



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101701

Course / Subject Name : Power Plant Technology

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PC

Prerequisite:	Thermodynamics & Heat Transfer
Rationale:	Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance and to address the underlying concepts, methods and application of different Thermal Power Plants.

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		
				(E)	(M)	(I)	(V)	
3	0	0	3	60	40	00	00	100



SWAMINARAYAN UNIVERSITY

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Coal Based Thermal Power Plant: Layout of modern coal power plant, site selection criteria, Rankine cycle and its improvisations, Supercritical, High Pressure Boilers, FBC Boilers, Steam Nozzles, Steam Turbines, Steam Condensers, Cooling Towers, Steam & Heat rate, Combined Cycle Power Plant: Binary Cycles and Cogeneration systems. Subsystems of thermal power plants – Draught system, Fuel and ash handling, Feed water treatment,	14	20
2	Gas Turbine Power Plant: Classification, Open and closed cycle, Gas turbine fuels, Actual Brayton cycle, Optimum pressure ratio for maximum thermal efficiency, Work ratio, Air rate, Effect of operating variables on the thermal efficiency and work, Cooling of gas turbine blade, Combined steam and gas turbine plant.	10	25
3	Nuclear Power Plant: Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Brief about the Nuclear program in India, Safety measures for Nuclear Power plants	8	10
4	Power from Renewable Energy: Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photovoltaic (SPV), Solar Thermal, Geothermal and Fuel Cell power systems.	8	25
5	Energy, Economic and Environmental issues of Power plants: Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants	5	20
	Total	45	100



SWAMINARAYAN UNIVERSITY

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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
20	25	15	-	-	-

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
1	Explain the layout, construction and working of the components of thermal, Diesel, Gas and Combined cycle power plants.	Understand
2	Explain the layout, construction and working of the components of Nuclear power plants.	Apply
3	Explain the layout, construction and working of the components of Renewable Energy power plants.	Apply
4	Explain the applications of power plants while extending their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations
PO5	Modern tools
PO6	Engineer and society
PO7	Environment & sustainability
PO8	Ethics
PO9	Individual & teamwork
PO10	Communication



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101701

Course / Subject Name : Power Plant Technology

PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	1	-	-	-	-	1
CO2	3	2	2	2	1	2	2	1	-	-	-	1
CO3	3	2	2	2	2	3	3	1	-	-	-	1
CO4	3	3	3	2	2	3	3	2	1	1	1	2

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply fundamental concepts of mechanical engineering to solve power plant problems.
PSO3	Design, analyze and evaluate performance of thermal and renewable power systems.
PSO2	Demonstrate awareness of energy economics, environmental impact and sustainable practices.

CO-PSO Mapping Table

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

References/Suggested Learning Resources:

(a) Books:

1. Power Plant Engineering, P.K. Nag, McGraw-Hill Education
2. Power Plant Technology, M.M. El-Wakil, McGraw-Hill Education
3. Thermal Engineering, R.K. Rajput, Laxmi Publication
4. Gas Turbines by V. Ganeshan, McGraw Hill Education
5. Steam Turbine Theory and Practice, William J. Kearton, CBS Publication



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101701

Course / Subject Name : Power Plant Technology

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List: NIL

List of Laboratory/Learning Resources Required: NIL

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Program Name: Engineering

Level: UG

Course / Subject Code : BE101701

Course / Subject Name : Power Plant Technology



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PC

Prerequisite:	Thermodynamics & Heat Transfer
Rationale:	The course aims to impart basic skills of force and stress analysis for design of machine elements

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Design Considerations - Standardization, Preferred numbers, Tolerances and Fits, Ergonomics, System design, Manufacturing considerations.	2	10
2	Design of Coupling - Types of coupling, Design of Muff coupling, Clamp coupling, Rigid flange coupling and Bush pin type flexible coupling	4	12
3	Spring - Types of spring, Stress and deflection equations, Design of helical spring, Concentric springs, Design of Multi-leaf spring	5	12
4	Pressure vessels - Thin cylinder, Thin spherical vessels, Thick cylinders, Lamé's equation, Clavarino's and Birnie's equations, Cylinder with external pressure, Autofrettage, Compound cylinder.	5	10
5	Rolling contact bearings** - Types of rolling-contact bearings, Selection of bearing type, Static load carrying capacity of bearing, Dynamic load carrying capacity of bearing, Equivalent bearing load, Load-life relationship, Selection of bearing from manufacturer's catalogue, Bearing with probability of survival other than 90 percent, Design for cyclic load	4	10
6	Sliding contact bearings** - Basic mode of lubrication, Measurement of viscosity, Viscosity index, Petroff's equation, McKee's equations, Interpretation of Reynold's equation, Difference between hydrodynamic and hydrostatic bearing, Performance parameters for journal bearings, Bearing design – selection of parameters for journal bearing	4	12
7	Design of gear drives (Spur, Helical, Bevel and Worm)** - Classification of gears, Selection of type of gears, Standard system of gear tooth, Force analysis, Gear tooth failures, selection of material, Beam strength of gear tooth, Wear strength of gear tooth, Virtual number of teeth, Thermal considerations for worm gear.	10	20
8	Speed Gear box - Various laws of stepped Regulation, Standard values of G. P. ratio and guidelines for selecting a proper value, Break up of speed steps, Structural diagram and their analysis to select the best possible version, Speed chart, and General recommendations for developing the gearing diagram, Determine the no. of teeth of gear.	6	10



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Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements

9	Design of Mechanisms - Valve gear mechanism for IC engine, Hoisting tackle analysis, Wire rope design ,Crane hook Assembly	7	08
	Teaching hours	47	

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	15	-	-	-

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
1	Relate various standard used in industry and utilize knowledge of manufacturing process in design of machine elements.	Understand
2	Determine forces acting on machine elements like couplings, springs, gears, bearings and perform stress analysis for machine components.	Apply
3	Estimate life of rolling element bearings and determine performance parameters of sliding contact bearings.	Apply
4	Evaluate speed variation on gear box shafts and optimize fluctuation of shaft speeds in gear box	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations
PO5	Modern tools
PO6	Engineer and society
PO7	Environment & sustainability



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements

PO8	Ethics
PO9	Individual & teamwork
PO10	Communication
PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	1	1	-	-	1	2	2
CO2	3	3	3	3	2	1	1	-	-	-	1	2
CO3	3	2	2	2	2	1	1	-	-	-	1	2
CO4	2	3	3	3	3	1	-	-	-	1	2	2

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply fundamental concepts of mechanical engineering to solve power plant problems.
PSO2	Design, analyze and evaluate performance of thermal and renewable power systems.
PSO3	Demonstrate awareness of energy economics, environmental impact and sustainable practices.

