop.	2, 3, 4
6	To Perform a Job of Black Smithy Shop.	2, 3, 4
7	Introduction and Demonstration of Grinding & Hacksaw Cutting Machine.	2, 3, 4

P P Savani University
School of Engineering
Department of Computer Engineering

Course Code: SECE1220
Course Name: Digital Proficiency
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	0	0	3	40	60	0	0	0	0	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- provide foundational knowledge of digital tools and technologies.
- introduce the principles of digital communication, collaboration, and problem-solving.
- enhance awareness of emerging digital trends and their applications in engineering.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Digital Literacy** Overview of digital tools and their applications, Introduction to operating systems (Windows, Linux), Basics of file management and cloud storage solutions, Digital communication tools: Email, messaging platforms, and video conferencing tools (Zoom, Teams).	06	13
2.	**Office Productivity Tools** Word Processing: Document formatting, templates, and styles (MS Word/Google Docs). Presentation Tools: Slide design, animations (MS PowerPoint/Google Slides).	04	10
3.	**Data Handling and Analysis** Spreadsheets: Data entry, formulas, charts, pivot tables (MS Excel/Google Sheets). Introduction to data visualization tools (e.g., Tableau, Power BI, Google Data Studio). Applications of data analysis in engineering contexts. AI features in Excel and Google Sheets for predictive analysis.	07	15
4.	**Computational Problem-Solving** Introduction to algorithms and flowcharts. Solving simple engineering problems through programming. Applications of computational techniques in various engineering domains.	06	12
5.	**Cybersecurity and Ethical Practices** Understanding cybersecurity principles, Awareness of phishing, malware, and secure passwords, Digital footprints and privacy concerns, Ethical use of technology and copyright considerations.	05	12
6.	**Introduction to AI Tools and Applications** Overview of AI, Machine Learning, and their applications in engineering. Practical use of AI tools: ChatGPT for content creation and brainstorming, Canva for design and visual communication, GitHub Copilot for coding assistance. Ethical considerations in AI usage.	07	15
7.	**Emerging Technologies and Industry Trends**	07	15

	Overview of Industry 4.0 concepts: IoT, AI, Robotics, and Blockchain. Applications of emerging technologies in various engineering domains. Case studies: Smart cities, sustainable manufacturing, and automation. Preparing for future technological trends and job roles.		
8.	**Capstone Project and Case Study** Group project: Solve a practical engineering problem using digital tools. Case study presentations on the application of digital and AI tools in real-world scenarios.	03	08
	TOTAL	45	100

Text Book(s):

Title	Author/s	Publication
Digital Literacy for Dummies	Faithe Wempen	Wiley
Literacy in a Digital World: The Evolution and Development of Literacy Proficiency	Lorraine Dagostino, Jennifer Bauer, Michael Deasy, Ed.D., Kathleen Ryan	Rowman & Littlefield

Reference Book(s):

Title	Author(s)	Publication
Computer Fundamentals	P.K. Sinha and Priti Sinha	BPB Publications- 6th Edition
Microsoft Office 365: In Practice	Randy Nordell and Annette Easton	McGraw Hill Education- Latest Edition
Ethics for the Information Age	Michael J. Quinn	Pearson Education- 8th Edition
Industry 4.0: Managing the Digital Transformation	Alp Ustundag and Emre Cevikcan	Springer

Web Material Link(s):

- https://learn.microsoft.com/en-us/training/browse/
- https://www.ibm.com/think/topics/cybersecurity
- https://www.youtube.com/playlist?list=PLlKpQrBME6xLGL3Ty_1Wbd3nTZ_q_OKFQ

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the students will be able to

SECE1220	Digital Proficiency
CO 1	Demonstrate proficiency in using digital tools, operating systems, and cloud platforms for effective communication and collaboration.
CO 2	Create, edit, and manage professional documents, presentations, and spreadsheets using modern office productivity software.
CO 3	Analyze and visualize data using advanced spreadsheet features and data visualization tools to solve engineering problems.
CO 4	Identify cybersecurity risks, implement ethical practices, and safeguard digital assets in professional environments.
CO 5	Apply AI tools and understand emerging technologies like IoT and blockchain to address real-world engineering challenges.

Mapping of CO with PO

SECE1220	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	3	3		1	3			2	3		1
CO 2	3	2			3				3		1
CO 3	3	2	1	3	3						1
CO 4	3	2			3		3				1
CO 5	3	3	1		3						1

Mapping of CO with PSO

SECE1220	PSO1	PSO2	PSO3
CO 1	3	3	1
CO 2	2	2	
CO 3	3	2	1
CO 4	2	3	1
CO 5	3	2	3

Level of Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1.	Introduction to Digital Literacy	1,2,3
2.	Office Productivity Tools	2,3,4
3.	Data Handling and Analysis	2,3,4,5
4.	Computational Problem-Solving	2,3
5.	Cybersecurity and Ethical Practices	1,2,3
6.	Introduction to AI Tools and Applications	1,2,3,5
7.	Emerging Technologies and Industry Trends	3,4,5
8.	Capstone Project and Case Study	2,3,5,6

SECOND YEAR B.TECH.

P P SAVANI UNIVERSITY																	
SCHOOL OF ENGINEERING																	
TEACHING & EXAMINATION SCHEME FOR SECOND YEAR B.TECH. MECHAICAL ENGINEERING(SUSTAINABLE ENERGY) PROGRAMME AY: 2026-27																	
Sem	Course Code	Course Title	Course Category	Offered By	Teaching Scheme					Examination Scheme							
					Contact Hours				Credit	Theory		Practical		Tutorial		Total	
					Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE		
3	SECT2010	Basics of Sustainable Energy	Interdisciplinary	CT	3	0	2	5	5	40	60	0	0	40	60	200	
	SEME2301	Engineering Thermodynamics	Major/Core	ME	3	0	2	5	5	40	60	0	0	40	60	200	
	SECV2310	Mechanics of Solids	Interdisciplinary	CV	3	2	0	5	4	40	60	40	60	0	0	200	
		Elective-I	Minor	MT	3	2	0	5	4	40	60	40	60	0	0	200	
		Elective-II	Minor	MT	3	2	0	5	4	40	60	40	60	0	0	200	
							Total	**25**	**22**							**1000**	
4	SEET2360	Energy Storage & Technology	Interdisciplinary	ET	3	0	2	5	5	40	60	0	0	40	60	200	
	SEMT2320	Energy Efficiency, Audit & Management	Major/Core	MT	3	0	2	5	5	40	60	0	0	40	60	200	
	SEME2350	Fluid Mechanics	Major/Core	ME	3	2	0	5	4	40	60	40	60	0	0	200	
		Elective-I	Minor	MT	3	2	0	5	4	40	60	40	60	0	0	200	
		Elective-II	Minor	MT	3	2	0	5	4	40	60	40	60	0	0	200	
							Total	**25**	**22**							**1000**	

P P Savani University
School of Engineering
Department of Civil Engineering (Sustainable Energy)

Course Code: SECT2260
Course Name: Basics of Sustainable Energy
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners

- To introduce students to the fundamentals of sustainable energy systems and the need for transitioning from conventional to renewable energy sources.
- To develop an understanding of major renewable energy technologies such as solar, wind, biomass, hydro, geothermal, and emerging systems.
- To enable students to analyze, compare, and evaluate sustainable energy solutions based on technical, environmental, and economic criteria.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Sustainable Energy** Energy demand, supply, global trends; Environmental impacts of conventional energy; Concept of sustainability and energy transition; Overview of renewable vs. non-renewable sources; Energy metrics: efficiency, intensity, per-capita consumption.	04	10
2.	**Fundamentals of Energy Engineering** Review of thermodynamics relevant to energy systems; Energy conversion principles; Heat transfer basics; Power cycle fundamentals (Rankine, Brayton, refrigeration concepts); Efficiency limits (Carnot efficiency, exergy basics).	06	20
3.	**Solar Energy Technologies** Solar radiation basics, measurement, and estimation; Solar thermal systems: collectors, concentrators, applications; Photovoltaics: working principles, characteristics, modules, and arrays; Solar energy storage and integration; Case studies of solar power plants.	08	15

Module No.	Content	Hours	Weightage in %
4.	**Wind Energy Systems** Basics of wind formation and wind resource assessment; Aerodynamics of wind turbines; Types of wind turbines and components; Power curves, performance analysis; Grid integration and challenges.	06	20
5.	**Biomass and Bioenergy** Biomass resources and characterization; Thermochemical conversion: combustion, pyrolysis, gasification; Biochemical conversion: anaerobic digestion, fermentation; Biofuels: biogas, biodiesel, bioethanol; Waste-to-energy systems.	05	08
6.	**Hydropower and Geothermal Energy** **Hydropower:** Types of hydropower plants**;** Turbines and power calculations**;** Small, micro, and pico hydro. **Geothermal:** Geothermal resources and classification**;** Geothermal power plants; Direct use applications.	06	10
7.	**Ocean, Hydrogen, and Emerging Energy Technologies** Tidal, wave, and ocean thermal energy conversion (OTEC); Hydrogen energy: production, storage, fuel cells; Emerging and next-generation technologies (e.g., advanced nuclear, hybrid renewable systems).	04	10
8.	**Energy Storage, Economics & Sustainability Assessment** Energy storage systems: thermal, mechanical, electrical, chemical; Grid integration and smart energy systems; Life-cycle assessment (LCA); Techno-economic analysis of sustainable energy projects; Policy, regulatory framework, global & Indian scenario.	06	07
	TOTAL	**45**	**100**

List of Tutorials:

Sr. No	Name of Tutorial	Hours
1.	Energy Fundamentals and Sustainability Concepts	02
2.	Thermodynamics and Energy Conversion Basics	04
3.	Solar Radiation, PV, and Solar Thermal Analysis	04
4.	Wind Resource Assessment and Turbine Performance	04
5.	Biomass Characterization and Bioenergy Calculations	04
6.	Hydropower Potential and Turbine Calculations	04
7.	Geothermal, Ocean Energy, and Hydrogen Systems Overview	04
8.	Energy Storage, LCA, and Techno-Economic Evaluation	04
	TOTAL	**30**

Text Book(s):

Title	Author/s	Publication
Sustainable Energy: Engineering Fundamentals and Applications	Serdar Celik	Cambridge University Press

Reference Book(s):

Title	Author/s	Publication
Principles of Sustainable Energy Systems	Charles F. Kutscher, Jana B. Milford, Frank Kreith	CRC Press
Sustainable Energy Systems and Applications	İbrahim Dincer and Calin Zamfirescu	Springer
Energy Systems and Sustainability: Power for a Sustainable Future	Bob Everett	Oxford University Press

Web Material Link(s):

- https://nptel.ac.in/courses/103103206
- https://nptel.ac.in/courses/103107157
- https://nptel.ac.in/courses/109107397

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 masrks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the student will be able to

SECT2260	Basics of Sustainable Energy
CO1	Explain basic concepts of sustainability and global energy challenges.
CO2	Describe the working principles and components of major renewable energy technologies.
CO3	Analyze energy potential and performance of solar, wind, biomass, and other systems.
CO4	Evaluate the environmental and economic impacts of different energy technologies.
CO5	Apply engineering fundamentals to propose sustainable and feasible energy solutions.

