



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE100303

Course/Subject Name: Complex Variables and Applications

w.e.f.Academic Year:	2025-26
Semester:	3 rd Semester/ 2 nd Year
Category of the Course:	Basic Science Course

Prerequisite:	Geometry, trigonometry, calculus and ODE.
Rationale:	This subject is a powerful tool for solving a wide array of applied problem

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				100
L	T	P		Theory Marks		Practical Marks		
				E	M	I	V	
3	2	0	5	60	40	0	0	

Detailed Syllabus –

Unit	Content	Hours	% of Weightage
1	Polar Form of Complex Numbers, Powers and Roots, Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	12	29%
2	Complex Variable - Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Sequences, Series, Convergence Tests, Power Series, Functions Given by Power Series, Taylor and Maclaurin Series, Uniform Convergence.	8	19%
3	Laurent's series; Zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Residue Integration Method, Residue Integration of Real Integrals.	6	14%
4	First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method	6	14%
5	Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	10	24%
	Total Teaching Hours	42	100%



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	28	35	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Course Outcome: After Completion of the Course, Student will able to:

Co No.	Course Outcomes	RBT level
CO-1	Convert complex numbers to polar form, plot roots, find harmonic conjugate of analytic functions, and apply conformal mapping.	Apply
CO-2	Evaluate complex integrals, test convergence of series, and expand analytic functions in Taylor's series.	Analyze
CO-3	Find Laurent's series and poles, and apply Cauchy Residue Theorem to evaluate real integrals.	Analyze
CO-4	Form and solve first-order linear and nonlinear partial differential equations	Apply
CO-5	Solve higher-order PDEs and model real-world problems related to Heat, Wave, and Laplace equations.	Apply & Evaluate

CO-PO Mapping

PO \ CO	CO1	CO2	CO3	CO4	CO5
PO1 – Engineering Knowledge	3	3	3	3	3
PO2 – Problem Analysis	2	3	3	2	2
PO3 – Design/Development of Solutions	0	0	0	0	2
PO4 – Investigation of Complex Problems	1	2	2	2	3
PO5 – Modern Tool Usage	2	2	2	1	2
PO6 – The Engineer and Society	0	0	0	0	0
PO7 – Environment and Sustainability	0	0	0	0	0
PO8 – Ethics	0	0	0	0	0
PO9 – Individual and Team Work	0	0	0	0	0
PO10 – Communication	0	0	0	0	0



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Course/Subject Name: Complex Variables and Applications

PO11 – Project Management and Finance	0	0	0	0	0
PO12 – Life-long Learning	0	0	0	0	0

CO-PSO

CO \ PSO	PSO1 - Apply mathematical concepts to solve real-world engineering problems	PSO2 – Develop models and use simulation tools to analyze engineering systems
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	3

References/Suggested Learning Resources:

(a) Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
- Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
- Dennis G. Zill, 4th edition, Advanced Engineering Mathematics, 4th Edition, Jones and Bartlett Publishers.
- Dennis G. Zill, Patrick D. Shanahan, A First Course in Complex Analysis with Applications, Jones and Bartlett Publishers.
- S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
- Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill.
- J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill.

(b) Opensource software and website:

- MIT Open course ware. NPTEL.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE100301

Subject Name : Technical Writing & Communication Skills

w.e.f.Academic Year:	2025-26
Semester:	3rd
Category of the Course:	Social science

Prerequisite:	Humanities and Social Science
Rationale:	The rationale of the curriculum is to help students learn technical communication along with necessary moral and ethical dimensions of engineering.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				150
L	T	P		Theory Marks		Practical Marks		
				E	M	I	V	
2	0	2	3	60	40	20	30	

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	Dynamics of Communication: Definition and process, Kinesics, Proxemics, Paralinguistic features, Importance of Interpersonal and Intercultural Communication in today's organizations	6	15
2	Technical Writing: Report writing, Technical proposal, Technical description, Business letters (sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter), Agenda of meeting, Minutes of meeting, Resume writing	8	20
3	Technical Communication: Public speaking Group discussion Presentation strategies Interview skills Negotiation skills Critical and Creative thinking in communication	6	15