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2

References/Suggested Learning Resources:

(a) Books:

1. Design of Machine Elements, V B Bhandari, 3/e, Tata McGraw Hill.
2. A Textbook of Machine Design, P C Sharma and D K Aggarwal, S K Kataria & sons.
3. Shigley's Mechanical Engineering Design, R G Budnyas, J K Nisbett, McGraw Hill.
4. Fundamentals of Machine Component Design, R C Juvinall, 4/e, Wiley.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements

5. Machine Design: An Integrated Approach, R L Norton, Pearson
6. Machine Tool Design and Numerical Control, N K Mehta, Tata McGraw Hill Edu.

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. Experiments should cover all topics discussed in subject content. Like.
2. Design of rigid and flexible couplings.
3. Design of helical and leaf springs.
4. Design of two stage gear box including gear design, bearing selection.
5. Design of pressure vessels

List of Laboratory/Learning Resources Required:

1. Computational facility.

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101702

Course / Subject Name : Design of Machine Elements



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PC

Prerequisite:	NIL
Rationale:	The course is designed to give fundamental knowledge of types of refrigeration, refrigeration cycles, refrigerants and their behavior under various conditions, air conditioning load calculation and designing of components of air distribution system.

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction and Refrigerant: Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, types and application of refrigeration and air condensing systems, Recapitulation of desirable properties of refrigerants, secondary refrigerants, future industrial refrigerants	4	10
2	Air refrigeration: Aircraft refrigeration, working and analysis of Simple, Bootstrap, Reduced ambient and Regenerative air refrigeration systems	5	12
3	Compound Compression VCR system: Multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system	7	12
4	Absorption refrigeration system: Practical H ₂ O -NH ₃ cycle, LiBr – H ₂ O system and its working, h-x diagram and simple calculation of various process like adiabatic mixing and mixing with heat transfer, throttling.	6	10
5	Refrigeration system components: Types, construction, working, comparison and selection of compressors, condensers, expansion devices and evaporators; refrigeration piping accessories, evacuation and charging of refrigerant, properties and classification of thermal insulation	4	10
6	Human comfort and Load analysis: Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions Site survey, outdoor and indoor design conditions, classification of loads, flywheel effect of building material and its use in design, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL) heat transmission through sunlit and shaded glass using tables, method of reduction of solar heat gain through glass, calculations of cooling load TETD due to sunlit and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants; electric lights; product; electric motor and appliances, load calculations for automobiles, use of load estimation sheet	9	12
7	Duct design and air distribution: Function; classification and economic factors influencing duct layout, equal friction, velocity reduction and static regain methods of duct design, use of friction chart, dynamic losses and its determination, Requirements of air distribution system, air distribution, grills, outlets, application, location	6	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning

8	Air-conditioning systems: Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems	4	14
	Teaching hours	45	

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	15	-	-	-

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
1	To select proper refrigerant for various applications and make basic calculations of aircraft refrigeration.	Understand
2	To analyze multi-evaporator systems and simple vapor absorption systems.	Apply
3	To explain construction and working of different refrigeration system components.	Apply
4	To solve air-conditioning load calculations for buildings and automobiles	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations
PO5	Modern tools
PO6	Engineer and society



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning

PO7	Environment & sustainability
PO8	Ethics
PO9	Individual & teamwork
PO10	Communication
PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	2	-	-	-	-	2
CO2	3	3	2	3	2	-	2	-	-	-	-	2
CO3	3	2	2	2	2	-	1	-	-	-	-	2
CO4	3	3	3	2	2	1	2	-	-	1	-	2

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply thermal and fluid sciences to HVAC&R systems.
PSO2	Analyze and design refrigeration and air-conditioning systems using practical and analytical approaches.
PSO3	Demonstrate environmental and energy-efficiency awareness in refrigeration system selection and design.

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	2	1
CO4	3	3	2

References/Suggested Learning Resources:

(a) Books:

1. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
2. Refrigeration and Air-conditioning by Ramesh Arora, Prentice Hall of India
3. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning

4. ASHRAE Handbook – Fundamentals 2017, ASHRAE Automobile Air conditioning by Crouse and Anglin, McGraw Hill McGraw Hill Edu.

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. To analyze multi-evaporator systems with different configurations.
2. To analyze cascade refrigeration system.
3. To analyze NH₃-H₂O system for specific application.
4. To analyze LiBr-H₂O system for specific application.
5. To understand construction and working of reciprocating, rotary and centrifugal compressor used for R&AC.
6. To understand various tools used for refrigeration tubing and to perform various operations like flaring, swaging, bending, brazing etc.
7. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.
8. To design duct layout of the confined space selected for above.
9. To select and analyze proper air-conditioning system for the confined space selected above.
10. To calculate cooling load of an automobile.

List of Laboratory/Learning Resources Required:

1. cut-sectional models of various types of compressors, condensers and evaporators used in R&AC industry
2. thermostatic expansion valve
3. automatic expansion valve
4. capillary tubes, tools for refrigeration tubing.

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101703

Course / Subject Name : Refrigeration and Air-conditioning



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PE

Prerequisite:	Professional Elective
Rationale:	The aim of present course is to introduce the students about the basic automation theory and understanding of its devices. Students can think and get innovative idea in the area of shop floor automation. This subject is useful to understand the different types of automation and production system used in industries

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction: Automation and types, Automated Manufacturing System, Reasons for Automating, the USA Principle, Strategies for automation and process improvement, automation migration strategies, levels of automations, Types of Automations.	4	5
2	GROUP TECHNOLOGY: Part family, Part classification and coding, production flow analysis – OPITZ classification system, cellular manufacturing, quantitative analysis in cellular manufacturing. Rank Order Clustering Technique (ROC), Holier Method –I,II, Single Linkage Cluster Analysis Technique(SLCA). Application of group technology	6	15
3	Flexible Manufacturing Systems: Types of flexibility, types of FMS, FMS components, FMS Components-Workstations, Material Handling and Storage Systems, Computer Control System, Human Recourses, FMS Applications and Benefits., Quantitative analysis of FMS, Sizing the FMS, System performance measure. Automated Material Handling & Storage: Functions, Types, Analysis of material handling equipment, Design of Conveyor & AGV systems. Problems. Development for total material handling system.	8	20
4	Pneumatic and Hydraulic System Design: Introduction, pneumatics and hydraulic system components, pneumatics and hydraulic actuators, application of pneumatics and hydraulic system in automation, pneumatics and hydraulic circuit design for automation, limitations of pneumatics and hydraulic system.	8	20
5	Industrial Robotics and Mechatronics System: Introduction, Robot Anatomy and Related Attributes, Robot Control Systems, End Effectors, Sensors in Robotics, Industrial Robot Applications, Robot Programming overview. Transducers, Sensors and Actuators: Classification, Principle of Operation, Selection Criteria, Signal Conditioning, Calibration	4	5
6	Automated Machinery: Introductions, Automated transfer machine, automated transfer line, auto-storage and retrieval system, automated guided vehicles, automated material handling system, automated inspection system and CMM.	6	15