Mapping of CO with PO

SECT2260	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	2	1	1	1						2	1
CO 2	1	3	3		2		3	3	2	3	1
CO 3	2	3	1	1		2			3		1
CO 4	2	1	1		3	3	2	2		3	1
CO 5	2	2	1	1	2		3		2	3	1

Mapping of CO with PSO

SECT2260	PSO1	PSO2	PSO3
CO 1	2	1	1
CO 2	3	1	1
CO 3	3	2	1
CO 4	2	2	2
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Sustainable Energy	1,2
2	Fundamentals of Energy Engineering	2,3,4,5
3	Solar Energy Technologies	2,3,4,5,6
4	Wind Energy Systems	4,5,6
6	Biomass and Bioenergy	4,5,6
7	Hydropower and Geothermal Energy	5,6
8	Ocean, Hydrogen, and Emerging Energy Technologies	5,6

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME2301
Course Name: Engineering Thermodynamics
Prerequisite Course(s): SEME1030-Elements of Mechanical Engineering

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- To identify different aspects of thermodynamics and their application.
- Interpret different laws of thermodynamics and their application to field and daily life.
- Understand various laws, Modes and equations related to heat transfer and their application.
- Understand the role of entropy, exergy to the universe.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Basic Concepts of Thermodynamic** Classical and statistical thermodynamic approach, Thermodynamic: system, properties, states, processes, cycle &equilibrium, Concepts of: control volume and control surface, Specific heat capacity, Internal Energy, Enthalpy, Specific Volume, heat and work.	05	07
2.	**First and Second law of Thermodynamics** First law for a closed system undergoing a cycle and change of state, energy, PMM1, First law of thermodynamics for a non- flow and flow process. Limitations of first law of thermodynamics, Statements of second law of thermodynamics and their equivalence, PMM2, Carnot's theorem, Corollary of Carnot's theorem, Causes of irreversibility.	08	20
3.	**Entropy** Clausius theorem, property of entropy, Clausius inequality, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes, third law of thermodynamics, PPM3, Entropy change for phase changing process.	05	15
4.	**Exergy** Energy of a heat input in a cycle, exergy destruction in heat transfer process, exergy of finite heat capacity body, exergy of closed and steady flow system, irreversibility and Gouy-Stodola theorem and its applications, second law efficiency.	05	08
5.	**Vapour Power Cycles** Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, carnot cycle efficiency, variables	06	15

	affectingefficiency of Rankine cycle.		
6.	**Gas Power Cycles** Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Brayton cycle.	06	15
7.	**Heat Transfer** Various modes of heat transfer. Conduction heat transfer- Fourier's law- explanation, thermal conductivity, heat transfer through a plain wall, composite wall and cylinder. Convection heat transfer, Newton's law of convection, Free and force convection, coefficient of convection. Radiation heat transfer, Blackbody concept, emissivity, refractivity, absorptivity, Stefan and Boltzmann's law, thermal conductivity, Difference between hot and cold insulation, Over all heat transfer coefficient. Simple numerical examples based on above.	06	12
8.	**Cryogenic Refrigeration System:** Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule-Thomson refrigeration systems, expansion engine and cold gas effectiveness for the Philips refrigerators, Gifford single volume refrigerators analysis, COP, FOM, refrigerators, pulse tube refrigerators, various types of pulse tube refrigerator.	04	08
	TOTAL	**45**	**100**

List of Tutorial:

Sr. No	Name of Tutorial	Hours
1	To solve numerical on S.F.E.E and its application to engineering devices like boiler, heat exchanger, turbine compressor etc.	06
2	To understand concept of heat engine, heat pump, and refrigerator based on second law of thermodynamics.	06
3	Calculation of Thermal Conductivity of Composite Wall	06
4	Determination Thermal Conductivity of Insulating Powder	06
5	Heat Transfer from a Pin Fin	06
	TOTAL	**30**

Text Book (s):

Title	Author/s	Publication
Engineering Thermodynamics	P.K. Nag	McGraw-Hill Education

Reference Book (s):

Title	Author/s	Publication
Fundamentals of Thermodynamics	Borgnakke & Sonntag	Wiley India (P) Ltd.

Web Material Link(s):

- http://nptel.ac.in/courses/112105123/1

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.

- End Semester Examination will consist of 60 marks.

Tutorial:

- Continuous Evaluation of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2301	ENGINEERING THERMODYNAMICS
CO 1	Interpret basic terminologies of thermodynamics.
CO 2	Define and demonstrate the laws of thermodynamics and its application in routine life.
CO 3	Interpret the concept of entropy and exergy.
CO 4	Analyze different gas and vapor power cycles and its applications to the diff. power plants.
CO 5	Identify different laws of heat transfer and their applications.

Mapping of CO with PO

SEME2301	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	3	3	2		3				3	
CO 2	2	3	3	3		3				3	
CO 3	2	3	3	3		3					
CO 4	2	3	3	3		3		3		3	
CO 5	2	3	3	3	3	3	1			3	

Mapping of CO with PSO

SEME2301	PSO1	PSO2	PSO3
CO 1	3	2	1
CO 2	3	2	
CO 3	2	2	
CO 4	2	2	
CO 5	3	2	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Basic Concepts of Thermodynamics	1,2
2	First & Second Law of Thermodynamics	2,3,4
3	Entropy	2,4
4	Exergy	4,5
5	Vapour Power Cycles	3,4
6	Gas Power Cycles	3,4
7	Heat Transfer	2,3,4,5
8	Cryogenic Refrigeration System	2,3,6

P P Savani University
School of Engineering
Department of Civil Engineering

Course Code: SECV2310
Course Name: Mechanics of Solids
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Understand different types of forces, systematic evaluation of effect of these forces, behavior of rigid and deformable bodies subjected to various types of forces at the state of rest or motion of the particles.
- Understand the stresses developed under the application of force.
- Understand the physical and mechanical properties of materials.
- Understand the behavior of structural elements under the influence of various loads.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**INTRODUCTION:** Definition of Rigid Body, Deformable Body, Scalar and Vector Quantities, Fundamental Principles of Mechanics: Principle of Transmissibility, Principle of Superposition, Law of Parallelogram of Forces.	05	10
2.	**Fundamental of Static:** Force, Types of Forces, Characteristics of a Force, System of Forces, Composition and Resolution of Forces. **Concurrent Forces:** Resultant of Coplanar Concurrent Force System by Analytical Method, Law of Triangle of Forces, Law of Polygon of Forces, Equilibrium Conditions for Coplanar Concurrent Forces. **Non-Concurrent Forces:** Moments & Couples, Characteristics of Moment And Couple, Varignon's Theorem, Resultant of Non-Concurrent Forces by Analytical Method, Equilibrium Conditions of Coplanar Non-Concurrent Force System.	06	15
3.	**Centroid and Centre of Gravity:** Centroid of Lines, Plane Areas and Volumes, Examples Related to Centroid of Composite Geometry, Pappus –Guldinus Theorems.	05	10
4.	**Moment of Inertia:** Parallel and Perpendicular Axis Theorems, Polar Moment of Inertia, Radius of Gyration of Areas, Examples related to moment of Inertia of Composite geometry.	06	10
5.	**Mechanical Properties of Materials:** Introduction, Classification of Materials, Properties Related to Axial, Bending, and Torsional & Shear Loading, Toughness, Hardness,	06	15

	Ductility, Brittleness. Proof stress, Factor of Safety, Working Stress,Load Factor.		
6.	**Strain Energy Methods & Advanced Topics** Castigliano's theorems, virtual work, principle of minimum potential energy, Introduction to stability and buckling of beams and frames	04	10
7.	**Simple Stress and Strain:** Definition of Stress and Strain, Tensile & Compressive Stresses: Shear and Complementary Shear Strains, Linear, Shear, Lateral, Thermal and Volumetric. Hooke's Law, Stresses and Strain in bars of Varying Sections, Tapering & Composite Section, Principle of Superposition. Elastic Constant, Relation between Elastic Constants.	05	10
8.	**Shear Force and Bending Moment:** Introduction, Types of Loads, Supports and Beams, Shear Force, Bending Moment, Sign Conventions for Shear Force & Bending Moment. Statically Determinate Beam, Support Reactions, SFD and BMD for Concentrated Load and Uniformly Distributed Load, Uniformly Varying Load, Point of Contra-flexure.	08	15
	TOTAL	**45**	**100**

List of Practical:

Sr. No	Name of Practical	Hours
1	Equilibrium of coplanar concurrent forces	02
2	To verify the law of parallelogram of forces	02
3	To verify the law of polygon of forces	02
4	To verify the Lami's theorem	02
5	Equilibrium of parallel force system – simply supported beam	02
6	Tensile test on Ductile materials.	02
7	Compression test on Ductile materials	02
8	Compression test on Brittle Materials	02
9	Determination of hardness of metals (Brinell/ Rockwell hardness test)	02
10	Determination of impact of metals (Izod/ Charpy impact test)	02
11	Tutorial on concurrent & non-concurrent forces	04
12	Tutorials on C. G & MI	02
13	Tutorials on SFD & BMD	04
	TOTAL	**30**

Text Book (s):

Title	Author/s	Publication
Applied Mechanics	S. B. Junnarkar & H. J. Shah	Charotar Publication
Strength of Materials (SI Units)	R S Khurmi, N Khurmi	S. Chand & Company Pvt. Ltd.

Reference Book (s):

Title	Author/s	Publication
Engineering Mechanics,	Meriam and Karaige,	Wiley-India
Engineering Mechanics: Statics and Dynamics	S Rajsekaran	Vikas Publication
Engineering Mechanics of Solids	Popov E.P	Prentice Hall of India

Web Material Link(s):

- http://nptel.ac.in/courses/122104014/
- http://nptel.ac.in/courses/112103108/

Course Evaluation:
Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):
After the completion of the course, the following course outcomes will be able to:

SECV2310	**MECHANICS OF SOLIDS**
CO 1	Understand and apply the fundamental principles of mechanics such as transmissibility, superposition, and equilibrium to analyze forces, moments, and resultants acting on rigid and deformable bodies.
CO 2	Determine geometric properties such as centroid, center of gravity, and moment of inertia of simple and composite sections, essential for structural and mechanical design.
CO 3	Explain and evaluate the mechanical properties of materials and relate them to behavior under different types of loading such as axial, bending, shear, and torsion.
CO 4	Analyze stresses, strains, and deflections in structural members subjected to different loading and boundary conditions using classical and energy methods.
CO 5	Construct shear force and bending moment diagrams for beams under various loading conditions and identify critical points such as points of contra-flexure to aid in safe and economical structural design

Mapping of CO with PO

SECV2310	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	3	2		2					3	
CO 2	2	2	3	2	2	2	2	3	2	2	3
CO 3	3	3	3	3	3	3	2	2	2	3	3
CO 4	2	3		2	2		3	3	2		
CO 5	3	2	3	3	3	3	2		3	2	3

Mapping of CO with PSO

SECV2310	PSO1	PSO2	PSO3
CO 1	3		3
CO 2	3	2	2
CO 3	3	3	
CO 4	2	2	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1, 2,
2	Fundamental of Static	2, 3, 4
3	Centroid and Centre of Gravity	2, 4, 5
4	Moment of Inertia	3, 4, 5
5	Mechanical Properties of Materials	1, 2, 5
6	Simple Stress and Strain	2, 4, 5
7	Shear Force and Bending Moment	3, 4, 5
8	Introduction	1, 2,

P P Savani University
School of Engineering
Department of Electrical Engineering (Sustainable Energy)

Course Code: SEET2360
Course Name: Energy Storage & Technology
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- To understand the principles, types, and applications of various energy storage systems in power and transportation sectors.
- Analyze the performance, advantages, and limitations of thermal, chemical, electromagnetic, and electrochemical storage technologies.
- Apply knowledge of batteries, super capacitors, and fuel cells for design, optimization, and management of energy storage systems in electric vehicles.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Energy storage systems overview** - Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market.	06	14
2.	**Thermal storage system**-heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems.	06	13
3.	**Chemical storage system-** hydrogen, methane etc., concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.	05	12
4.	**Electromagnetic storage systems** - double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.	05	12
5.	**Electrochemical storage system:** Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and	06	13

	their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery.		
6.	**Super capacitors-** Working principle of super capacitor, types of super capacitors, cycling and performance characteristics, difference between battery and super capacitors, Introduction to Hybrid electrochemical super capacitors	04	08
7.	**Fuel cell:** Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-super capacitor systems.	04	08
8.	Battery design for transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Lithium-Ion Batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.	09	20
	TOTAL	45	100

List of Tutorial:

Sr. No	Name of Tutorial	Hours
1	Numerical problems on time-scale matching of storage with applications	02
2	Numerical problems on thermal energy calculations (sensible & latent heat)	04
3	Heat pump COP calculation exercises	04
4	Phase change material selection & justification problems	04
5	Problems on capacitor energy storage (EDLC)	02
6	SMES inductive energy and power calculations	02
7	Hybrid battery–super capacitor sizing numerical	02
8	Super capacitor energy, power & cycle life calculations	02
9	Battery performance evaluation: SoC, DoD, C-rate numericals	04
10	Fuel cell efficiency & Nernst equation numericals	04
	TOTAL	30

Text Book (s):

Title	Author/s	Publication
Large Energy Storage Systems	Frank S. Barnes and Jonah G. Levine	CRC press

Reference Book (s):

Title	Author/s	Publication
Energy storage: A new approach	Ralph Zito	Wiley
Energy storage	Robert A. Huggins	Springer Science & Business Media

Web Material Link(s):

- https://nptel.ac.in
- https://nitw.ac.in

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEET2360	ENERGY STORAGE & TECHNOLOGY
CO 1	Understand the scope, need, and applications of energy storage systems in power and transportation sectors.
CO 2	Explain thermal and chemical energy storage principles, materials, efficiencies, and limitations.
CO 3	Describe and compare electromagnetic and electrochemical storage systems including batteries and super capacitors.
CO 4	Understand fuel cell operation and hybrid energy storage configurations.
CO 5	Apply concepts of battery design, charging, thermal management, and safety in electric vehicle systems.