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

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Subject Code: BE100301

Subject Name : Technical Writing & Communication Skills

4	Ethics in Engineering: Scope of engineering ethics Accepting and sharing responsibility Responsible professionals and ethical corporations Resolving ethical dilemmas Making moral choices	4	15
5	Etiquettes: Telephone etiquettes Etiquettes for foreign business trips Visits of foreign counterparts Etiquettes for small talks, Respecting privacy Learning to say NO Time management	5	20
6	Self-development and Assessment: Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream	3	15
	Teaching hours	32	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Define and discuss dynamics of verbal and non-verbal aspects of communication.	Understand
CO2	Write various formal documents used in technical and professional communication.	Applying
CO3	Communicate effectively in diverse formal situations taking place in organizations.	Applying
CO4	Illustrate and examine the knowledge of ethical aspects related to engineering practice.	Analyze
CO5	Demonstrate and explain professional and social etiquettes.	Understand
CO6	Plan self-development activities and practice self-assessment for continuous personal and professional growth.	Create

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5	CO6
PO1 Engineering Knowledge	-	-	-	2	-	-
PO2 Problem Analysis	-	-	-	-	-	-
PO3 Design/Development of Solutions	-	-	-	-	-	-
PO4 Conduct Investigations of Complex Problems	-	-	-	-	-	-
PO5 Modern Tool Usage	-	2	2	2	-	2
PO6 The Engineer and Society	2	-	-	1	-	-
PO7 Environment and Sustainability	-	-	-	-	-	-
PO8 Ethics	-	-	-	3	3	2



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Subject Code: BE100301

Subject Name : Technical Writing & Communication Skills

PO9 Individual and Team Work	1	1	2	1	1	1
PO10 Communication	3	3	3	2	2	2
PO11 Project Management and Finance	-	1	2	-	-	2
PO12 Life-long learning	2	2	2	2	2	3

CO\PSO MATRIX

CO \ PSO	PSO1(Engineering Communication)	PSO2(Professional Ethics & Soft Skills)
CO1	2	3
CO2	3	2
CO3	3	3
CO4	2	3
CO5	1	3
CO6	2	3

Reference Books –

- Raman and Sharma, Technical Communications, OUP, New Delhi, 2017
- Lata and Kumar, Communication Skills, OUP, New Delhi, 2018
- Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014
- Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance, Pearson, UP, 2013
- Ramesh and Ramesh, The Ace of Soft Skills, Pearson, UP, 2019
- Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009

List of Exercise –

- Role Play
- Letter writing: Formal
- Group Discussion
- Presentations
- Book Review(Preferably related to self-development)
- Mock Interview
- Report writing
- Case studies related to unit 4, 5 and 6
- Conducting meetings and minutes of meeting



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Level: Degree

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Subject Code: BE100301

Subject Name : Technical Writing & Communication Skills

- Practical assessment

Open Sources –

- <https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases/>



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE100302

Subject Name : Indian Constitution

w.e.f.Academic Year:	2025-26
Semester:	3rd
Category of the Course:	Mandatory course

Prerequisite:	Zeal to learn the subject
Rationale:	The subject <i>Indian Constitution</i> aims to create awareness among students about the fundamental principles, values, and structure of the Indian democratic system. It helps learners understand their rights, duties, and responsibilities as citizens and professionals. By studying the Constitution, students develop a sense of legal literacy, national integrity, ethical values, and participation in democratic governance , which are essential for responsible and informed citizenship..

Faculty of Engineering (Degree)

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				50
L	T	P		Theory Marks		Practical Marks		
				E	M	I	V	
2	0	0	0	50	0	0	0	

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	Constitutional Framework: Meaning of the Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Salient Future of Constitution Preamble of Constitution, Schedules, National Symbols.	6	20
2	Fundamental Rights and Duties: Right to equality, Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational rights, Right to Property, Right to	6	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE100302

Subject Name : Indian Constitution

	constitutional remedies, Writs types The Scheme of the Fundamental Duties and its legal status		
3	Amendments of the Constitution and Emergency Provisions: Procedure for Amendment, Types of Amendment, The historical perspectives of the constitutional amendments in India National Emergency, President's Rule, Financial Emergency, Parliamentary Approval, and Duration	6	20
4	Central Government: Lok Sabha, Rajya Sabha, Duration of Two Houses, System of Elections of Lok Sabha and Rajya Sabha, Budget in Parliament, Constitution Powers and Status of the President of India, Supreme Court	6	20
5	Constitutional Bodies: Introduction, Power & Function of Election Commission, Union Public Service Commission, State Public Commission, Finance Commission, National Commission for SCs, National Commissions for STs, Comptroller and Auditor General of India, Attorney General of India, Advocate General of State	6	20
	Teaching hours	30	100