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing

7	Modular Automation Design: Introduction to modular design, modular automations, Case study for modular design: 1. Casting shop design, 2. Press working shop design, 3. Machine shop design	4	05
8	Automation Economy: Plant Economy, feasibility of automation on economical sense, effect of automation on economy, feasibility of automation in Indian market, Scope of automation in Indian industries, Break Even point analysis for automation	5	05
	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
20	25	15	-	-	-

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
1	Overall understanding of automated systems integration using CIM	Understand
2	Identify scope of automation in shop floor: Casting, Machine shop and Press work	Apply
3	Understand working of different sensors and actuator and find application for industrial automation	Apply
4	Design small automated system	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing

PO4	Conduct investigations
PO5	Use of modern tools
PO6	Engineer and society
PO7	Environment and sustainability
PO8	Ethics
PO9	Individual and teamwork
PO10	Communication
PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	-	-	-	-	2
CO2	3	3	2	2	2	1	2	-	-	-	-	2
CO3	3	2	2	2	3	1	1	-	-	-	-	2
CO4	3	3	3	3	3	-	1	-	1	1	2	3

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply manufacturing principles and automation tools to design and optimize processes.
PSO2	Integrate sensors, actuators, and control systems into automated industrial applications.
PSO3	Demonstrate practical ability to implement and manage small-scale industrial automation systems

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing

References/Suggested Learning Resources:

(a) Books:

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover, P.H.I. Learning Private Limited.
2. Hydraulics and Pneumatics by Andrew Parr, JAICO Publishing Home, Ahmedabad
3. Industrial Automation and Robotics by Er. A. K. Gupta and S. K. Arora, University Science Press, Laxmi Publishing Pvt. Ltd.
4. Robotics and Control by R. K. Mittal and I. J. Nagrath, McGraw Hill Education (India) Private Limited.

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. To study the fundamentals of automation and its types.
2. Study and report on Pneumatic Automation system.
3. Study and report on Hydraulic Automation system.
4. Study and report on micro controller and its application.
5. Study and report on Industrial Robotics: Sensors and Actuators
6. Study and report on Different Automated Machinery
7. Study and report on Modular Automation System: Casting shop, Machine shop, Press Shop
8. Study and report on Economic analysis of Automation

List of Laboratory/Learning Resources Required: NIL

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101704

Course / Subject Name : Automation in Manufacturing



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101705

Course / Subject Name: Finite Element Methods

w. e. f. Academic Year:	2023-24
Semester:	7 th
Category of the Course:	Professional Elective - 6

Prerequisite:	NIL
Rationale:	The course aims to impart basic skills of formulation and application of finite element methods for the analysis of mechanical systems.

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit	Content	Hours	% of Weightage
1	Fundamental Concepts Introduction, Stresses and Equilibrium, Boundary Conditions, Strain—Displacement Relations, Stress—Strain Relations, Temperature Effects, Potential Energy and Equilibrium: The Rayleigh—Ritz Method, Potential Energy, Rayleigh—Ritz Method, Galerkin's Method, Saint Venant's Principle, Von Mises Stress, Principle of Superposition, Matrix Algebra and Gaussian Elimination, Conjugate Gradient Method for Equation Solving, Conjugate Gradient Algorithm.	5	20
2	One-Dimensional Problems Introduction, Finite Element Modeling, Element Division, Numbering Scheme, Shape Functions and Local Coordinates, The Potential-Energy Approach, Element Stiffness Matrix, Force Terms, The Galerkin Approach, Element Stiffness, Force Terms, Assembly of the Global Stiffness Matrix and Load Vector, Properties of K, The Finite Element Equations: Treatment of Boundary Conditions, Types of Boundary Conditions, Elimination Approach, Penalty Approach, Multipoint Constraints, Quadratic Shape Functions Temperature	9	10



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101705

Course / Subject Name: Finite Element Methods

सर्व विद्या अधिपतये

	Effects, Problem Modeling and Boundary Conditions, Problem in Equilibrium, Symmetry, Two Elements with Same End Displacements, Problem with a Closing Gap		
3	Trusses Introduction, Plane Trusses, Local and Global Coordinate Systems, Formulas for Calculating I and m, Element Stiffness Matrix, Stress Calculations, Temperature Effects, Three-Dimensional Trusses, Assembly of Global Stiffness Matrix for the Banded and Skyline Solutions, Assembly for Banded Solution, Skyline Assembly, Problem Modeling and Boundary Conditions, Inclined Support in Two Dimensions, Inclined Support in Three Dimensions–Line Constraint, Inclined Support in Three Dimensions–Plane Constraint, Symmetry and Antisymmetry	9	30
4	Beams and Frames Introduction, Potential-Energy Approach, Galerkin Approach, Finite Element Formulation, Element Stiffness–Direct Approach, Load Vector, Boundary Considerations, Shear Force and Bending Moment, Beams on Elastic Supports, Plane Frames, Three-Dimensional Frames, Problem Modeling and Boundary Conditions	6	10
5	Two-Dimensional Problems using Constant Strain Triangles Introduction, Finite Element Modeling, Constant Strain Triangle (CST), Isoparametric Representation, Potential-Energy Approach, Element Stiffness, Force Terms, Integration Formula on a Triangle, Galerkin Approach, Stress Calculations, Temperature Effects, Problem Modeling and Boundary Conditions, Some General Comments on Dividing into Elements, Patch Test and Convergence, Patch Test, Orthotropic Materials, Temperature Effects.	8	20
6	Axisymmetric Solids Subjected to Axisymmetric Loading Introduction, Axisymmetric Formulation, Finite Element Modeling: Triangular Element, Potential-Energy Approach, Body Force Term, Rotating Flywheel, Surface Traction, Galerkin Approach, Stress Calculations, Temperature Effects, Problem Modeling and Boundary Conditions, Cylinder Subjected to Internal Pressure, Infinite Cylinder, Belleville Spring, Thermal Stress Problem	7	10
	Total	45	100

Suggested Specification Table with Marks (Theory):

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

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



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101705

Course / Subject Name: Finite Element Methods

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Demonstrate the concepts of finite element methods and its application in the field of mechanical engineering.	Understand
2	Analyze one dimensional and two dimensional systems using finite element methods	Apply
3	Make use of finite element methods for analysis of trusses, beams, frames and axisymmetric solids.	Apply
4	Estimate thermal stresses of machine elements.	Apply