Mapping of CO with PO

SEET2360	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	1				2	2			1	1
CO 2	2	2				1	2			1	1
CO 3	2	2		1	1	1	2			1	1
CO 4	3	2	1	1	1	2	3			1	1
CO 5	3	3	2	2	2	2	3	1	1	1	2

Mapping of CO with PSO

SEET2360	PSO1	PSO2	PSO3
CO 1	2	1	1
CO 2	2	1	2
CO 3	2	2	2
CO 4	3	2	2
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Overview of Energy Storage Systems	1,2
2	Thermal Energy Storage Systems	2,3
3	Chemical Energy Storage Systems	2,4
4	Electromagnetic Energy Storage Systems	2,4
5	Electrochemical Storage Systems – Batteries	2,4
6	Super capacitors & Hybrid Storage	2,3
7	Fuel Cells & Hybrid Systems	2,4,5
8	Battery Systems for Transportation & Safety	3,4,5,6

P P Savani University
School of Engineering
Department of Mechanical Engineering (Sustainable Energy)

Course Code: SEMT2320
Course Name: Energy Efficiency, Audit & Management
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Identify the basics energy management and its requirement.
- Interpret types of energy audit their significance and need.
- Understand audit planning and management with energy system and process.
- Explore data collection, audit tools, analysis, energy conversion measures.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Energy Management** Energy basics and terminology, Global and national energy scenarios, Importance of energy efficiency. Regulatory frameworks, codes, and standards (ISO 50001, ASHRAE, etc.), Energy policies and sustainability goals	03	10
2.	**Types of Energy Audits** Preliminary/Walk-through audits, General/Typical audits. Detailed energy audits, Investment-grade audits, Choosing the appropriate audit level	04	10
3.	**Audit Planning & Management** Audit objectives, scope, and boundaries, creating audit plans, schedules, and resource allocation, Stakeholder engagement and communication, Collecting baseline data & documentation review, Health, safety, and compliance considerations	04	15
4.	**Energy Systems and Process Review** **Electrical systems:** Motors, drives, transformers, power quality **HVAC systems:** Chillers, boilers, AHUs, cooling towers **Lighting systems:** Technologies, controls, day lighting **Industrial processes:** Steam systems, compressed air, furnaces, pumps Building envelope and thermal performance	10	20
5.	**Audit Tools, Instrumentation & Technology** Measurement and data-logging instruments, Thermal imaging and infrared analysis, Smart meters and IoT-based monitoring Energy	04	10

	modeling software (eQuest, RETScreen, etc.), Safety and calibration practices		
6.	**Data Collection & Analysis** Energy balance and benchmarking, Load profiling and consumption pattern analysis, Regression analysis and normalization, Utility bill analysis, Identifying anomalies and losses	04	10
7.	**Identifying Energy Conservation Measures (ECMs)** Cost-effective vs. capital-intensive solutions, Automation & control strategies, Optimization of systems and operations Maintenance and behavioural ECMs, Renewable energy integration opportunities	06	10
8.	**Financial & Economic Analysis** Cost–benefit analysis, Life cycle costing, Simple payback, NPV, IRR, ROI, Prioritizing ECMs based on economics and feasibility **Audit Report Preparation** Structure and components of a good audit report, Presenting findings and ECMs, Visuals, charts, baselines, and summary tables, Recommendations and implementation roadmaps Post-audit review and verification	10	15
	TOTAL	**45**	**100**

List of Tutorial:

Sr. No.	Name of Tutorial	Hours
1.	Audit and load calculation of all electrical appliances.	06
2.	Audit and load calculation of the mechanical appliances	06
3.	Baseline whole-building energy meter check	06
4.	Audit and load calculation of HVAC system.	06
5.	Fault detection and diagnosis of the system	06
	TOTAL	**30**

Text Book(s):

Title	Author/s	Publication
Energy Efficiency and Management for Engineers, 1st Edition	Mehmet Kanoğlu Yunus A. Çengel	McGraw hill

Reference Book(s):

Title	Author/s	Publication
Energy Management Conservation and Audits	Anil Kumar, Om Prakash, Prashant Singh Chauhan, Samsher Gautam	Routledge Taylor & Francis

Web Material Link(s):

- https://beeindia.gov.in/sites/default/files

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of Practical/Tutorial which should be evaluated out of 10 for each practical and average of the same will be converted to 20 Marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the students will be able to

SEMT2320	ENERGY EFFICIENCY, AUDIT & MANAGEMENT
CO 1	Understand the basic tool of the audit and system requires regular audit management.
CO 2	Estimate the audit planning for various system like electrical, mechanical audits.
CO 3	Understand the data collection and analyze techniques.
CO 4	Relate with the financial & economic analysis with audit preparation
CO 5	Understand the energy conservation measures.

Mapping of CO with PO

SEMT2320	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2		1	2		1			1	
CO 2	3	3	2	2	2		1		1	1	
CO 3	3	3		3	2		1			1	
CO 4	2	3	2	2	1		1			2	3
CO 5	2	3	3	2	2	2	3	1	1	1	2

Mapping of CO with PSO

SEMT2320	PSO1	PSO2	PSO3
CO 1	2	1	1
CO 2	3	2	2
CO 3	3	2	2
CO 4	3	2	2
CO 5	3	3	3

Level of Revised Bloom's Taxonomy in Assessment:

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Energy Management	1, 2
2	Types of Energy Audits	1, 2, 3
3	Audit Planning & Management	1, 2, 3
4	Energy Systems and Process Review	1, 2, 4,5
5	Audit Tools, Instrumentation & Technology	1, 2,3
6	Data Collection & Analysis	1,2,3,4
7	Identifying Energy Conservation Measures (ECMs)	1,2,4,5,6
8	Financial & Economic Analysis and Audit Report Preparation	1,2,3,5, 6

P P Savani University
School of Engineering
Department of Mechanical Engineering

Course Code: SEME2350
Course Name: Fluid Mechanics
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand basic fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
- learn Fluid Properties.
- understand the importance of flow measurement and its applications in Industries and to obtain the loss of flow in a flow system.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Properties of Fluids** Density, Viscosity, Surface Tension, Compressibility, Capillary, Vapour Pressure, Bulk Modulus, Cavitation, Classification of Fluids	02	5
2.	**Fluid Statics** Force and Pressure, Pascal's law of Pressure at a point, Pressure measurement by Manometers – U tube, Inclined U tube and Differential, Centre of Pressure, Hydrostatic forces on surface – Vertical, Horizontal and Inclined, Forces on curved Surfaces, Buoyancy and Buoyant Force, Centre of Buoyancy andMeta Centre, Determination of Metacentric Height, Stability of Floating and Submerged Body, Position of metacenter relative to Centre of buoyancy.	06	14
3.	**Fluid Kinematics** Steady and Unsteady Flow, One – two and three DimensionalFlow, Uniform and Non Uniform Flow, Rotational and Irrotational Flow, Stream Lines and Stream Function, Velocity Potential Function, Relation between stream and velocity potential function, Flow nets, Continuity Equation for 2D and 3D flow in Cartesian co-ordinates system.	07	16
4.	**Fluid Dynamics**	06	15

	Newton's law of motion, Euler's Equation and its applications, Bernoulli's Equation and its applications, Momentum Equation,Pitot Tube, Determination of volumetric flow with pitot tube, Principle of Venturimeter, Pipe Orifice and Rotameter.		
5.	**Dimensional Analysis** Dimensions, Dimensional Homogeneity, Raleigh and Buckingham π Theorem, Non-Dimensional Numbers, Similarities – Geometrical, Kinematics and Dynamic.	05	10
6.	**Flow Through Pipes & Open Channels** Major and Minor Losses in Pipes, Losses in Pipe Fittings, Hydraulic Gradient line and Total energy line, Equivalent Pipes,Pipes in series and parallel, Siphon, Power transmission through pipe, Moody's Diagram, Dracy Weishbach Equation, Types of open channel flow, Specific Energy and Specific Force, Critical Flow, Hydraulic Jump, Measurement of Discharge in open Channels.	07	16
7.	**Viscous Flow** Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe- Hagen Poiseuille formula, Flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, foot step and collar bearing, measurement of viscosity. **Boundary Layer Theory** Concept of Boundary Layer, Boundary layer Thickness, Momentum Thickness, Displacement Thickness, Drag and Lift, Separation of Boundary layer, Streamlined and Bluffed Bodies.	08	16
8.	**Nano Fluids** Introduction to nanofluids, nanostructure materials, base fluids, dispersion, sonication and stable suspension. Various types of nanofluids-volumetric concentration. Thermophysical properties: Density; principles of measurement and apparatus. Theoretical equations to determine the density of different nanofluids. Viscosity: principles of measurement and apparatus. Andrade's and other theoretical equations. Effect of volumetric concentration and temperature. Effect of subzero temperature on nanofluid viscosity.	04	08
	TOTAL	**45**	**100**

List of Tutorial:

Sr. No	Name of Tutorial	Hours
1.	Determine metacentric height of floating body.	02
2.	Measurement of pressure using different types of manometers.	02
3.	Determine Co-efficient of Discharge by venturimeter, Orificemeter and Rotameter.	06
4.	Verification of Bernoulli's apparatus.	02
5.	Measurement of velocity of flow using Pitot tube.	02
6.	Measurement of Friction factor for Different pipes.	04
7.	Measurement of viscosity using Redwood Viscometer.	02
8.	Determine discharge through triangular notch.	02
9.	Determine discharge through trapezoidal notch.	02
10.	Determine discharge through rectangular notch.	02

11.	Determine different flow patterns by Reynolds's apparatus.	02
12.	Determine friction loss for different pipes fittings	02
	TOTAL	30

Text Book (s):

Title	Author/s	Publication
Textbook of Fluid Mechanics and Hydraulic Machines	R. K. Bansal	Laxmi Publications

Reference Book (s):

Title	Author/s	Publication
Fluid Mechanics	Frank M. White	Tata McGraw Hill Publication
Fluid Mechanics	R.K.Rajput	Schand Publication
Introduction to Fluid Mechanics and Fluid Machines	S.K.Som & Biswas.G	Tata McGraw Hill Publication

Web Material Link(s):

- http://nptel.ac.in/courses/112105171/1

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical/Tutorial:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2350	FLUID MECHANICS
CO 1	Differentiate fluid properties and its behavior in static and dynamic mode.
CO 2	Apply dimensional analysis to design the system and interpret types of fluid flow.
CO 3	Determine major and minor losses through different pipes.
CO 4	Diagnose the viscosity of fluids.
CO 5	Diagnose pressure exerted by the fluids and rate of flow of fluids.