Course Outcomes –

CO No	Course Outcome Description	RBT Level
CO1	Enhance human values, understand law enactment, and appreciate the importance of the Constitution	Understand
CO2	Understand Fundamental Rights and Duties to develop morality, social values, dignity, and responsibilities	Understand
CO3	Create awareness of social issues and suggest suitable solutions by considering citizen rights and duties.	Applying
CO4	Understand the distribution of powers and functions of Local Self Government.	Understand
CO5	Understand the concept of National and Financial Emergency and their impact on the Indian economy	Understand

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Engineering Knowledge	-	-	-	-	-
PO2 Problem Analysis	-	-	-	-	-
PO3 Design/Development of Solutions	-	-	-	-	-



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE100302

Subject Name : Indian Constitution

PO4 Conduct Investigations of Complex Problems	-	-	-	-	-
PO5 Modern Tool Usage	-	-	-	-	-
PO6 The Engineer and Society	3	2	3	2	2
PO7 Environment and Sustainability	2	2	3	2	2
PO8 Ethics	2	3	2	2	2
PO9 Individual and Team Work	-	-	2	-	-
PO10 Communication	2	-	2	2	-
PO11 Project Management and Finance	-	-	-	-	-
PO12 Life-long learning	2	2	3	2	2

CO\PSO MATRIX

CO \ PSO	PSO1(Ethical and Civic Understanding)	PSO2(Professional and Social Responsibility)
CO1	3	2
CO2	3	3
CO3	3	3
CO4	2	3
CO5	2	2

- Enhance human values , create awareness about law enactment and importance of Consitution
- To Understand the Fundamental Rights and Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsibilities.
- Create Awareness of their Surroundings, Society, Social problems and their sutable solutions while keeping rights and duties of the citizen keeping in mind.
- Understand distribution of powers and functions of Local Self Government.
- Understand the National Emergency, Financial Emergency and their impact on Economy of the country.

Reference Books –

- Constitutional Law of India, Dr. J.N. Pandey, Central Law Agency
- Introduction to the Consitution of India, Durga Das Basu, LexisNexis.
- Indian Constitutional Law, M.P. Jain, LexisNexis
- V.N.Shukla's Constitution of India, Mahndra Pal Singh, Eastern Book Company
- Constitutional Law – I Structure, Udai Raj Rai, Eastern Book Company



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch:Electrical Engineering

Subject Code: BE100302

Subject Name : Indian Constitution



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

w. e. f. Academic Year:	2024-25
Semester:	3 RD / 2 ND
Category of the Course:	PCC

Prerequisite:	Knowledge of basic science
Rationale:	The course will provide an over view of the study of basic knowledge of various materials and their properties, commonly used for engineering applications applications. It also includes the various heat treatment processes and their practical applications. This course covers the importance of non-destructive testing methods to evaluate the properties and integrity of materials without causing any damage or altering their usefulness. It also involves the study of corrosion, including its principle, types and prevention techniques.

Course Outcomes:

Sr. No.	CO statement
CO-1	Understand the different types of engineering materials and their structure –property relationships.
CO-2	Examine the microstructure of metallic materials through phase diagrams and alter their microstructure and properties by applying various heat treatments.
CO-3	Understand the scope of different non-destructive testing methods and powder metallurgy.
CO-4	Interpret the causes of metallic corrosion and identify the methods for its prevention.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	60	40	30	20	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Material Science and Metallurgy: Basics of engineering materials, their classifications and application, Basics of advance engineering materials, Engineering requirements of materials, Properties of engineering materials, Criteria for selection of materials for engineering applications.	4	9
2	Crystal Geometry and Crystal Imperfection: Unit cell, Crystal structure, Bravais lattice, atomic packing factor, coordination number, Metallic crystal structures- SC, BCC, FCC and HCP, crystal directions and planes, Miller indices, Imperfections in crystals and their effect on properties, Solute strengthening.	6	14
3	Solidification and Theory of Alloys: Solidification of metals and an alloy, Crystallization: Mechanism of crystallization - nucleation and growth, factors influencing nucleation and growth, Solid solutions and compounds, Hume-Rothery rules; Cooling curves, lever-arm principle.	4	9
4	Phase Diagrams: Systems, phases and phase rule, structural constituents, Gibb's phase rule. Binary equilibrium phase diagrams, Allotropy of iron; Iron-iron carbide equilibrium diagram with different reactions like eutectic, eutectoid and peritectic. Constituents, microstructures and properties of plain carbon steels. Alloy groups (Pig Iron, Wrought Irons, Steels and Cast Irons) of Iron-Iron Carbide equilibrium system and their characteristics in general. Equilibrium cooling of eutectoid, hypoeutectoid and hypereutectoid steels, their resultant microstructures and hence correlated properties and applications. IS and ISO Codification, Different specifications and designations of steels.	8	17
5	Non-ferrous Metal and Alloys: Introduction, properties and application of aluminium, copper, magnesium, titanium, nickel and their alloys.	4	9
6	TTT diagram and Heat Treatment of Steel: Time-Temperature-Transformation Diagram, Isothermal and continuous transformations. Study of heat treatment processes such as annealing, normalizing, hardening, tempering, carburizing, nitriding, cyaniding, induction hardening and flame hardening. Hardenability of	7	15