CO-PO Mapping

PO/CO	CO1	CO2	CO3	CO4
PO-1 Basic Engg Knowledge	3	3	3	2
PO-2 Problem Analysis	2	2	2	2
PO-3 Design/Development	2	2	3	3
PO-4 Investigations	1	2	3	3
PO-5 Modern Tool Usage	1	2	2	2
PO-6 Engineer & Society	0	0	0	0
PO-7 Environment & Sustainability	0	0	0	0
PO-8 Ethics	1	1	1	1
PO-9 Individual & Team Work	1	1	1	1



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101705

Course / Subject Name: Finite Element Methods

PO-10 Communication	1	1	1	1
PO-11 Project Management	1	1	1	1
PO-12 Lifelong Learning	1	1	1	1

CO-PSO Mapping

PSO	CO1	CO2	CO3	CO4
PSO1	3	3	3	2
PSO2	2	2	2	2
PSO3	1	1	1	1

References/Suggested Learning Resources:

Books:

1. Introduction to Finite Elements in Engineering, Chandrupatla T. R. and Belegunda A. D., PHI.
2. A First Course in Finite Elements, Jacob Fish, Ted Belytschko, John Wiley & Sons Ltd
3. An Introduction to Finite Element Method, J N Reddy, McGraw - Hill.
4. Concepts and Applications of Finite Element Analysis, R D Cook, Wiley India.

Open source software and website:

1. <http://nptel.ac.in>

Suggested Course Practical List:

1. Introduction to Finite Element Analysis software.
2. Solve 1D – Structural, thermal and fluid problems using FEA software and manually.
3. Solve Plane truss problems, using FEA software and manually. Include problems with symmetry.
4. Solve Beam problems with different boundary and loading conditions using FEA software and manually.
5. Solve planar problems.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101705

Course / Subject Name: Finite Element Methods

6. Solve axis symmetric problems.

Suggested Equipment list:

1. Computational facility and FAE solvers.

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PC

Prerequisite:	Thermodynamics & Heat Transfer
Rationale:	The course aims to impart basic skills of force and stress analysis for design of machine elements

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction: Comparison of SI and CI Engines, Difference in thermodynamic and operating variables, comparison of performance characteristics, comparison of initial and maintenance costs application of SI and CI engine.	4	10
2	Fuels and its supply system for SI and CI engine: Important qualities of IC engine fuels, rating of fuels, Carburetion, mixture requirement for different loads and speeds, simple carburetor and its working, types of carburetors, MPFI, types of injection systems in CI engine, fuel pumps and injectors, types of nozzles, spray formation.	6	12
3	Combustion in SI and CI Engines: Combustion equations, calculations of air requirement in I C Engine, stoichiometric air fuel ratio, proximate and ultimate analysis, enthalpy of formation, adiabatic flame temperature. Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation, combustion chamber for SI and CI engine	8	12
4	Engine lubrication: Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers	7	10
5	Rating, Testing and Performance: Measurements of speed, air flow, fuel consumption, indicated power brake power, frictional horse power, and smoke, testing of engines as per Indian Standard 10001, performance test for variable speed I C Engines, heat balance sheet, governing test for constant speed IC engines, effect of fuel injection parameters in CI engines and ignition advance of SI engines on performance of engine. Rating of internal combustion engine based on (I) continuous operation of engine (II) Maximum power an engine can develop (III) Power calculated from empirical formula, Trouble Shooting and Overhauling of Engines.	8	10
6	Emission of IC engine: Emission from SI engine, effect of engine maintenance on exhaust emission control of SI engine, diesel emission, diesel smoke and control, diesel and control comparison of gasoline and diesel emission. Measurement and calculation for of emission constituents.	6	12



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine

7	Unconventional Engines & Alternative Fuels for IC Engine: Working principle of stratified charge engines sterling engine, Wankel engine Methanol, Ethanol, vegetable oils, bio gas, bio-fuels, hydrogen and comparison of their properties with Diesel and petrol.	6	08
	Teaching hours	45	

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	15	-	-	-

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
1	Describe and explain the major phenomena going on in an internal combustion engine such as gas exchange, combustion and emissions formation/reduction.	Understand
2	Explain the performance and evaluation of internal combustion engine and to discuss how this is affected	Apply
3	Reflect on the role of internal combustion engines for transports in society as well as the emissions issue from both a sustainable and ethical perspective.	Apply
4	To aware about the alternative fuels and their properties	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine

PO5	Modern tool usage
PO6	Engineer and society
PO7	Environment & sustainability
PO8	Ethics
PO9	Teamwork
PO10	Communication
PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	2	-	-	-	-	2
CO2	3	3	3	2	2	1	1	-	-	1	1	2
CO3	2	2	1	-	1	2	3	3	-	2	1	2
CO4	3	2	2	-	2	2	3	2	-	-	-	2

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply fundamental concepts of mechanical engineering to solve power plant problems.
PSO2	Design, analyze and evaluate performance of thermal and renewable power systems.
PSO3	Demonstrate awareness of energy economics, environmental impact and sustainable practices.

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	2	2	3
CO4	3	3	3



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine

References/Suggested Learning Resources:

(a) Books:

1. Design of Machine Elements, V B Bhandari, 3/e, Tata McGraw Hill.
2. I. C. Engines by Heywood.
3. I. C. Engines by Mathur & Sharma, Dhanpatrai
4. I. C. Engines by V. Ganeshan, Tata McGraw Hill
5. I. C. Engines by Domkundwar & Domkundwar, Dhanpatrai
6. I. C. Engines by R.K. Rajput, Laxmi Prakashan

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. To demonstrate various engines and their components.
2. Demonstration of valve timing diagram
3. To demonstrate about the fuel injection system for C.I. Engine
4. To demonstrate about carburetor and its types.
5. To carry out the performance analysis of single cylinder two stroke petrol engine.
6. To carry out the performance analysis of multi cylinder four stroke petrol engine.
7. To carry out the performance analysis of multi cylinder four stroke diesel engine.
8. To carry out various Performance tests: Morse Test and William Line Plot

List of Laboratory/Learning Resources Required:

1. Internal combustion engines, Bomb calorimeter, Junker gas calorimeter

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101706

Course / Subject Name : Internal Combustion Engine



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

w.e.f. Academic Year:	2025-26
Semester:	7 th SEM / 4 th year
Category of the Course:	Professional Elective

Prerequisite:	Zeal to learn the subject
Rationale:	Applications of combustion exist in many fields of Mechanical Engineering and therefore basic course on combustion may be helpful to the interested ones.