Mapping of CO with PO

SEME2350	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2			2	1				3		
CO 2	3	2	2	3	2				3		
CO 3	3	2		3	2	1			3		2
CO 4	3	3		3	2				3		1
CO 5	3	1		3	3	1			3		2

Mapping of CO with PSO

SEME2350	PSO1	PSO2	PSO3
CO 1		2	
CO 2	3	3	
CO 3	3	3	
CO 4	3	3	
CO 5		2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Properties of Fluids	1, 2
2	Fluid Statics	1, 2, 5
3	Fluid Kinematics	1, 2, 5
4	Fluid Dynamics	2, 3, 4, 5
5	Dimensional Analysis	2, 3, 5
6	Flow Through Pipes & Open Channels	2, 3, 4, 5
7	Viscous Flow, Boundary Layer Theory	2, 3, 4, 5
8	Nano Fluids	2, 3, 4, 5

P P Savani University

School of Engineering

Department of Mechanical Engineering (Sustainable Energy)

Course Code: SEMT2510

Course Name: Solar Thermal Systems

Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help the leaners to learn:

- To understand the fundamentals of solar radiation, solar geometry, and principles of thermal energy conversion.
- To analyze the design, working, and performance of various solar thermal collectors and storage systems.
- To apply principles of thermodynamics and heat transfer in the design and evaluation of solar thermal applications.
- To evaluate solar thermal systems from technical, economic, and environmental sustainability perspectives.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Solar Thermal Energy** Global and Indian energy scenario, renewable energy overview, importance of solar thermal energy, classification of solar thermal systems, applications and limitations, comparison of solar thermal and photovoltaic systems.	05	10
2.	**Solar Radiation and Geometry** Solar angles, declination, hour angle, altitude and azimuth angles, extraterrestrial radiation, atmospheric attenuation, measurement of solar radiation, estimation of solar radiation on horizontal and tilted surfaces.	06	14

3.	**Heat Transfer in Solar Thermal Systems** Review of conduction, convection and radiation, radiative properties of surfaces, selective coatings, heat losses in solar collectors, efficiency and performance parameters.	06	14

4.	**Solar Thermal Collectors** Flat plate collectors – construction, working and performance analysis; evacuated tube collectors; concentrating collectors – parabolic trough, parabolic dish, linear Fresnel reflector; comparison and selection criteria.	07	15
5.	**Thermal Energy Storage** Need for storage, sensible heat storage, latent heat storage using phase change materials, thermochemical storage, materials and design considerations.	05	11
6.	**Solar Water Heating and Heating/Cooling Applications** Domestic and industrial solar water heating systems, system design and sizing, solar space heating, solar cooling and absorption refrigeration systems, solar dryers.	06	14
7.	**Solar Thermal Power Plants** Principles of solar thermal power generation, Rankine cycle integration, parabolic trough and central receiver systems, hybrid solar thermal plants, operational challenges.	05	11
8.	**Economics, Environmental Impact and Future Trends** Life cycle cost analysis, economic feasibility, environmental benefits, carbon mitigation potential, policies and standards, recent advancements and future prospects in solar thermal technologies.	05	11
	TOTAL	45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Measurement of solar radiation using pyranometer	03
2.	Performance testing of flat plate solar collector	03
3.	Heat loss analysis of solar thermal collector	03
4.	Efficiency evaluation of evacuated tube collector	03
5.	Study of concentrating solar collector setup	03
6.	Thermal energy storage using sensible heat storage unit	03
7.	Performance study of solar water heater	03
8.	Solar dryer performance analysis	03
9.	Simulation of solar thermal system using MATLAB / TRNSYS / RETScreen	03
10.	Mini-project / case study on solar thermal application	03
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Solar Energy: Principles of Thermal Collection and Storage, 4th Edition	Sukhatme, S. P. & Nayak, J. K.	Tata McGraw Hill Education

Reference Book(s):

Title	Author/s	Publication
Solar Engineering of Thermal Processes, 4th Edition	Duffie, J. A. & Beckman, W. A.	Wiley Eastern Ltd.
Solar Energy Engineering: Processes and Systems, 2nd Edition	Kalogirou, S. A.	Academic Press
Principles of Solar Engineering, 2nd Edition	Goswami, D. Y., Kreith, F., & Kreider, J. F.	CRC Press, Taylor & Francis.

Web Material Links:

- https://archive.nptel.ac.in/content/storage2/courses/112105050/m1l1.pdf

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEMT2510	Solar Thermal Systems
CO1	Explain fundamentals of solar radiation and thermal energy conversion principles.
CO2	Analyze performance of different solar thermal collectors.
CO3	Apply heat transfer concepts to design basic solar thermal systems.
CO4	Evaluate solar thermal power plants and heating applications.
CO5	Assess economic feasibility and sustainability of solar thermal technologies.

Mapping of CO with PO

SEMT2510	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	1	2						2	1	
CO 2	1	1	1	1	1					1	
CO 3	1	1	2		1				2	1	2
CO 4	1	1	2	1			1		2	1	
CO 5	1	1	3	1	1		2		2	1	2

Mapping of CO with PSO

SEME2510	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	3	1
CO 3	3	3	2
CO 4	3	2	1
CO 5	3	3	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Solar Thermal Energy	1, 2
2	Solar Radiation and Geometry	1, 2, 3
3	Heat Transfer in Solar Thermal Systems	1, 2, 3, 5
4	Solar Thermal Collectors	2, 5
5	Thermal Energy Storage	2, 5
6	Solar Water Heating and Heating/Cooling Applications	3,4, 5
7	Solar Thermal Power Plants	3,4,5
8	Economics, Environmental Impact and Future Trends	3,4

P P Savani University

School of Engineering

Department of Mechanical Engineering

Course Code: SEME2311

Course Name: Material Science & Metallurgy
Prerequisite Course(s): -- None

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- identify the different materials and their properties described.
- understand the microstructures, crystallography, defects, and phase diagrams of different materials.
- understand the process involved in mechanical testing of materials and their deformation under certain conditions.
- understand the role of heat treatment to achieve desired variation in properties of materials.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Materials** Classification of Engineering Materials, Engineering requirements of materials, Methods/Tools to reveal the different levels of structure. Defects-Point, Line, Planar; Crystal geometry and Crystal Imperfections: Unit Cell, Crystal structure, Bravise lattice, atomic packing, coordination number, crystal structures of metallic elements, crystal directions and planes, Miller indices, Polymorphism or Allotropy. Crystal structure and correlated properties. diffusion processes, Mechanism of crystallization – nucleation and growth, factors influencing nucleation and growth, Imperfections in crystals and their effect on properties, Solute strengthening, Corrosion.	07	13
2.	**Phase Diagrams and Phase Transformation** Phase, Gibbs's Phase rule, Solubility and Solid Solutions,Iso- morphous alloy system, Eutectoid and Peritecticsystem, Evol ution of Microstructure, Phase Transformation-Temperature-Time-Transformation (TTT) and Continuous Cooling Transformation (CCT) Diagrams, Electro Microscopy.	07	11

3.	**Solidification of Metals** Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure onMechanical Properties, Methods to control the grain structure resulting from solidification, Solidification defects like porosity and shrinkage and remedies. Cooling curve of pure metal and alloy.	06	11
4.	**Heat Treatment** Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching and Temper heat treatment, Hardenability, Applications of above processes for theindustrial practices. **Surface hardening processes** Flame and induction hardening, Carburizing, Nitriding and Carbonitriding, Applications of above processes for the industrial practices.	04	14
5.	**Powder Metallurgy** Application and advantages, Production of powder, Compacting, Sintering, Equipment and process capability.	03	07
6.	**Cast Iron and Alloy steel** Iron-Iron Carbide and Iron-carbon diagrams, Transformations resulting into White Cast Iron, Grey Cast Iron, Malleable Cast Iron, S. G. Iron, Alloy Cast Iron. Their microstructures and correlated properties and applications, IS Codification, Purpose of alloying, General effect of alloying elements on ferrite, carbide, transformation temperature, hardenability and tempering. Types of steel: Chromium, Manganese, Molybdenum and Manganese steels, IS Codification, Tool Steels Classification, properties, applications and IS and ISO Codification.	10	22
7.	**Non-Ferrous Alloys** Non-Ferrous Alloys of Aluminum, Magnesium, Copper, Nickel, Titanium, Microstructure and mechanical property relationships; Composite, Classification, Processing, Metal Matrix	04	07
8.	**Mechanical Behavior of Metals** Properties of metals, Deformation of metals, Mechanisms of deformation, Deformation in polycrystalline materials, Mechanical testing of materials (destructive & nondestructive) testing methods.	04	15

List of Practical:

Sr. No.	Name of Practical	Hours
1.	To understand construction and working of metallographic microscope.	02
2.	To study procedure of specimen preparation for microscopic examination and to carry out a specimen preparation.	04
3.	To understand what is micro examination, importance of micro examination and to study various ferrous, non-ferrous microstructure	04
4.	To show the effect of different quenching media like Oil, Water and Brine on the hardness of medium carbon steel.	04
5.	To find out the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section.	04
6.	To determine machine defects by dye -penetrant test and magnetic particle test.	04
7.	To determine the hardenability by Jominy end quench test.	04

8.	Study of different heat treatment processes- annealing, normalizing, hardening and tempering, surface and casehardening to improve properties of steel during	04
	processes and applications with the help of muffle furnace.	
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Callister's Material Science and Engineering	R. Balasubramaniam	Wiley India

Reference Book(s):

Title	Author/s	Publication
Materials Science and Metallurgy	O. P. khanna	Dhanpatrai Publication
Principles of Materials Science and Engineering	W F Smith	McGraw Hill
Elements of Material Science and Engineering	Lawrence H. Van Vlack,	Pearson Education

Web Material Links:

- http://nptel.ac.in/downloads/113106032/

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2311	MATERIAL SCIENCE & METALLURGY
CO1	Understand the basic concept of material science and metallurgy.
CO2	Know about the ferrous and non ferrous metals and alloys and their applications.
CO3	Understand and apply various heat treatment process to get desired material properties.

CO4	Examine the mechanical properties of metals through various destructive and non destructive methods.
CO5	Understand the importance of powder metallurgy & judge the scope and limitations of different materials.

Mapping of CO with PO

SEME2311	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	3	2			3	3	1			
CO 2	2	3	2			3	3	3	2	1	1
CO 3	2	3	2			3	3	3	2		2
CO 4	2	3	3	3	3	3	3	3	1	2	2
CO 5	2	3	2			3	3		2		1

Mapping of CO with PSO

SEME2311	PSO1	PSO2	PSO3
CO 1	1	3	2
CO 2	1	3	1
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Materials	1
2	Phase diagrams and phase transformation	1, 2, 4
3	Solidification of Metals	2, 4
4	Heat Treatment, Surface hardening process	3, 5
5	Powder Metallurgy	2, 5
6	Cast Iron and Alloy Steel	1, 2
7	Non Ferrous Alloys	1, 2
8	Mechanical Behaviour of Metals	2, 3, 5

P P Savani University
School of Engineering

Department of Electrical Engineering (Sustainable Energy)

Course Code: SEET2520
Course Name: Basics of Biomass and Bioenergy Systems
Prerequisite Course(s):

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	01	04	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- To provide fundamental knowledge of biomass resources and their characteristics for sustainable energy production.
- To understand various biomass conversion technologies, including thermochemical and biochemical processes.
- To develop the ability to evaluate bioenergy systems, their applications, and their environmental and economic impacts.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Biomass & Bioenergy:** Definition, classification, importance; global & national energy scenario; role of biomass; advantages & limitations	05	12
2.	**Biomass Resources & Characteristics:** Types of biomass; physical, chemical & biological properties; proximate & ultimate analysis; resource assessment methods	07	15
3.	**Biomass Conversion Technologies – Overview:** Conversion pathways (thermochemical, biochemical, mechanical); comparison, energy balance & efficiency	06	13
4.	**Thermochemical Conversion:** Combustion; gasification; pyrolysis; bio-oil & biochar, factors affecting processes	05	12
5.	**Biochemical Conversion:** Anaerobic digestion; fermentation; biogas composition; microbial fuel cells basics; key parameters	07	15
6.	**Liquid Biofuels:** Biodiesel production, transesterification, feed stocks, quality standards & applications	05	12
7.	**Biomass Resource Management & Supply Chain:** Biomass collection, preprocessing, storage, logistics, sustainability, environmental impacts; LCA basics	06	13
8.	**Applications, Policies & Future Trends:** Biomass power plants, government policies & subsidies, emerging technologies, challenges & future prospects	04	08
	TOTAL	**45**	**100**

List of Tutorial:

Sr. No	Name of Tutorial	Hours
1	To study moisture content, volatile matter, ash content, and fixed carbon in various biomass samples.	02
2	Classify different types of biomass and their importance in the global and national energy scenario.	02
3	Study the role of biomass in achieving sustainable energy development.	02
4	Discuss various types of biomass resources (agricultural, forest, industrial, municipal) and their physical, chemical, and biological properties affecting energy conversion.	04
5	Solve numerical based on Proximate and Ultimate Analysis	04
6	Discuss methods used for biomass resource assessment.	02
7	Classify biomass conversion processes into thermochemical, biochemical, and mechanical methods. Compare these methods based on efficiency, cost, and applications.	04
8	Study biodiesel production using the transesterification process.	02
9	Discuss different feed stocks, reaction conditions, and fuel quality standards.	04
10	Case study on biodiesel with conventional diesel.	04
	TOTAL	**30**

Text Book (s):

Title	Author/s	Publication
Biomass and Bioenergy: Processing and Properties	Khalid Rehman Hakeem, Mohammad Jawaid & Umer Rashid	Springer

Reference Book (s):

Title	Author/s	Publication
Bioenergy Research: Basic and Advanced Concepts	Manish Srivastava, Neha Srivastava & Rajeev Singh	Springer
Fundamentals of Biofuels Engineering and Technology	Cataldo De Blasio	Springer

Web Material Link(s):

- https://nptel.ac.in
- https://nitw.ac.in

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEET2520	BASICS OF BIOMASS AND BIOENERGY SYSTEMS
CO 1	Understand the fundamentals of biomass and bioenergy, including types, properties, energy scenarios, and their advantages and limitations.
CO 2	Analyze different biomass resources using their physical, chemical, and biological properties along with proximate and ultimate analysis methods.
CO 3	Evaluate various biomass conversion technologies and compare their efficiency, energy balance, and applications.
CO 4	Apply knowledge of biochemical and thermochemical processes to study the production and quality of biofuels such as biogas and biodiesel.
CO 5	Assess biomass management, supply chain, environmental impacts, and analyze applications, policies, and future trends in bioenergy.