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

	steel. Application of above processes to machine components and mechanical equipments such as gears, shaft bearings, turbine blades, crank shafts, pistons etc.		
7	Powder Metallurgy: Introduction, advantages, disadvantages and applications of powder metallurgy, production of powder, compacting, sintering.	3	7
8	Non Destructive Testing: Non Destructive testing of materials such as Visual inspection, Dye Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography Testing, Eddy current testing with their principles, relative merits, demerits and applications.	4	9
9	Corrosion of Metal And Alloys: Principle of corrosion, types of corrosion, corrosion prevention techniques.	3	7
10	Metallography: Structure of Metals, Macro-examination: Macro-etching; Microscopic examinations: Specimen Preparation, etching, Spark Test, Sculptures Print, Magnetic Testing, Chemical analysis of steel and iron for Carbon, Sulphur & Phosphorous.	*	4
	Total	42	100

* Topic should be cover during laboratory session only.

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	10	26	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create
(as per revised Bloom's Taxonomy)



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Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

Course Outcomes:

Sr. No.	CO statement
CO-1	Understand the different types of engineering materials and their structure –property relationships.
CO-2	Examine the microstructure of metallic materials through phase diagrams and alter their microstructure and properties by applying various heat treatments.
CO-3	Understand the scope of different non-destructive testing methods and powder metallurgy.
CO-4	Interpret the causes of metallic corrosion and identify the methods for its prevention.

Program Specific Outcomes (PSOs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions
PO4	Conduct investigations
PO5	Modern tool usage
PO6	Engineer and society
PO7	Environment and sustainability
PO8	Ethics
PO9	Individual and teamwork
PO10	Communication
PO11	Project management
PO12	Life-long learning



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

CO-PO MAPPING:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6 - PO12
CO1	3	2				
CO2	3	3		2	2	
CO3	2	2		2	3	PO12 2
CO4	2	3			2	PO7 3
CO1	3	2				

Program Specific Outcomes (PSOs)

PSO No.	PSO Description
PSO1	Apply knowledge of materials science and mechanical engineering to solve industrial and research problems.
PSO2	Use modern engineering tools and techniques for the analysis, design, and manufacturing of engineering components.

CO-PSO Mapping Table

CO \ PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	3
CO5	2	2

References/Suggested Learning Resources:

(a) Books:

1. Materials Science and Engineering: An Introduction: William D Callister and David G. Rethwisch, 10th edition, 2020.
2. Elements of Material Science and Engineering, Lawrence H. Van Vlack, Pearson Education.



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Program Name: Engineering

Level: UG

Course / Subject Code : BE101301

Course / Subject Name : Material Science and Metallurgy

3. The Science and Engineering of Materials Donald R. Askeland and Pradeep P. Phule, Cengage Learning.
4. Material Science and Metallurgy by G. H. Upadhyay, Atul Prakashan.
5. Introduction to Physical Metallurgy, Sydney H. Avner, Tata McGraw-Hill.
6. Practical Non-Destructive Testing, Baldev Raj, T. Jayakumar and M. Thavasimuthu, Narosa Pub. House.
7. Corrosion Engineering, Mars G. Fontana, McGraw Hill Education India.
8. ASM Handbook Vol. 9: Metallography and Microstructure, Ed. George F. Vander Voort, ASM International 2004.
9. <https://nptel.ac.in/course.php>