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)	
3	0	2	4	60	40	20	30	150



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	Combustion and Thermo chemistry: <ul style="list-style-type: none"> • Introduction, Heat of reaction and formation, • Free energy and the equilibrium constants, • Flame temperature calculations – Analysis & Practical considerations, • Sub and supersonic combustion thermodynamics – Comparisons & Stagnation pressure considerations 	4	8
2	Chemical Kinetics: <ul style="list-style-type: none"> • Introduction, Rates of reactions and their temperature dependence - The Arrhenius rate expression & Transition state and recombination rate theories, • Simultaneous interdependent reactions, Chain reactions, • Pseudo-first-order reactions and the “fall-off” range, • The partial equilibrium assumption, • Pressure effect in fractional conversion, • Chemical kinetics of large reaction mechanisms – Sensitivity analysis, • Rate of production analysis, • Coupled thermal and chemical reacting systems & Mechanism simplification 	10	18
3	Chemical and Thermal Systems: <ul style="list-style-type: none"> • Constant pressure fixed mass reactor, • constant volume reactor, • well stirred reactor, plug flow reactor, • application to combustion system modelling 	6	18
4	Conservative Equations: <ul style="list-style-type: none"> • Mass conservation, Species mass conservation, • Multi component diffusion, • momentum conservation, Energy conservation, • Conserved Scalar Concept 	6	18
5	Laminar Flames: <ul style="list-style-type: none"> • Laminar Premixed Flames - Physical Description, • Simplified Analysis, • Detailed analysis Factors influencing flame velocity and thickness, 	10	10



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

	<ul style="list-style-type: none"> flame stabilization, ignition Laminar Diffusion Flames – non reacting constant density laminar jet, jet flame, flame lengths, soot formation and destruction, counter flow flames 		
6	Turbulent Flames: <ul style="list-style-type: none"> Applications of turbulent flames, Definition of turbulent flame speed, structure of turbulent premixed flames, wrinkled flame regime, flame lets, flame stabilization, Jet Flames 	9	10
	Teaching hours	45	10

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	24	12	-	-	-

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 , the Student will be able to:

No	Course Outcomes	RBT level
CO1	To comprehend combustion, types of flames and effect and control of combustion.	Understand
CO2	To apply the theories of chemical equilibrium.	Apply
CO3	To mass, momentum and energy conservation to combustion process and make calculations of various reactors.	Apply
CO4	To apply concepts of laminar premixed and diffusion flames to appropriate reactive systems.	Analyze
CO5	To apply concepts of turbulent flames to appropriate reactive systems.	Analyze



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

Program Outcomes (POs)

PO No.	Program Outcome
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 team work
PO10	Communication
PO11	Project management and finance
PO12	Life-long learning

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	1	0	3	2	2	2	3
CO2	3	3	2	3	2	1	0	2	3	2	2	3
CO3	3	3	3	3	3	1	0	2	2	3	2	3
CO4	2	3	3	2	3	1	0	2	2	2	1	3
CO5	2	3	3	2	3	1	0	2	2	2	1	3



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply thermodynamic and chemical principles to design and analyze combustion systems.
PSO2	Utilize advanced computational tools to model combustion and reactive flow systems.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. An Introduction to Combustion, Concepts and Applications, Stephen R. Turns, McGraw-Hill Education
2. Combustion, Irvin Glassman, Academic Press
3. Combustion Theory, Forman A Williams, Addison-Wesley
4. Combustion Physics, C.K. Law, Cambridge University Press
5. Combustion, Flames and Explosions of Gases, Bernard Lewis and Guenther von Elbe, Academic Press
6. Chemical Kinetics, Keith Laidler, Harper and Row

(b) Open-source website:

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

Suggested Course Practical List:

1. Find the smoke point of different fuels.
2. Find the pour point and cloud point of various lubricants.
3. Test the performance of fuel pump with fuel pump test rig.
4. Study of various spray characteristics of fuel.
5. Study of flame stabilization at different equivalence ratio.
6. Study of laminar premixed flames.
7. Study of turbulent flames.
8. Model different H₂/O₂ mechanism and find equilibrium temperatures at different equivalence ratios.



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101707

Course/Subject Name: Principles of Combustion

List of Laboratory/Learning Resources Required:

1. Fuel pump test rig,
2. Bunsen Burner,
3. Temperature measurement apparatus,
4. Fuel supply system,
5. Ignition system



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

w.e.f. Academic Year:	2025-26
Semester:	7 th SEM / 4 th year
Category of the Course:	Professional Elective

Prerequisite:	Zeal to learn the subject
Rationale:	The course aims to impart basic knowledge of fracture mechanics, surface failure and failure of machine elements under creep, fatigue and multi axial stresses.

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)	
3	0	2	4	60	40	20	30	150



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	Fracture Mechanics: <ul style="list-style-type: none">• Introduction, Rise in stresses due to crack,• Crack tip opening displacement,• LEFM: Effect of crack on strength of ductile and brittle material,• Crack opening modes and Griffith theory,• Concept of <i>SIF</i> and <i>K</i> Crack Tip Plasticity,• Use of <i>K</i> in design and analysis, Determination of plastic zone,• size and shape, Limitations of LEFM.	9	8
2	Surface Failures: <ul style="list-style-type: none">• Friction: Rolling, Effect of roughness,• velocity and lubrication on friction,• Wear: Adhesive, Abrasive and Corrosive,• Lubrication: Hydrodynamic,• hydrostatic and elasto hydrodynamic lubrication,• Surface Fatigue, Contact Stresses: Spherical, Cylindrical,• General and Dynamic, Surface Fatigue Strength,• design to avoid surface fatigue.	7	18
3	Creep and Damping: <ul style="list-style-type: none">• True stress and true strain, Creep phenomenon,• Creep Curve, Creep parameters,• Time-temperature parameters and life estimate: Sherby- Dorn and Larson-Miller, Stress relaxation.• Stress-Strain-Time relation, Creep deformation under varying stress,• Component stress- strain analysis, Energy dissipation in materials.	7	18
4	Fatigue Failure: <ul style="list-style-type: none">• Fatigue test and stress life (S-N) approach,• Factor Influences on S-N Behavior,• Life Estimating using S-N curve,• Fatigue from Variable Amplitude Loading,• Spectrum Load and Cumulative Damage,• Cumulative Damage Theories, Cycle Counting Methods,• Life estimation using Stress Life Approach,• Life Estimation using Strain Life Approach,• Crack Growth and Life Estimation Model,	8	18



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

5	Multi axial Stresses: <ul style="list-style-type: none"> States of Stress and Strain and Proportional versus Non proportional Loading, Yielding and Plasticity in Multi axial Fatigue , Stress-Based Criteria, Equivalent Stress Approaches, Sines Method, Examples Using the Stress-Life Approach , Strain-Based, Energy-Based, and Critical Plane Approaches, Strain-Based and Energy-Based Approaches, Critical Plane Approaches and the Fatemi-Socie Model, Example of Non proportional Loading, Fracture Mechanics Models for Fatigue Crack Growth, Notch Effects and Variable Amplitude Loading. 	8	10
6	Housings: <ul style="list-style-type: none"> The Function of Housings, Materials for Housings, Design of Housings , Housings Split through the Axes of Shafts, Design of Mounting Feet, Design of Lifting Elements, Housings Split at Right Angle to the Axes of the Shafts, Non-split Housings, Deformations and Stiffness Problems, Housing Seals, Sealing of Rigid Connections (Static Seals, Sealing Movable Joints, Noncontact Seals, Contact Seals, Combined Seals. 	6	10
	Teaching hours	45	10