Mapping of CO with PO

SEET2520	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	1				1	2			1	1
CO 2	2	2		1	1	1	2			1	1
CO 3	3	2	1	2	1	2	3			1	1
CO 4	3	3	2	2	2	2	3	1	1	1	2
CO 5	2	2	2	2	1	3	3	2	1	2	2

Mapping of CO with PSO

SEET2520	PSO1	PSO2	PSO3
CO 1	2	1	1
CO 2	2	2	2
CO 3	3	2	2
CO 4	3	2	3
CO 5	2	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Biomass & Bioenergy	1,2
2	Biomass Resources & Characteristics	2,3
3	Biomass Conversion Technologies – Overview	2,4
4	Thermochemical Conversion	2,4
5	Biochemical Conversion	2,4
6	Liquid Biofuels	2,3
7	Biomass Resource Management & Supply Chain	2,4,5
8	Applications, Policies & Future Trends	6

P P Savani University
School of Engineering
Department of Electrical Engineering (Sustainable Energy)

Course Code: SEET2530
Course Name: Hybrid Renewable Energy Systems
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- Understand fundamentals of HRES including solar PV, wind, and system configurations.
- Apply concepts for modeling, sizing, and control of hybrid energy systems.
- Analyze economic performance, optimization, and grid integration of HRES.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction & Solar PV System Fundamentals:** Need for Hybrid Renewable Energy Systems (HRES), Classification of HRES: Grid-connected, Stand-alone, DC, AC, and AC/DC coupled, Solar PV Module: Structure, I-V characteristics, Equivalent circuit model, Maximum Power Point Tracking (MPPT): Basic principle and P&O algorithm, Solar PV System Sizing and Balance of System (BOS) components.	06	14
2.	**Wind Energy Conversion Systems (WECS):** Wind Power Fundamentals: Wind speed characteristics, Betz limit, Power curve, Types of Wind Turbines: HAWT and VAWT, classification based on rotor speed (fixed vs. variable speed), WECS Components: Aerodynamics, blades, gearbox, generators (DFIG, PMSG - basic structure and application), Wind Farm Layout and site selection considerations.	06	14
3.	Hybrid System Architectures & Power Electronics: HRES Architectures, Key components of a typical PV-Wind HRES: Sources, Power Converters, Energy Storage, Power Conditioning Units (PCU): DC-DC converters, Inverters (VSC and CSC principles), Role of centralized and distributed converters in HRES integration.	06	13
4.	Energy Storage Technologies for HRES: Need for energy storage in HRES: Bridging intermittency, improving power quality, Battery Energy Storage Systems (BESS): Types (Lead-Acid, Li-ion, Flow batteries), Characteristics (Energy density, Cycle life, DOD), Modeling and Sizing of BESS for stand-alone and grid-tied applications, Other storage methods: Flywheel, Supercapacitors, Pumped Hydro Storage	06	13

5.	**HRES Modeling and Component Sizing:** Modeling of HRES Components: Mathematical models for PV array, Wind turbine, and Battery, Load Estimation: Techniques for predicting daily, weekly, and seasonal load profiles, Methods for optimal component sizing: Loss of Power Supply Probability (LPSP), Reliability Index, Introduction to Simulation Tools for HRES analysis.	05	11
6.	**Control and Power Management Strategies:** Hierarchical Control of HRES: Primary, Secondary, and Tertiary control levels, Power Management Strategy (PMS): Load following, Cycle charging, Control strategies for stand-alone HRES: Coordinating power flow between sources, storage, and load, Grid-tied HRES control: Active and reactive power control, Grid synchronization.	05	11
7.	**Optimization and Economic Analysis:** Economic Analysis: Capital Cost (CC), Operating Cost (OC), Replacement Cost (RC), Cost of Energy (COE): Calculation and optimization, Net Present Cost (NPC) and Levelized Cost of Electricity (LCOE) calculations, Optimization techniques: Introduction to Genetic Algorithms (GA) and Particle Swarm Optimization (PSO) for HRES sizing and optimal operation.	06	13
8.	**Microgrids, Grid Integration, and Case Studies:** Introduction to Microgrids: Definition, types (AC, DC, Hybrid), advantages, Challenges of integrating HRES with the main grid (Harmonics, protection, islanding detection), Case Studies: Detailed analysis of two or three operational HRES projects, HRES Policies and Regulatory Frameworks	05	11
	TOTAL	**45**	**100**

List of Practical:

Sr. No	Name of Practical	Hours
1	Measure and plot the I-V and P-V characteristics of a PV module under varying solar irradiation and temperature.	03
2	Simulate and implement a Perturb and Observe (P&O) or Incremental Conductance algorithm to track the maximum power point of a PV array.	03
3	Determine the performance characteristics of a small wind turbine, including the power-speed curve and tip-speed ratio calculation.	03
4	Perform charge/discharge cycle testing on a battery and estimate the State-of-Charge (SOC) and effective capacity.	03
5	Design and simulate a DC-DC (Buck/Boost) converter to regulate the voltage and current for charging a battery bank (using MATLAB/Simulink).	03
6	Simulate a three-phase Voltage Source Converter (VSC) and implement a basic control loop for grid synchronization and power injection.	03
7	Model a complex load profile. Perform component sizing for a PV-Wind-Battery system, running optimization to minimize the Net Present Cost (NPC) and calculating the LCOE.	06
8	Develop and simulate the full control logic (flowchart and Simulink model) for optimal power dispatch and coordination between all sources, storage, and the load/grid connection.	06
	TOTAL	30

Text Book (s):

Title	Author/s	Publication
Renewable and Efficient Electric Power Systems	Gilbert M. Masters	IEEE Press / Wiley

Reference Book (s):

Title	Author/s	Publication
Hybrid Renewable Energy Systems: Design and Control	K. Balamurugan, V. Balaji	CRC Press
Integration of Renewable Energy Sources with Smart Grid	Ali H. M. F. et al.	Springer

Web Material Link(s):

- https://nptel.ac.in
- https://nitw.ac.in

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEET2530	Hybrid Renewable Energy Systems
CO 1	Analyze the dynamic constraints of all components in a hybrid system.
CO 2	Design the control logic for power dispatch and energy storage management.
CO 3	Simulate the HRES control strategy using specialized software (Simulink).
CO 4	Optimize power flow to maximize renewable energy utilization.
CO 5	Evaluate the system's performance during grid connection and islanding operations.

Mapping of CO with PO

SEET2530	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	3	1	2	2		2				
CO 2	2	3	3	2	2		2		1	1	
CO 3	1	2	2	3	3		2		1	1	
CO 4	2	3	3	2	2		3		1	1	1
CO 5	2	3	2	3	2	1	3	1	1	1	

Mapping of CO with PSO

SEET2530	PSO1	PSO2	PSO3
CO 1	3	2	1
CO 2	2	3	1
CO 3	2	3	1
CO 4	3	3	2

CO 5	2	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction & Solar PV System Fundamentals	1,3,4
2	Wind Energy Conversion Systems (WECS)	3,4
3	Hybrid System Architectures & Power Electronics	2,3
4	Energy Storage Technologies for HRES	2,3
5	HRES Modeling and Component Sizing	3,4
6	Control and Power Management Strategies	3,4,6
7	Optimization and Economic Analysis	3,5
8	Microgrids, Grid Integration, and Case Studies	2,5

P P Savani University

School of Engineering

Department of Mechanical Engineering

Course Code: SEME2531

Course Name: Manufacturing Technology - I

Prerequisite Course(s): -- SEME1020 – Engineering Workshop

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand various manufacturing techniques.
- learn the background for higher level subjects in engineering like Production Technology.
- understand the relevance and importance of the Different manufacturing techniques and real-life application in industry.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Manufacturing Processes** Basic Introduction, Economics and Technological Definition, Importance of Manufacturing, Classification and Selection of Manufacturing Processes.	02	05
2.	**Patternmaking and Foundry** Patterns, Allowances, Types of patterns, Moulding materials, Moulding sands; properties and sand testing: Grain fineness, moisture content, clay content and permeability test. Core materials and core making, Gating & Riser systems, Spure, Gating, Ration, Cupola, Inspection and Cleaning of casting, Casting defects.	12	25
3.	**Miscellaneous Casting Process** Shell moulding, Die casting, investment Casting, Carbon dioxide molding process, Centrifugal casting, Slush casting,Continuous casting process, Advanced technologies in casting.	08	18

4.	**Gas Welding** Principles of gas welding, Types of gases used, Types of flames, Welding techniques, Edge preparation, Equipment used, Torch, Regulators, Welding filler rods, Gas cutting, Principles of gas cutting, Position of torch, Soldering, Brazing, Adhesive bonding.	08	16
5.	**Electric Arc Welding** Principles of electric arc welding, A.C. / D.C. welding, Edge preparation, Equipment used, ISI electrode classification: Designation and selection, Manual metal arc welding, Carbon arc welding, Inert gas shielded arc welding, TIG & MIG, Submerged arc welding, Atomic hydrogen arc welding, Plasma arc welding, Stud arc welding, Arc cutting.	04	08
6.	**Resistance Welding** Principles of resistance welding, Heat balance, Electrodes, Spot welding, Seam welding, Projection welding, Upset welding, Flash welding, Fusion welding processes: Thermit welding, electro-slag welding, Electron beam and laser beam welding.	04	10
7.	**Solid-State and Advanced Joining Processes** Solid-state welding: friction welding, friction stir welding, ultrasonic welding, diffusion bonding, Brazing and soldering: principles, materials, applications, Adhesive bonding, Introduction to advanced manufacturing: additive manufacturing basics, hybrid processes	03	08
8.	**Green Manufacturing** Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing. The Social, Business, and Policy Environment for Green Manufacturing: Introduction, The Social Environment—Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment—Present Atmosphere and Challenges for Green Manufacturing.	04	10
	TOTAL	45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Study of different types of patterns & types of molding methods	02
2.	Design of Gating system & Design of Riser	02
3.	To Find out the Moisture Content, Permeability and Hardness of Moulding Sand	04
4.	Casting Defects, their Causes and Remedies	02
5.	Tutorial on Casting Simulation	04

6.	Study different Welding Processes, Weld Joint Design as per I.S. code and Weld Symbols	04
7.	Gas Welding and Gas Cutting Processes	04
8.	MIG & TIG Welding Process	04
9.	Resistance Welding Process	04
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Manufacturing Technology Vol. II	P.N. Rao	Tata McGraw Hill
A Textbook of Production Technology	Sharma P. C.	S. Chand

Reference Book(s):

Title	Author/s	Publication
Manufacturing Technology – I	Rao	Tata McGraw Hill
A Textbook of Production Engineering	Sharma P.C.	S. Chand
Manufacturing Processes and Systems	Phillip F., Ostwald, Jairo Munoz	Wiley India

Web Material Links:

- https://nptel.ac.in/courses/112107145

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2231	MANUFACTURING TECHNOLOGY – I
CO1	Articulate basic knowledge of manufacturing processes to implement in professional skills.