(B) List of Open Source Software/learning website:

<https://archive.nptel.ac.in/courses/113/106/113106032/>
<https://archive.nptel.ac.in/courses/113/102/113102080/>
<https://archive.nptel.ac.in/courses/113/107/113107078/>

Suggested Course Practical List:

1. To understand the concept of crystal planes and directions: a) To determine the coordination number (CN), Atomic Packing Factor (APF) and Effective number of atoms per unit cell for SC, BCC, FCC, and HCP structures.
b) To draw the crystal planes and directions in a unit cell.
2. To get acquainted with the operation, construction, use and capabilities of a metallurgical microscope.
3. To perform specimen preparation for microscopic examination and gain a deeper understanding of the specimen preparation process.
4. To examine different ferrous microstructures and identify the micro-constituents and phase present in a specimen.
5. To examine different non-ferrous microstructures and identify the micro-constituents and phase present in a specimen.
6. To learn different heat treatment processes- annealing, normalizing, hardening and tempering to improve properties of steel during processes and applications.
7. To observe the effect of different quenching media (Oil, Water and Brine) on the hardness of medium/high carbon steel specimen.



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Course / Subject Name : Material Science and Metallurgy

8. To determine the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section.
9. To understand the procedure of testing, nature of indication, the capability and sensitivity of the liquid penetrant test.
10. To understand the procedure of testing, nature of indication, the capability and sensitivity of the magnetic particle test.

List of Laboratory/Learning Resources Required:

1. Metallurgical microscope with computerized image analysis system
2. Standard specimen set of steel
3. cast iron and non- ferrous metals and alloys
4. Spectrometer
5. Muffle furnace
6. standard specimens of steels and cast iron for heat treatment
7. Hardness tester
8. Universal tensile testing machine



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Course / Subject Name : Material Science and Metallurgy

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11. To understand the procedure of testing, nature of indication, the capability and sensitivity of Ultrasound test.
 12. To identify the different types of material through spark test.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

w. e. f. Academic Year:	2023-24
Semester:	3 rd sem/ 2 nd year
Category of the Course:	PCC

Prerequisite:	Zeal to learn the subject
Rationale:	Engineering Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer. It is based on certain laws of nature which are never seen to be violated.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE(V)	
4	0	2	5	60	40	20	30	150

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	First Law and Second Law of Thermodynamics: <ul style="list-style-type: none"> First law for a closed system undergoing a cycle (Joule's experiment) and change of state, Internal energy- a property of the system, PMM1, first law applied to non-flow systems, f irst law of thermodynamics for steady flow process, Steady flow energy equation applied to nozzle, diffuser, heat exchangers, turbine, pump, compressor, throttling process, Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalency, PMM2, Causes of irreversibility, Carnot theorem, Corollary of Carnot theorem. 	9	20
2.	Entropy and Exergy: <ul style="list-style-type: none"> Introduction of entropy, Entropy generation in daily life, Clausius theorem, Clausius inequality, Entropy - A property of system, Entropy changes of non-flow processes, Increase of entropy principle, The statement of third law of thermodynamics, Introduction of exergy, Available energy referred to a cycle, Exergy destruction in heat transfer process, Exergy of closed and open system, irreversibility and Gouy-Stodola theorem, second law efficiency. 	10	20
3.	Gas Power Cycles: <ul style="list-style-type: none"> The air standard cycle assumptions, Air standard efficiencies of Otto, Diesel and Dual cycle, Comparison of gas power cycles, Ideal and actual Brayton cycle, Methods for improvement of thermal efficiency of open cycle gas turbine plant. 	9	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

4.	Vapour Power Cycles: <ul style="list-style-type: none"> Carnot vapor cycle, Rankine cycle, Comparison of Carnot and Rankine cycle, Calculation of cycle efficiencies, Variables affecting efficiency of Rankine cycle, Reheat cycle, Regenerative cycle with open and closed feed water heaters. 	9	20
5	Combustion and Thermodynamic Relations: <ul style="list-style-type: none"> Combustion equations, stoichiometric air-fuel ratio, enthalpy of formation, adiabatic flame temperature, determination of calorific values of fuels, calorimeter: Bomb and Junker's gas calorimeter, Equation of state, Ideal gas and real gas behaviour, Joule's law, Avogadro's law, Vander Waal's equation, Helmholtz and Gibb's function, First and second TdS equation, Maxwell relations, Clapeyron equation, Joule-Thomson coefficient. 	8	20
Teaching hours		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	10	26	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
CO1	Identify the vocabulary and basic concepts of thermodynamics.	Understand
CO2	Apply the first and second laws of thermodynamics to closed and open systems.	Apply
CO3	Apply entropy and exergy concepts to thermodynamic processes.	Apply
CO4	Analyze gas power, vapor power, and refrigeration cycles.	
CO5	Perform basic calculations related to combustion.	Apply