Suggested Specification Table with Marks (Theory):

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

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



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Make use of fracture mechanics, surface failure and creep in design of machine components.	Apply
CO2	Demonstrate time dependent failure of machine components.	Understand
CO3	Examine life of machine components based on fatigue failure.	Analyze
CO4	Construct the housing for gearboxes.	Create
CO5	Determine multi axial stresses in machine components.	Evaluate

Program Outcomes (POs)

PO No.	Program Outcome
PO1	Engineering knowledge: Apply knowledge of mathematics, science, engineering fundamentals...
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex
PO3	Design/development of solutions: Design solutions for complex engineering problems

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3
CO1	3	2	3
CO2	3	3	2
CO3	3	3	3
CO4	2	3	3
CO5	2	3	3



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply advanced design concepts for machine elements and systems.
PSO2	Analyze and solve fatigue, creep, and multiaxial stress-related issues
PSO3	Develop and evaluate housings for mechanical components

CO-PSO MAPPING:

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	2	0
CO2	3	2	0
CO3	3	3	0
CO4	3	2	0
CO5	3	3	0

References/Suggested Learning Resources:

(a) Books:

- 1 Mechanical Behaviour of Materials: Engineering Methods for Deformation Fracture and Fatigue 4th Edition N E Dowling Pearson.
- 2 Machine Design: An Integrated Approach 3rd Edition R L Norton, Pearson Education.
- 3 Fundamentals of Machine Design 5th Edition R C Juvinall & K M Marshek, Wiley India.
- 4 Mechanical Design of Machine Elements and Machines: A failure prevention perspective J A Collins, H Busby and G Stabb, Wiley India.
- 5 Metal Fatigue in Engineering R I Stephens, A Fatemi, R R Stephens and H O Fuchs, John-Wiley.
- 6 Elements of Fracture Mechanics, Prashant Kumar McGraw-Hill.
- 7 Engineering Design Dieter, McGraw-Hill
- 8 Machine Elements Life and Design, B M Khebanov, D M Barlam, F E Nystrom, CRC Press

(b) Open-source website:

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

Suggested Course Practical List:

- 1 Design of machine components subjected to fatigue loading, creep.
- 2 Design of mechanical components subjected to multiaxial stresses.



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101708

Course/Subject Name: Advanced Machine Design

- 3 Failure analysis based on fracture mechanics.
- 4 Case study based on surface failure considerations, contact stresses for mating surfaces.

List of Laboratory/Learning Resources Required:

- 1 Computational facility and drawing hall facility.



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101709

Course/Subject Name: Turbo machines

w.e.f. Academic Year:	2025-26
Semester:	7 th SEM / 4 th year
Category of the Course:	Professional Elective

Prerequisite:	Fluid Mechanics and Thermodynamics
Rationale:	Turbines, compressors and fans are required to study as all turbo machines and their basic rotating components. The subject offers the thorough knowledge of fluid flow pattern, basic working principles and need of rotating element as per its requirement in all kind of turbo machines.

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)	
3	0	2	4	60	40	20	30	150



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101709

Course/Subject Name: Turbo machines

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	Introduction to Turbo machineries: <ul style="list-style-type: none"> turbines, pumps and compressors, fans and blowers, compressible flow machines, incompressible flow machines Energy transfer between fluid and rotor-classification of fluid machinery,- dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency. 	7	12
2	Axial Flow Turbines: <ul style="list-style-type: none"> Introduction, Stage velocity triangle, Single impulse stage, Multistage velocity compounded impulse and Multistage pressure compounded impulse, Reaction stages, Blade to gas speed ratio, Losses and efficiencies, Performance charts, Low hub-tip ration stage. Radial Flow Turbines: <ul style="list-style-type: none"> Elements of radial turbine stage, Stage velocity triangles, H-S diagram, Stage losses, Outward flow radial stage and Performance characteristics. 	12	25
3	Axial Flow Compressor: <ul style="list-style-type: none"> Introduction. Geometry and working principle, Stage velocity triangles, H-S diagram. Flow through blade row, Stage losses and efficiency, Work done factor, Low hub-tip ratio, Supersonic and transonic stages, Performance characteristics 	8	20
4	Centrifugal Compressor: <ul style="list-style-type: none"> Introduction and different parts of centrifugal compressor, Principles of operation. H-S diagram. Nature of impeller flow, Slip factor, Diffuser, Volute casing, Performance characteristics and losses in centrifugal compressor. 	8	20
5	Fans and Blowers: <ul style="list-style-type: none"> Fan and Blowers types-stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, drives and noise. Noise problems in fans and Blowers 	7	15



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101709

Course/Subject Name: Turbo machines

6	<ul style="list-style-type: none"> Use of CFD for Turbo machineries analysis and design. 	3	8
	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
20	22	18	-	-	-

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, the Student will be able to:

No	Course Outcomes	RBT level
CO1	Understand to apply physics of flow through turbo machines.	Understand
CO2	Analyze radial and axial flow turbines, their losses and performance.	Analyze
CO3	Analyze centrifugal and axial flow compressors, their losses and performance.	Analyze
CO4	Evaluate fans and blowers, their design parameters and applications.	Evaluate
CO5	Apply CFD techniques for turbo machinery analysis and design.	Apply

Program Outcomes (POs)

PO No.	Program Outcome
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions
PO4	Conduct investigations of complex problems



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101709

Course/Subject Name: Turbo machines

PO5	Modern tool usage
PO6	The engineer and society
PO7	Environment and sustainability
PO8	Ethics
PO9	Individual and team work
PO10	Communication
PO11	Project management and finance
PO12	Life-long learning

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	0	1	0	0	0	0	2	0	2
CO2	3	3	3	2	2	0	0	0	0	2	0	2
CO3	3	3	3	2	2	0	0	0	0	2	0	2
CO4	3	3	3	3	3	0	0	0	0	3	0	2
CO5	3	3	3	3	3	0	0	0	0	3	0	2

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply fundamental knowledge of fluid mechanics and thermodynamics for analyzing and designing turbo machinery systems.
PSO2	Evaluate the performance of turbines, compressors, fans, and blowers using modern analysis tools and techniques.
PSO3	Utilize computational fluid dynamics (CFD) for analysis and optimization of turbo machinery components and systems.