CO2	Describe patternmaking process and casting defects
CO3	Differentiate various casting processes for good manufacturing practices.
CO4	Demonstrate gas welding and cutting process for different application
CO 5	Identify, classify and apply arc & resistance welding processes used for various applications in industrial practice.

Mapping of CO with PO

SEME2531	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1		2	3	2		3	3	1		3	
CO 2		1	3	3			3	1	3	3	
CO 3		2	3	2		3		1	3	3	
CO 4		2	3	3	3	3	3	1	3		
CO 5		2	3	2	3	3	3	1	3	3	

Mapping of CO with PSO

SEME2531	PSO1	PSO2	PSO3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Manufacturing Processes	1, 2, 4, 6
2	Patternmaking and Foundry	1, 2, 5, 6
3	Miscellaneous Casting Process	1, 2, 6
4	Gas Welding	1, 2, 5
5	Electric Arc Welding	2, 5, 6
6	Resistance Welding	2, 5, 6
7	Solid-State and Advanced Joining Processes	3,4,5
8	Green Manufacturing	1, 2, 3

P P Savani University

School of Engineering

Department of Mechanical Engineering (Sustainable Energy)

Course Code: SEMT2540

Course Name: Entrepreneurship in Energy Sector

Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	01	04	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Establish an entrepreneurial attitude to uncover fresh, technical business opportunities within the renewable and conventional energy sectors.
- Develop essential abilities in designing and assessing business models using frameworks like the Business Model Canvas.
- Analyze the financial viability of energy projects and determine necessary resources, finance, and regulatory pathways.
- Communicate and propose a clear business strategy, considering the legal and supply chain challenges of scaling an energy firm.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Introduction to Entrepreneurship and Energy Transition** The Entrepreneurial Mindset: Characteristics of successful entrepreneurs; distinction between invention and innovation. Global Energy Overview: Current energy mix (Fossil Fuels, Nuclear, Renewables); the need for energy transition. Overview of Indian Energy Scenario: Policy drivers (e.g., National Solar Mission, PLI schemes); opportunities for small and medium enterprises. Role of Mechanical Engineers: Opportunities in manufacturing, project EPC (Engineering, Procurement, Construction), and O&M (Operation and Maintenance).	06	14

2.	**Ideation and Opportunity Identification** Need-Gap Analysis: Identifying unmet needs in the energy value chain (generation, transmission, storage, efficiency). Renewable Energy Opportunities: Focus on Solar PV (advanced mounting systems, cooling), Wind (Blade O&M, Drivetrain components), and Biomass. Energy Efficiency: Market for HVAC efficiency, energy auditing, and industrial heat recovery systems. The Idea Funnel: Techniques for generating, screening, and selecting the most viable business concept.	06	13
3.	**Business Model Development** Introduction to Business Models: Components of a successful business model. The Business Model Canvas (BMC): Detailed study of all nine blocks (Value Proposition, Customer Segments, Key Activities, etc.). Application to Energy Sector: Developing for different energy services (e.g., PV rooftop installer vs. EV battery recycler). Lean Startup Principles: Conceptual introduction to Minimum Viable Product (MVP) and validated learning.	06	13
4.	**Market Assessment and Strategy** Market Research: Primary and secondary research methods; identifying target customers (Industrial, Commercial, Residential). Market Sizing: Total Addressable Market (TAM), Serviceable Available Market (SAM), and Serviceable Obtainable Market (SOM) calculation (conceptual). Competitive Analysis: Identifying direct and indirect competitors; SWOT analysis. Go-to-Market Strategy: Basic concepts of sales channels, distribution, and marketing for energy products.	06	13
5.	**Project Finance and Financial Feasibility** Basic Financial Statements: Introduction to Profit & Loss (P&L) and Balance Sheet (conceptual). Project Cost Estimation: Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) for energy projects. Feasibility Metrics (Basic): Calculation of Simple Payback Period and concept of Discounted Cash Flow (DCF). Funding Sources: Bootstrapping, Angel Investors, Venture Capital (VC), and debt financing (bank loans).	05	11
6.	**Legal, Policy, and Regulatory Landscape** Business Registration: Types of legal entities (Sole Proprietorship, Partnership, Private Limited Company). Intellectual Property (IP): Importance of patents, trademarks, and copyright in technology. Key Energy Policies: Understanding Net Metering, Power Purchase Agreements (PPA), and Renewable Purchase Obligations(RPO). Safety and Standards: Relevant national and international standards (e.g., IEC, BIS) for energy products.	05	11

7.	**Operations, Supply Chain, and Scaling** Supply Chain Management (SCM): Mapping the supply chain for renewable energy components (PV cells, wind blades, batteries). Logistics and Inventory: Management challenges in the project-based energy sector. Scaling Strategies: Challenges related to manufacturing capacity expansion and talent acquisition. Contract Management: Basics of EPC contracts and service level agreements (SLA).	05	11
8.	**Risk Management and Case Studies** Project Risk: Identifying technical, financial, and regulatory risks in energy projects. Mitigation Strategies: Insurance, diversification, and contingency planning. Case Studies: Analysis of successful and failed energy startups (e.g., in solar EPC, electric mobility, or green hydrogen). Pitching the Idea: Elements of an effective business plan and investor pitch deck.	06	14
	TOTAL	45	100

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Case Study Analysis: Analyze the business model and success factors of a pre-selected, regional renewable energy SME.	02
2.	Idea Generation Workshop: Brainstorm and perform a basic SWOT analysis for 3 distinct, mechanically-focused energy startup ideas..	02
3.	Value Proposition Design: Deep dive into the value proposition block, creating a 'jobs-to-be-done' matrix for the target customer.	02
4.	Market Sizing Exercise: Estimate the Serviceable Obtainable Market (SOM) for a chosen product (e.g., solar water pump maintenance service).	02
5.	Feasibility Calculation: Calculate the Simple Payback Period and Breakeven Point for a small rooftop PV project using provided cost data.	02
6.	Policy Analysis Report: Prepare a short report on the key incentives and subsidies available for a specific energy technology (e.g., waste-to-energy) in the state/country.	02
7.	Supply Chain Mapping: Draw a simplified supply chain map for a solar inverter or an EV battery pack, identifying key international and local suppliers.	03
	TOTAL	15

Text Book(s):

Title	Author/s	Publication
Entrepreneurship	Hisrich, Robert D. and Michael P Peters	McGraw-Hill

Reference Book(s):

Title	Author/s	Publication
Business Policy and Strategic Management: Concepts and Applications	Vipin Gupta, Kamala Gollakota, and R. Srinivasan	PHI Publication
Platform Business Models: Frameworks, Concepts and Design	R Srinivasan	Springer

Web Material Links:

- https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs172

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration andaverage of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEMT2540	Entrepreneurship in Energy
CO1	Explain the fundamental entrepreneurial mindset and identify the global and local market landscape of the conventional and renewable energy sectors.
CO2	Identify feasible business opportunities in technical areas relevant to mechanical engineers (e.g., HVAC optimization, solar mounting, EV components).
CO3	Develop a preliminary Business Model Canvas (BMC) for an energy startup, defining value propositions and key resources.
CO4	Analyze basic project finance methods (e.g., payback period) and identify potential funding sources, including government subsidies and venture capital.
CO5	Assess the legal, regulatory, and supply chain challenges associated with scaling an energy technology venture.

Mapping of CO with PO

SEME2540	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	2		1	1						2
CO 2	2	1	1	1	3		3				
CO 3	2		1	2	2	1	3		2		2

CO 4	2				3		3	1	2		
CO 5	2	3	1	2	3	1	3	1	2		2

Mapping of CO with PSO

SEME2360	PSO1	PSO2	PSO3
CO 1	1	1	1
CO 2	3	2	2
CO 3	3	2	2
CO 4	3	2	2
CO 5	3	2	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Entrepreneurship & Energy Transition	1, 2
2	Ideation & Opportunity Identification	2, 3
3	Business Model Development	2,3,4,6
4	Market Assessment Strategy	3,5
5	Project Finance and Financial Feasibility	3,4, 5
6	Legal Policy and Regulatory Landscape	2, 5, 6
7	Operations, Supply Chain and Scaling	1, 2, 3
8	Risk Management and Case Studies	2,3,4

P P Savani University
School of Engineering
Department of Science & Humanities

Course Code: SESH2220
Course Name: Numerical Analysis & Applied Statistics
Prerequisite Course(s): --SESH2110- Differential Methods and Complex Variable

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		Total
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	100	--	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- provide the knowledge of numerical analysis & statistical methods to the students.
- mentally prepare the students to identify and formulate the engineering problem and obtain their solution.
- inculcate the analytical skill of the students to apply the Numerical & Statistical techniques to the problems of respective field.

Course Content:

Module No.	Content	Hours	Weightage in %
1	**Approximations and Errors:** Errors and Their computations, General error formula. **Solution of Algebraic and Transcendental Equations:** Bracketing Methods (Bisection, Secant, Method of False Position), Convergence of Iterative Methods, Newton-Raphson Method, Newton-Raphson Method	07	14
2	**Numerical Solutions of Linear Equations** Gauss-Seidel Method Iteration Method, Jacobi's Method, Gauss-Seidel Method, Eigen Value Problem.	05	07
3	**Numerical Differentiation** Finite Differences: Forward, Backward and Divided Differences Table, Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula Interpolation	06	14
4	**Numerical Integration** Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule.	04	10
5	**Numerical Methods for ODEs** Taylor's Series and Euler's Method, Modifications and Improvements in Euler's Method, Runge-Kutta 2nd Order & 4th Order Methods, Boundary Value Problems.	07	11
6	**Basics of Statistics** Elements, Variables, Observations, Quantitative and Qualitative data, Cross-sectional and Time series data, Frequency distribution, Dot plot,	04	10

	Histogram, Cumulative distribution		
7	**Regression Analysis** Measure of location, Mean, Median, Mode, Percentile, Quartile, Measure of variability, Range, Interquartile Range, Variance, Standard Deviation, Coefficient of Variation, Regression line and regression coefficient, Karl Pearson's method	05	16
8	**Probability Distribution** Introduction, Conditional probability, Independent events, independent experiments, Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Normal distribution.	07	18
	TOTAL	45	100

List of Tutorial(s):

Sr. No.	Name of Practical	Hours
1.	Approximations and Errors	2
2.	Solution of Algebraic and Transcendental Equations	4
3.	Numerical Solutions of Linear Equations	2
4.	Numerical Differentiation	2
5.	Numerical Integration	2
6.	Numerical Methods for ODEs	2
7.	Basics of Statistics	4
8.	Regression Analysis	4
9.	Probability-1	4
10.	Probability-2	4
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Advanced Engineering Mathematics	Erwin Kreyszig	Wiley India Pvt. Ltd. New Delhi.
Probability and Statistics for Engineers	Richard A. Johnson Irwin Miller, John Freund	Pearson India Education Services Pvt. Ltd., Noida.

Reference Book(s):

Title	Author(s)	Publication
Numerical Methods in Engineering & Science	B. S. Grewal	Khanna Publishers, New Delhi
Advanced Engineering Mathematics	R. K. Jain, S. R. K. Iyengar	Narosa Publishing House, New Delhi.
Introductory Methods of Numerical Analysis.	S. S. Sastry	PHI Learning Pvt. Ltd., New Delhi.
Statistics for Business and Economics	David R. Anderson, Dennis J. Sweeney, Thomas A.Williams	Cengage Learning

Web Material Link(s):

- http://nptel.ac.in/courses/111106094/
- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111101003/
- http://nptel.ac.in/courses/111105090/
- http://nptel.ac.in/courses/111107105/
- http://nptel.ac.in/courses/110107114

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of the performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 100 marks.

Course Outcome(s):

After completion of the course, the students will be able to

SESH2220	NUMERICAL ANALYSIS & APPLIED STATISTICS
CO 1	Derive numerical solution of linear and nonlinear system of equation.
CO 2	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration.
CO 3	Compare variety of numerical methods for solving ordinary differential Equation.
CO 4	Construct different statistical methods to collect, compare, interpret & evaluate data.
CO 5	Apply probability in decision making, artificial intelligence, machine learning etc.