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions
PO4	Conduct investigations of complex problems
PO5	Modern tool usage
PO6	The engineer and society
PO7	Environment and sustainability
PO8	Ethics
PO9	Individual and teamwork
PO10	Communication
PO11	Project management and finance
PO12	Life-long learning

CO-PO Mapping Table

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6 - PO12
CO1	3	2	-	-	-	-
CO2	3	3	2	-	-	-
CO3	3	3	-	2	-	-
CO4	3	3	2	3	-	-
CO5	2	2	-	2	2	-

Program Specific Outcomes (PSOs)

PSO No.	PSO Description
PSO1	Apply mechanical engineering principles for thermal, design, and manufacturing applications.
PSO2	Use modern engineering tools and computational techniques in mechanical system modeling.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

CO-PSO Mapping Table

CO \ PSO	PSO1	PSO2
CO1	3	
CO2	3	2
CO3	2	3
CO4	3	2
CO1	3	

References/Suggested Learning Resources:

(a) Books:

1. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Fundamentals of Thermodynamics by Borgnakke & Sonntag, 7th Ed. Wiley India (P) Ltd.
3. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education
4. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.
5. Engineering Thermodynamics by Krieth, CRC Press
6. Engineering Thermodynamics by Jones and Dugan, PHI Learning Pvt. Ltd.

(b) Open source software and website:

1. <https://nptel.ac.in/course.php>

Suggested Course Practical List:

1. To verify First and Second Law with Mechanical Heat Pump
2. To verify First and Second Law with I.C. Engine
3. To determine heat loss from pipe-in-pipe heat exchanger using SFEE and to verify entropy principle for the heat exchanger.
4. To understand applications of SFEE
5. To understand applications of entropy principle and Gouy-Stodola theorem
6. To compare Otto, Diesel and Dual cycles
7. To study variables affecting the performance of Rankine cycle
8. To understand different components of VCR system and to determine its COP
9. To understand the effect of various operating parameters on performance of VCR cycle.
10. To find out the calorific value of given fuel with the help of Oxygen Bomb calorimeter.
11. To find out the calorific value of given fuel with the help of Junker gas calorimeter



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE101302

Course/Subject Name: Engineering Thermodynamics

List of Laboratory/Learning Resources Required:

1. Mechanical Heat Pump
2. Internal combustion engine
3. Heat exchanger
4. Vapor compression test rig
5. Bomb calorimeter
6. Junker gas calorimeter

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SWAMINARAYAN UNIVERSITY

Program Name:

ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

w. e. f. Academic Year:	2024-25
Semester:	3 RD /2 ND YEAR
Category of the Course:	PCC

Prerequisite:	Knowledge of basic science
Rationale:	The course will provide an over view of the study of basic knowledge of various materials and their properties, commonly used for engineering applications applications. It also includes the various heat treatment processes and their practical applications. This course covers the importance of non-destructive testing methods to evaluate the properties and integrity of materials without causing any damage or altering their usefulness. It also involves the study of corrosion, including its principle, types and prevention techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	60	40	30	20	150



SWAMINARAYAN UNIVERSITY

Program Name:

ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction of Mechanisms and Machines: Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, Mobility and range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion, straight line mechanisms.	8	15
2	Graphical and Analytical Linkage Synthesis: Synthesis, Function, Path, and Motion Generation, Dimensional synthesis (Graphical): Two position synthesis, Three Position synthesis, Coupler curves, Position Analysis : Graphical position analysis of linkages, Algebraic position analysis of linkages, Four bar slider crank position solution, Two position motion generated by analytical synthesis, Three position motion generated by analytical synthesis.	10	20
3	Velocity and Acceleration Analysis: Graphical and analytical velocity analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Instant centers of velocity, Graphical and analytical acceleration analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Graphical velocity and acceleration analysis of quick return mechanisms.	10	20
4	Cams: Types of cams, Types of followers, Follower displacement programming, Derivatives of follower Motion, Motions of follower, Layout of cam profiles.	5	10
5	Belt, Ropes and Chains: Types of belt drive, Velocity ratio, Slip, Pulley arrangement, Length of belt, Law of belting, Ratio of friction tension, Power transmitted, Centrifugal effects on belts, Maximum power transmitted, Creep, Chains, Chain length, Angular speed ratio, Classification of chain.	5	10
6	Friction, Clutch and Brake: Introduction to friction, Law of friction, Coefficient of friction, Inclined plane, Pivot and Collars, Friction clutches, Rolling Friction, Types of brakes, Block and	6	10



SWAMINARAYAN UNIVERSITY

Program Name:
ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

	Shoe brakes, Differential band brake, Internal expanding shoe brake, Braking effect in vehicle.		
7	Gears and Gear Trains: Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur, helical, spiral bevel and worm gears, problems. Gear Trains: Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	8	15
	Teaching hours	52	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	10	26	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
CO-1	Understand basic structure and elements of machines.	Understand
CO-2	Identify functional characteristics of various machine elements.	Apply
CO-3	Synthesize various mechanisms based on position, velocity and acceleration requirement.	Apply
CO-4	Determine position, velocity and acceleration of linkages in mechanism at any instant.	Apply



SWAMINARAYAN UNIVERSITY

Program Name:

ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions
PO4	Conduct investigations of complex problems
PO5	Modern tool usage
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CO2	3	3	2	-	-	-
CO3	2	2	3	3	2	-
CO4	3	3	2	3	3	-
CO1	3	2	-	-	-	-

Program Specific Outcomes (PSOs)

PSO No.	PSO Description
PSO1	Apply mechanical engineering principles to design and analyze mechanical systems.
PSO2	Use modern tools and simulation software for solving real-life mechanical problems.



SWAMINARAYAN UNIVERSITY

Program Name:

ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

CO-PSO Mapping Table

CO \ PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	3

References/Suggested Learning Resources:

(a) Books:

1. Theory of Machines, Rattan S S, Tata McGraw-Hill
2. Theory of Machines and Mechanisms, Uicker J J Jr., Pennock G R, Shigley J E, Oxford Press.
3. Kinematics and Dynamics of Machinery, Norton R L, McGraw-Hill
4. Mechanism and Machine Theory, Ambekar, A G, Prentice Hall
5. Theory of Machines, Singh Sadhu, Pearson Education.

(b) Open source software and website:

1. <https://nptel.ac.in/courses/112104121/>

Suggested Course Practical List:

1. Drawing work related to inversion of four bar mechanism and slider and crank mechanism.
2. Drawing work related to velocity and acceleration diagram of various mechanisms.
3. Drawing work related to cam profile.
4. Drawing work and computation related to synthesis.
5. Computerised Synthesis.
6. Analysis related to belt, rope, and chain drive.
7. Analysis related to brakes, and clutches.
8. Analysis related to gears and gear train



SWAMINARAYAN UNIVERSITY

Program Name:

ENGINEERING

Level: Degree

Course/ Subject Code: BE101303

Course/Subject Name: Kinematics and Theory of Machines

List of Laboratory/Learning Resources Required:

1. Drawing hall facility
2. Models of different mechanisms like four bar mechanism, quick return mechanisms, mechanisms with lower pairs and machine elements like belt, pulley, gear, gear train and cams



Swaminarayan University

Teaching & Examination Scheme
Course – Faculty of Engineering (Degree)
Branch – Mechanical Engineering
Semester – 3rd

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100301	Technical Writing & Communication Skills	Humanities and Social Science	2	0	2	3	60	40	20	30	150
BE100302	Indian Constitution	Mandatory	2	0	0	0	50	0	0	0	50
BE100303	Complex Variables and Applications	Basic Science	3	2	0	5	60	40	0	0	100
BE101301	Material Science and Metallurgy	Engineering Science	3	0	2	4	60	40	20	30	150
BE101302	Engineering Thermodynamics	Professional Core	4	0	2	5	60	40	20	30	150
BE101303	Kinematics and Theory of Machines	Professional Core	4	0	2	5	60	40	20	30	150
	Total		18	2	8	22					

L=Lecture, T=tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External