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101709

Course/Subject Name: Turbo machines

CO-PSO MAPPING:

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	2	0
CO2	3	2	0
CO3	3	2	0
CO4	3	2	0
CO5	3	3	0

References/Suggested Learning Resources:

(a) Books:

1. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., latest edition.
3. Principals of Turbomachines, D. G. Shepherd, The Macmillan Company (1964)
4. Fluid Mechanics & Thermodynamics of Turbomachines, S. L. Dixon, Elsevier (2005)
5. Text Book of Turbomachines, M. S. Govindgouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008
6. Turbomachine, B.K.Venkanna PHI, New Delhi 2009

(b) Open-source website:

1. <https://nptel.ac.in/courses/101/101/101101058>

Suggested Course Practical List:

1. Study or performance of axial flow turbines performance and its efficiency.
2. Study or performance of Radial flow turbines performance and its efficiency.
3. Study or performance of axial flow Compressors performance and its efficiency.
4. Study or performance of centrifugal compressors performance and its efficiency.
5. Performance study of axial fan
6. Study of centrifugal air blower

List of Laboratory/Learning Resources Required:

1. Apparatus for Axial and Radial Turbines,
2. Axial fan apparatus, Test rig for Centrifugal compressor and computer systems for CFD



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PE

Prerequisite:	Professional Elective
Rationale:	The course aims to impart basic skills of force and stress analysis for design of machine elements.

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction: Objectives of material handling system, Principal groups of materials handling equipment and classification, Scope of Material Handling, Criteria for selection of Material Handling Equipment's, Basic kind of material handling problems, Various methods to analyze material Handling problems.	6	05
2	Conveyor Design: Introduction to Apron conveyors, Pneumatic conveyors, Belt Conveyors, Chain conveyors, Screw conveyors and vibratory conveyors and their applications, Design of Belt conveyor- Belt selection procedure and calculation of drop energy, Idler design	10	25
3	Design of bucket and Cage Elevator: Introduction, Types of Bucket Elevator, Design of Bucket Elevator- loading and bucket arrangements, Cage elevators, shaft way, guides, counter weights.	5	10
4	Design of Hoists: Design of hoisting elements: Welded and roller chains – Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments – Design of arresting gear - Brakes: shoe, band and cone types.	10	25
5	Design of Cranes: Hand-propelled and electrically driven overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes, goliath cranes; design considerations for structures of rotary cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.	10	25
6	Packaging and storage of bulk materials: Steps for design of packages, protective packaging, testing the physical characteristics of packaging, container testing, types of storage and industrial containers, Automatic guided vehicles, Automatic storage and retrieval system.	4	10



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment

	Teaching hours	45	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
20	25	15	-	-	-

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
1	Compare and select material handling equipment for material transportation.	Analyze
2	Construct the conveyors for handling bulk materials.	Apply
3	Analyze elements of hoisting mechanisms used in industry for material handling,	Analyze
4	Examine packaging and storage systems used in industry	Analyze



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Engineering Knowledge			3	
PO2 Problem Analysis	2	3	3	3
PO3 Design/Development of Solutions	2	2	3	2
PO4 Conduct Investigations of Complex Problems		3	2	2
PO5 Modern Tool Usage	3	2	3	
PO6 The Engineer and Society		3		2
PO7 Environment and Sustainability				
PO8 Ethics				
PO9 Individual and Team Work				
PO10 Communication	1		1	
PO11 Project Management and Finance	1	2	1	1
PO12 Lifelong learning	2	1	2	1

CO-PSO Mapping Table

CO / PSO	PSO1 Apply material handling and storage systems in plant layout & logistics	PSO2 Integrate material handling with productivity and safety goals
CO1	3	3
CO2	3	2
CO3	3	3
CO4	2	3

References/Suggested Learning Resources:

(a) Books:

1. Belt conveyors for bulk materials Conveyor Equipment Manufacturer's Association, 6th edition, The New CEMA Book.
2. Materials handling equipment, Rudenko N., Elnvee Publishers.
3. Material Handling Handbook, Raymond A Kulwiec, John Wiley & Sons.
4. Engineering Science and application design for belt conveyor , Ishwar G Mulani and Mrs. Madhu I Mulani, Madhu I. Mulani.
5. Materials Handling Equipments, Alexandrov, M, MIR Publishers.
6. Bulk Materials Handling Handbook, Jacob Fruchtbaum, Springer Science + Business Media



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. Computation and drawing work related to design of belt conveyor, hoisting mechanism, cranes and packaging systems

List of Laboratory/Learning Resources Required: NIL

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101710

Course / Subject Name : Design of Material Handling Equipment



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PE

Prerequisite:	Professional Elective
Rationale:	The course aims to impart basic knowledge about various aspects of Quality and Quality Management. It also helps students to understand design of experiments. Latest advance in the area of Just in time and TQM has been covered with contemporary issues. This subject also gives knowledge about reliability and product life cycle

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		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Introduction to Quality: Concept, Different Definitions and Dimensions, Inspection, Quality Control, Quality Assurance and Quality Management, Quality as Winning Strategy, Views of different Quality Gurus.	4	05
2	Total Quality Management (TQM): Introduction, Definitions and Principles of Operation, Tools and Techniques, such as, Quality Circles, 5 S Practice, Total Quality Control (TQC), Total Employee Involvement (TEI), Problem Solving Process, Quality Function Deployment (QFD), Failure Mode and Effect analysis (FMEA), Fault Tree Analysis (FTA), Kizen, Poka-Yoke, 7QC Tools, PDCA Cycle, 7 New Quality Improvement Tools, TQM Implementation and Limitations	8	25
3	Introduction to Design of Experiments: Introduction, Methods, Taguchi approach, Achieving robust design, Steps in experimental design.	7	10
4	Just –in –Time, Quality Management, Total Productive Maintenance (TPM) and ISO: Introduction to JIT production system KANBAN system, JIT and Quality Production, TPM: Content, Methods and Advantages ISO 9000, ISO 14000 and QS 9000: Basic Concepts, Scope, Implementation, Benefits, Implantation Barriers.	8	25
5	Contemporary Trends: Concurrent Engineering, Lean Manufacturing, Agile Manufacturing, World Class Manufacturing, Cost of Quality (COQ) system, Bench Marking, Business Process Re- engineering, Six Sigma: Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation of all as applicable.	8	25
6	Reliability: Introduction, Concepts of Reliability and failure: Reliability, Failure, Failure mechanism, failure severity and consequences. Reliability basic functions: Probability density function, cumulative function and reliability function, conditional distribution and residual life, failure rate and cumulative hazard functions, relation between reliability basic functions. Life characteristics: Measure of life time, Dispersion of lifetime, Skewness and kurtosis of life dispersion. Reliability of repairable system: Failure repair process, Reliability measure, Reliability point process. Evolution of reliability over Product life cycle: Design reliability, Inherent reliability, Reliability at sale, field reliability.	10	10



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering

	Teaching hours	45	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
20	25	15	-	-	-