Mapping of CO with PO

SESH2220	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11
CO 1	3	1	1	1							1
CO 2	2	1	1	2							1
CO 3	2	2	1	1							1
CO 4	2	1	1	1							1
CO 5	3	1	1								2

Mapping of CO with PSO

SESH2220	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2	1	2	
CO 3	1	2	
CO 4	2	2	
CO 5	2	2	

Level of Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1.	Solution of Algebraic and Transcendental Equations	1, 2, 3, 4, 6
2.	Numerical Solutions of Linear Equations	1, 2, 3, 5
3.	Numerical Differentiation	1, 2, 3, 5
4.	Numerical Integration	1, 2, 3, 5
5.	Numerical Methods for ODEs	1, 2, 3, 5, 6
6.	Basics of Statistics-I	1, 2, 3, 4, 5
7.	Basics of Statistics-II	1, 2, 3, 4, 5
8.	Probability Distribution	1, 2, 3, 4, 5

P P Savani University
School of Engineering
Department of Mechanical Engineering (Sustainable Energy)

Course Code: SEMT2551
Course Name: Solar Energy for Industrial Process Heat
Prerequisite Course(s): Basics of Sustainable Energy

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- To understand the principles and technologies of solar energy utilization for industrial process heat applications.
- To develop the ability to analyze and design solar thermal systems for meeting industrial heat requirements.
- To evaluate the techno-economic and environmental benefits of integrating solar energy into industrial processes.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Solar Energy & Industrial Heat Demand:** Energy scenario, role of solar energy, industrial process heat requirements, temperature ranges, classification of industrial heat processes	04	10
2.	**Solar Radiation & Resource Assessment:** Solar radiation fundamentals, solar geometry, measurement of solar radiation, availability assessment for industrial applications	05	11
3.	**Low Temperature Solar Thermal Collectors:** Flat plate collectors, evacuated tube collectors, performance parameters, efficiency, applications in low-temperature industrial processes	06	13
4.	**Medium & High Temperature Solar Collectors:** Concentrating collectors: parabolic trough, linear Fresnel, parabolic dish, central receiver systems; tracking mechanisms	06	13
5.	**Thermal Energy Storage for Industrial Heat:** Sensible heat storage, latent heat storage, thermochemical storage, storage materials, design considerations	05	12
6.	**Solar Process Heat System Design & Integration:** System configurations, heat exchangers, control strategies, integration with conventional boilers, hybrid systems	06	13
7.	**Applications of Solar Industrial Process Heat:** Solar heat applications in food processing, textile, chemical, dairy, pulp & paper industries; case studies	06	13
8.	**Applications, Economics & Future Trends:** Economic analysis, payback period, carbon reduction benefits, government policies, standards, challenges and future trends	07	15

	TOTAL	**45**	**100%**

List of Practical:

Sr. No	Name of Practical	Hours
1	Study of solar energy potential and industrial process heat temperature requirements	02
2	Measurement and analysis of solar radiation using pyranometer / solar data tools	04
3	Performance analysis of flat plate and evacuated tube solar collectors	04
4	Study of concentrating solar collectors (parabolic trough / dish) and tracking mechanisms	06
5	Experimental study of thermal energy storage methods for solar process heat	04
6	Design of solar thermal system for a selected industrial process heat application	02
7	Simulation and performance evaluation of solar industrial process heat systems	06
8	Techno-economic and environmental analysis of solar process heat integration in industries	02
	TOTAL	**30**

Text Book (s):

Title	Author/s	Publication
Solar Energy: Principles of Thermal Collection and Storage	S. P. Sukhatme & J. K. Nayak	McGraw Hill Education
Solar Energy Engineering: Processes and Systems	Soteris A. Kalogirou	Elsevier

Reference Book (s):

Title	Author/s	Publication
Solar Thermal Systems: Analysis and Design	Tiwari & Sahota	Springer
Renewable Energy Sources and Emerging Technologies	D. P. Kothari, K. C. Singal, Rakesh Ranjan	PHI

Web Material Link(s):

- https://nptel.ac.in
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me42

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEMT2551	SOLAR ENERGY FOR INDUSTRIAL PROCESS HEAT
CO 1	Understand solar energy fundamentals and industrial process heat requirements.
CO 2	Explain solar thermal collectors and concentration technologies used for industrial

	heating.
CO 3	Analyze the performance of solar thermal systems for different industrial applications.
CO 4	Design basic solar process heat systems with thermal energy storage.
CO 5	Evaluate techno-economic and environmental aspects of solar industrial process heat integration.

Mapping of CO with PO

SEMT2551	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2					2				
CO 2	3	3	2		2		2				
CO 3	3	3	2	2	2		2				
CO 4	2	3	3	2	2		3				2
CO 5	2	2	2			2	3	2			3

Mapping of CO with PSO

SEMT2551	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	3	
CO 3	3	3	1
CO 4	2	3	2
CO 5	2	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Solar Energy & Industrial Heat Demand	1,2
2	Solar Radiation & Resource Assessment	2
3	Low Temperature Solar Thermal Collectors	2,3
4	Medium & High Temperature Solar Collectors	3,4
5	Thermal Energy Storage for Industrial Heat	4
6	Solar Process Heat System Design & Integration	4,5
7	Applications of Solar Industrial Process Heat	5
8	Economics, Policies & Future Trends	5,6

P P Savani University
School of Engineering
Department of Mechanical Engineering

Course Code: SEME2270
Course Name: Theory of Machines
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	-	02	05	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help the leaners to learn:

- basics types of mechanism, degree of freedom, joints.
- about velocity and acceleration analysis for different mechanism.
- about kinematic analysis of cam and follower motion.
- about types of belts, ropes, chain and gears drives and its applications.

Course Content:

Module No.	Content	Hours	Weightage in %
1.	**Basics of Mechanisms** Introduction, Mechanism and machine, Rigid and resistant body, Link, Kinematic pair, Types of motion, Degrees of freedom (mobility), Classification of kinematic pairs, Kinematic chain, Linkage, Mechanisms, Kinematic inversion, Inversions ofslider crank chain, Synthesis of Mechanism, Double slider- crank chain, Quick return mechanism, Limiting Positions and Mechanical Advantage.	06	10
2.	**Velocity Analysis** Vectors, Displacement of a rigid body, Relative displacement, Definition of velocity, Angular velocity, Rotation of a rigid body, Translation and rotation of a rigid body, Relative velocity method (graphical and analytical), Instantaneous axes of motion, Properties of instantaneous centers, The Aronhold - Kennedy theorem of three centers, Velocity analysis by instantaneous centers. The line-of- centers method, Velocity analysis by components, Velocity images, Velocity diagrams.	06	10

3.	**Acceleration Analysis** Definition of acceleration, Angular acceleration, A general case of acceleration, Radial and transverse components of acceleration, The coriolis component of acceleration, Examples of acceleration analysis, Acceleration diagrams.	06	10
4.	**Kinematics of Belts, Ropes and Chain Drives** Introduction, Belt and rope drives, Open and crossed belt drives, Velocity ratio, Slip, Materials for belt and ropes, Law of belting, Length of belt, Ratio of friction tensions, Power transmitted, Centrifugal effect on belts, Maximum power transmitted by a belt, Initial tension, Creep, Chains, Chain length, Angular speed ratio, Classification of chains.	07	10
5.	**Kinematics of Gears** Introduction, Classification of gears, Gear terminology, Law of gearing, Velocity of sliding, Forms of teeth, Cycloidal profile teeth, Involute profile Teeth, Comparison of Cycloidal and involute tooth forms, Path of contact, Arc of contact, number of pairs of teeth in contact, Interference in involute gears, Minimum number of teeth, Interference between rack and pinion, Undercutting, Introduction to helical, Spiral, Worm, Worm gear and bevel gears.	15	15
6.	**Kinematics of Cams** Introduction, Types of cams, Types of followers, Cam terminology, Displacement diagrams, Motions of the follower, Graphical construction of cam profile, High Speed CAM.	08	10
7.	**Balancing of rotating and reciprocating masses** Balancing of rotating masses Single and multiple – single and different planes. Balancing of Reciprocating Masses- Primary, Secondary balancing of reciprocating masses using Analytical methods.	06	15
8.	**Flywheels & Governors** Significance of flywheel, Turning moment and crank effort diagrams for reciprocating machines, coefficient of fluctuation of speed and energy, Limiting velocity of flywheel. Classification of Governors, Working principle of centrifugal governors, Sensitivity of governor, Characteristics of governors, Hunting of governors.	06	15
	Total	**60**	**100**

List of Practical:

Sr No	Name of Practical	Hours
1.	To measure the ratio of time of cutting stroke to the return stroke in shaping machine by varying the stroke length.	02
2.	To understand the ratio of time of cutting stroke to the return stroke in shaper machine by varying the stroke length.	08
3.	To estimate kinematic data related to bicycle free wheel sprocket mechanism and Geneva mechanism.	02

4.	To prepare different kinematic links and to determine velocity and acceleration by relative velocity method for analysis of motion links.	08
5.	To draw a radial cam profile for given follower type to obtain desired follower motion.	02
6.	To estimate the slip, length of belt, angle of contact in open and cross belt drive.	02
7.	To estimate the Velocity of sliding, Path of contact, Arc of contact, number of pairs of teeth in contact in gears.	02
8.	To measure radius and height of all types of governors for different rotational speeds and mass of balls.	04
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Theory of Machines	S. S. Rattan	Tata McGraw Hill Education

Reference Book(s):

Title	Author/s	Publication
Mechanism and Machine Theory	J.S Rao, R.V Dukkipati	Wiley Eastern Ltd.
Theory of Mechanism and Machine	Ghosh A., Malick A.K	East-West Pvt. Ltd.
Theory of Machines and Mechanisms	John J. Uicker, Gordon R. Pennock, Joseph E. Shigley	Oxford University Press

Web Material Links:

- http://nptel.ac.in/courses/112104121/1

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2270	THEORY OF MACHINES
CO 1	Understand the essential components of linkage and mechanism in the assembly of machines.
CO 2	Analyze the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
CO 3	Apply the concept of the belt, rope, and chains, in machines operations.
CO 4	Understand a power transmission machine's element and its mechanism to solve the problems associated with it.
CO 5	Design a layout of cam and follower for specific motion.

Mapping of CO with PO

SEME2270	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2						2	1		
CO 2	1	1	1	1	1					1		1
CO 3	1	1	2		1				2	1	2	1
CO 4	1	1	2	1			1		2	1		
CO 5	1	1	3	1	1		2		2	1	2	1

Mapping of CO with PSO

SEME2270	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	3	1
CO 3	3	3	2
CO 4	3	2	1
CO 5	3	3	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Basics of Mechanisms	1, 2
2	Velocity Analysis	1, 2, 3, 5
3	Acceleration Analysis	1, 2, 3, 5
4	Kinematics of Belts, Ropes and Chain Drives	2, 5
5	Kinematics of Gears	2, 5
6	Kinematics of Cams	2, 5

P P Savani University

School of Engineering

Department of Mechanical Engineering

Course Code: SEME2360

Course Name: Mechanical Measurement & Metrology

Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	-	04	40	60	40	60	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help the learners to

- know various types and methods of measurement.
- assess the suitability of measuring instruments.
- describe the basic concepts of metrology.
- know how to operate different types of mechanical measuring instruments.
- explain the different instruments used in industry.
- evaluate quality of surface produced using various methods of measurements.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Principles of Metrology & Screw threads and gear Metrology** Concept of Metrology, Need for inspection, Linearity, Repeatability, Sensitivity and readability, Precision & Accuracy, Standards of measurements. Measurement of Screw thread: Screw terminology, Errors in threads, measuring elements of the internal and external threads. Measurement of Gear: Introduction and Classification of gears,Forms of gear teeth, Gear tooth terminology, Measurement andtesting of spur gear: Various methods of measuring tooth thickness, tooth profile and pitch, Gear Errors.	10	20
2.	**Surface Roughness Metrology** Introduction, Surface Texture, Methods of Measuring Surface finish,	04	10

	Comparison Methods and Direct Instrument Measurement, Sample Length, Numerical Evaluation of Surface Texture, Indication of Surface roughness Symbols used, Adverse effects of poor surface finish		
3.	**Straightness, Flatness, Squareness, Parallelism and Machine Tool Tests & Miscellaneous Metrology** Introduction, Measurement of Straightness, Flatness, Squareness and Parallelism, run out and concentricity, Tool makers microscope, Interferometry and its use in checking flatness, surface contour, parallelism etc., Interferometers andoptical flats, Introduction to Machine tool testing; Various Alignment test on lathe, Milling Machine, Drilling Machine etc. Measurement of Force, Torque, Power, Measurement of displacement, Velocity and Acceleration, Measurement ofSpeed and Frequency	09	20
4.	**Measurement Concept** Economics of measurement, Need of mechanical measurement, Basic definitions: Hysteresis, Linearity, Resolution of measuring instruments, Threshold, Drift, Zero stability, loading effect and system response. Source of Errors and their classification. Methods of measurement and performance characteristics	04	09
5.	**Linear Measurements** Precision and Non-precision linear Measurements, Vernier caliper, Micrometer, Use of End standard – Slip Gauge, Indian standard on Slip gauge, Care and use of slip gauge for workshop and inspection purpose, Telescopic gauge, Comparators.	06	14
6.	**Angular and Taper Measurements** Introduction; Working principle and construction of Angular Measuring instruments like Protractors, Sine bars, Sine Centre,Angle gauges, Spirit level, Clinometers, Angle dekkor, Taper Measuring Instruments: Measurement of taper shafts and Holes	04	09
7.	**Temperature measurement** Temperature scales, Temperature measuring devices, Methods of Temperature Measurement, Expansion Thermometers;Filled System thermometers; Electrical Temperature Measuring Instrument, Pyrometers; Calibration of Temperature Measuring Instruments, Reliability and calibration.	04	09

8.	**Inspection Technologies** History of Coordinate Measuring Machines, Important feature of CMM, CMM construction, CMM Operation and Programming, Performance of CMM, Possible causes of errors in CMM, Trigger type and Measuring type probes in computer controlled CMM, Accuracy Specification for CMM, Calibration of CMM, CMM Applications and Benefits, Role of computer in field of Metrology, Advances in Metrology.	04	09
	TOTAL	45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Study of various instrument characteristics	02
2.	Study, Use and calibration of Linear Measuring Instruments	08
3.	Study and use of slip gauge	02
4.	Study of angle measurement using (a) Bevel Protractor (b) Combination Set and (c) Sine Bar	08
5.	Study of Temperature Measurement	02
6.	Study of Surface Roughness Tester	02
7.	Study of Gear Tooth Measurement	02
8.	Study Strain gauge Transducer	04
9.	Study of Coordinate Measuring Machines (CMM) (Industrial Visit)	-
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Textbook Of Metrology	M. Mahajan	Dhanpat rai & Co.

Reference Book(s):

Title	Author/s	Publication
Mechanical Measurement and Metrology	R K Jain	Khanna Publisher
Mechanical Measurements and Instrumentations	R K Rajput	Kataria Publication
Mechanical Measurements	Beckwith & Buck	Narosa publishing House
Metrology and Measurement	Anand Bewoor & Vinay Kulkarni	McGraw-Hill
Mechanical Measurements & Control	D. S. Kumar	Metropolitan books co pvt ltd

Web Material Links:

- http://nptel.ac.in/courses/112106179

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2360	MECHANICAL MEASUREMENT & METROLOGY
CO 1	Select linear and angular measuring instrument for measurement of various Components
CO 2	Distinguish between various gears and screws by measuring their dimensions
CO 3	Measure surface finish of the component produced
CO 4	Compare appropriate temperature measuring device for various applications
CO 5	Describe methods of measurement for various quantities like force, torque, power, displacement.

Mapping of CO with PO

SEME2360	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	2		1	1						2
CO 2	2	1	1	1	3		3				
CO 3	2		1	2	2	1	3		2		2
CO 4	2				3		3	1	2		
CO 5	2	3	1	2	3	1	3	1	2		2

Mapping of CO with PSO

SEME2360	PSO1	PSO2	PSO3
CO 1	1	1	1
CO 2	3	2	2
CO 3	3	2	2
CO 4	3	2	2
CO 5	3	2	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply

4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Principles of Metrology, Screw threads and gear Metrology	1,2, 3
2	Surface Roughness Metrology	2, 4 , 5
3	Straightness, Flatness, Squareness, Parallelism and Machine Tool Tests Miscellaneous Metrology	2, 4, 5
4	Measurement Concept	2, 4, 5
5	Linear Measurements	2, 5
6	Angular and Taper Measurements	2, 5
7	Temperature Measurement	2, 5
8	Inspection Technologies	2, 3, 4, 5

Course Name: Photovoltaic Cell Technology
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		Total
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	
03	-	01	04	40	60	-	-	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- To provide fundamental understanding of solar energy principles and photovoltaic cell operation.
- To develop the ability to analyze performance characteristics and design basic photovoltaic systems.
- To introduce applications, standards, and future trends of photovoltaic technology in sustainable energy systems.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Solar Energy & PV Systems:** Energy scenario, renewable energy overview, solar energy fundamentals, solar radiation, basics of photovoltaic systems	04	10
2.	**Semiconductor Physics for PV Cells:** Semiconductor basics, p–n junction, energy bands, charge carriers, recombination, photovoltaic effect	05	11
3.	**Photovoltaic Cell Technologies:** Silicon solar cells (mono, poly, amorphous), thin-film technologies, III–V cells, perovskite cells, efficiency comparison	06	13
4.	**Electrical Characteristics of PV Cells:** I–V and P–V characteristics, cell parameters, fill factor, efficiency, temperature and irradiance effects	06	13
5.	**PV Modules and Array Design:** PV module construction, series–parallel connections, array configurations, shading effects, mismatch losses	05	12
6.	**Power Conditioning & MPPT**: DC–DC converters, inverters for PV systems, Maximum Power Point Tracking (MPPT) techniques, grid-connected and standalone systems	06	13
7.	**PV System Installation, Performance & Standards**: System sizing, performance parameters, testing and monitoring, PV system standards, safety and reliability issues	06	13
8.	**Applications, Economics & Future Trends:** PV applications (rooftop, utility scale, EV charging), energy storage integration, economics of PV systems, future trends in solar technology	07	15
	TOTAL	**45**	**100%**

List of Tutorial:

Sr. No	Name of Tutorial	Hours
1	Study of solar radiation parameters and basic photovoltaic system components.	02
2	Study of p–n junction behavior and demonstration of photovoltaic effect in a solar cell.	04
3	Performance analysis of different photovoltaic cell technologies and comparison of efficiencies.	04

4	Plotting and analysis of I–V and P–V characteristics of a photovoltaic cell under varying irradiance and temperature.	06
5	Study of photovoltaic modules and array configurations including series–parallel connections and shading effects.	06
6	Study of DC–DC converters and Maximum Power Point Tracking (MPPT) techniques used in photovoltaic systems.	02
7	Study of photovoltaic system installation, performance evaluation, standards, safety aspects and economic analysis.	06
	TOTAL	**30**

Text Book (s):

Title	Author/s	Publication
Solar Photovoltaics: Fundamentals, Technologies and Applications	Chetan Singh Solanki	PHI
Photovoltaic Systems Engineering	Roger A. Messenger & Jerry Ventre	CRC Press

Reference Book (s):

Title	Author/s	Publication
Handbook of Photovoltaic Science and Engineering	Antonio Luque & Steven Hegedus	John Wiley & Sons

Web Material Link(s):

- https://nptel.ac.in
- https://nitw.ac.in

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Exam.
- Viva/oral performance consists of 30 marks during End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEET2550	PHOTOVOLTAIC CELL TECHNOLOGY
CO 1	Understand solar energy fundamentals and the basic operation of photovoltaic cells.
CO 2	Explain semiconductor principles and photovoltaic effects used in solar cells.
CO 3	Analyze electrical characteristics and performance parameters of photovoltaic cells and modules.
CO 4	Design and evaluate photovoltaic modules, arrays and power conditioning systems with MPPT.
CO 5	Understand photovoltaic system applications, standards, economics and future trends in

	sustainable energy.

Mapping of CO with PO

SEET2550	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	2					2		1	1	1
CO 2	3	2						1			
CO 3	3	3		1							
CO 4	3	3	2		2						
CO 5	2	2	1		1		3	1	2		2

Mapping of CO with PSO

SEET2550	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	2	
CO 3	3	3	
CO 4	2	3	2
CO 5	2	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Introduction to Solar Energy & PV Systems	1
2	Semiconductor Physics for PV Cells	2
3	Photovoltaic Cell Technologies	2,4
4	Electrical Characteristics of PV Cells	2,4
5	PV Modules and Array Design	3,4
6	Power Conditioning & MPPT	4
7	PV System Installation, Performance & Standards	3,4
8	Applications, Economics & Future Trends	5,6

P P Savani University

School of Engineering

Department of Mechanical Engineering

Course Code: SEME2370

Course Name: Machine Drawing

Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	Theory	Practical	Tutorial	Total

				CE	ESE	CE	ESE	CE	ESE	
00	00	04	04	00	00	100	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Understand the Basic Concepts of Engineering Graphics and Machine Drawing.
- understand the industrial drawing.
- learn a machining and welding symbols.
- know the part and assembly drawings.
- know an application of screw threads, screw fasteners, welding and riveted joints.

List of Practical:

Sr No	Name of Tutorial	Hours
1.	Sheet of Machining Symbols and Surface Textures	06
2.	Sheet of Types of Screw Threads	06
3.	Drafting Exercise of Types of Nuts and Bolts	08
4.	Sheet of Types of Keys, Cotter and Knuckle Joint	08
5.	Sheet of Types of Riveted Joints, Welding Joints and Welding Symbols	04
6.	Sheet of Plummer Block or Pedestal Bearing	04
7.	Drafting Exercise of Part in Drafting software	15
8.	Parts designing using software tools	12
9.	Study of force analysis using software	12
10.	Assembly and disassembly of parts	10
	TOTAL	60

Text Book(s):

Title	Author/s	Publication
Machine Drawing	N. D. Bhatt, V. M. Panchal	Charotar Publishing House Pvt. Ltd.

Reference Book(s):

Title	Author/s	Publication
Machine Drawing	N. Sidheshwar, P. Kannaiah, V. V. S. Sastry	Tata McGraw Hill Publication

Web Material Links:

- https://nptel.ac.in/courses/112105294

Course Evaluation:

Practical:

- Continuous Evaluation consists of performance of practical which should be evaluated out of 10

marks for each practical and average of the same will be converted to 20 marks.

- Internal viva consists of 20 marks.
- Practical performance/quiz/drawing/test consists of 30 marks during End Semester Exam.
- Viva/Oral performance consists of 30 marks during the End Semester Exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME2370	MACHINE DRAWING
CO1	Illuminate machining and welding symbols and its representation in the industrial drawings.
CO2	Interpret and differentiate part and assembly drawing.
CO3	Explore various types of screw threads, screw fasteners, welding, riveted and pin joints and its applications.
CO4	Understand limit, fits and tolerance systems and its representation in drawings.
CO5	Discover the drafting software to create 2D and 3D geometry.

Mapping of CO with PO

SEME2370	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	3	3	2		3				3	
CO 2	2	3	3	3		3				3	
CO 3	2	3	3	3		3					
CO 4	2	3	3	3		3		3		3	
CO 5	2	3	3	3	3	3	1			3	

Mapping of CO with PSO

SEME2370	PSO1	PSO2	PSO3
CO 1	3	2	1
CO 2	3	2	
CO 3	2	2	
CO 4	2	2	
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Tutorial No	Content	RBT Level
1	Sheet of Machining Symbols and Surface Textures	1, 2,3
2	Sheet of Types of Screw Threads	1, 2, 3
3	Drafting Exercise of Types of Nuts and Bolts	1, 2, 3,4
4	Sheet of Types of Keys, Cotter and Knuckle Joint	1, 2,3,4

5	Sheet of Types of Riveted Joints, Welding Joints and Welding Symbols	1,2,3,4
6	Sheet of Plummer Block or Pedestal Bearing	1,2,3,4
7	Drafting Exercise of Part in Drafting software	1,2,3,4,5
8	Parts designing using software tools	1,2,3,4,5,6
9	Study of force analysis using software	1,2,3,4,5
10	Assembly and disassembly of parts	1,2,3,4