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
1	Interpret Quality and Total quality management	Understand
2	Make use of design of experiments, concepts of just in time and quality management.	Apply
3	Illustrate Total Productive maintenance and ISO.	Apply
4	Utilize knowledge of contemporary trends in quality engineering and Reliability Engineering in industry	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations
PO5	Modern tool usage
PO6	Engineer and society
PO7	Environment & sustainability
PO8	Ethics
PO9	Teamwork
PO10	Communication
PO11	Project management



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering

PO12	Lifelong learning
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CO-PO Mapping Table:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	1	2	2	-	2	1	2
CO2	3	3	3	3	3	1	2	-	-	1	2	2
CO3	2	2	2	2	2	2	2	2	-	1	2	2
CO4	3	3	2	2	3	2	3	2	-	1	2	3

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply statistical and reliability tools in quality improvement processes.
PSO2	Integrate industry standards and quality systems into engineering solutions.
PSO3	Demonstrate awareness of emerging trends in quality and reliability engineering for sustainable development.

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	3	2
CO3	2	3	2
CO4	3	3	3

References/Suggested Learning Resources:

(a) Books:



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering

1. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India
2. Introduction to Quality and Reliability Engineering, Jiang R, Springer Publication, 2015.
3. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jainand A K Chitale, Khanna Publishers
4. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Education
5. Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd.
6. Reliability Engineering by Srinath L. S., Affiliated East West Press.
7. Total Quality Management by K C Arora, S K Kataria & Sons
8. Total Quality Management: Poornima M. Charantimath, Pearson Education (Singapore) Pte. Ltd.
9. Managing for Total Quality: N. Logothetis, Prentice Hall of India Pvt. Ltd.
10. Managing Quality : Barrie G. Dole, Blackwell publishing
11. TQM – an integrated approach – Samuel K Ho, Crest Publishing House

(b) Open source software and website:

1. <http://nptel.ac.in/>
2. <http://npti.in/default.aspx>

Suggested Course Practical List:

1. Exercise on Quality Circle and 5S
2. Exercise on PDCA and Fault tree analysis
3. Exercise on Taguchi methods (Small case problems)
4. Case study problems analysis on JIT, ISO and kanban
5. Problems on Failure repair process, Reliability measure
6. Problems on failure mechanism
7. Case study presentation on Six sigma

List of Laboratory/Learning Resources Required: NIL

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code : BE101711

Course / Subject Name : Quality and Reliability Engineering



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

w. e. f. Academic Year:	2025-26
Semester:	7 th / 4 ND Year
Category of the Course:	PC

Prerequisite:	Thermodynamics & Heat Transfer
Rationale:	The course aims to impart basic skills of force and stress analysis for design of machine elements

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		
				(E)	(M)	(I)	(V)	
3	0	0	3	60	40	00	00	100



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Basic Elements of Nano-science and Nanotechnology: Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry..	12	25
2	Nanotechnology and Ceramics: Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods .	8	20
3	Tools to characterize Nano materials: X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV/Visible Spectroscopy	6	15
4	Surface Engineering: Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.	6	15
5	Different methods for surface modifications: Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites	10	20
6	Case studies based on coatings and surface modification of important engineering components.	5	05



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

	Teaching hours	47	
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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
20	25	15	-	-	-

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
1	To comprehend basics of nano-science and technology and their applications in the domain of engineering.	Understand
2	To impart fundamental knowledge of various methods used in the field of nano-technology	Apply
3	To impart basics of various characterization tools/methods in the field of Nano-Technology.	Apply
4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes	Understand

Program Outcomes (POs)

PO No.	PO Description (Abbreviated)
PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development
PO4	Investigations
PO5	Modern tool usage
PO6	Engineer and society
PO7	Environment & sustainability
PO8	Ethics



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

PO9	Teamwork
PO10	Communication
PO11	Project management
PO12	Lifelong learning

CO-PO Mapping Table:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	2	2	1	-	-	-	3
CO2	3	2	2	2	3	1	2	-	-	-	-	2
CO3	3	2	2	3	3	-	1	-	-	-	-	2
CO4	3	3	3	3	3	1	2	-	-	1	-	2

Program Specific Outcomes (PSOs):

PSO No.	PSO Description
PSO1	Apply foundational and interdisciplinary knowledge to nanotechnology-related engineering problems.
PSO2	Utilize nanomaterials synthesis and characterization methods in practical applications.
PSO3	Demonstrate awareness of nano-coating and microstructure-property relationships in industrial processes.

CO-PSO Mapping Table

CO / PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

References/Suggested Learning Resources:

(a) Books:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, Imperial College Press, 2004.
2. Nanoscale Science and technology by Robert Kelsall (editor), Ian W. Hamley (co-editor), Mark Geoghegan (co-editor) , ISBN: 978-0-470-85086-2
3. The Chemistry of Nanomaterials: Synthesis, Properties and Applications by C. N. R. Rao, A. Muller, A. K. Cheetham, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 3-527-30686-2.
4. Nanoscale Materials in Chemistry Edited by Kenneth J. Klabunde, John Wiley & Sons, Inc., ISBNs: 0-471-38395-3 (Hardback); 0-471-22062-0.
5. Textbook of Nanoscience and Nanotechnology, B.S. Muty, P. Shankar, Baldev Raj, B.B Rath and James Murday, University Press, IIM (ISBN-978 81 7371 738 3).
6. Introduction to Nanotechnology by Charles P. Poole Jr and. Frank J. Owens, Wiley-Inter science, 2003.
7. James A. Murphy- Surface Preparation and Finishes for Metal, McGraw-Hill, New York 1971
8. Surface Engineering Hand Book, edited by Keith Austin, London : Kogan Page, 1998

(b) Open source software and website:

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

Suggested Course Practical List:

1. To demonstrate various engines and their components.
2. Demonstration of valve timing diagram
3. To demonstrate about the fuel injection system for C.I. Engine
4. To demonstrate about carburetor and its types.
5. To carry out the performance analysis of single cylinder two stroke petrol engine.
6. To carry out the performance analysis of multi cylinder four stroke petrol engine.
7. To carry out the performance analysis of multi cylinder four stroke diesel engine.
8. To carry out various Performance tests: Morse Test and William Line Plot

List of Laboratory/Learning Resources Required:

1. Electronics Microscope, XRD, UV

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

w. e. f. Academic Year:	2023-24
Semester:	7 th
Category of the Course:	Professional Elective - 3

Prerequisite:	NIL
Rationale:	To make students understand the use of concept of nanotechnology and nano science in the industries and in consumer products. The surface properties must be modified for aesthetics, oxidation resistance, hardness, wear resistance, fatigue resistance or other considerations. This course will be useful for the student to develop essential skill & knowledge of the surface coating technologies in demand.

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		
				(E)	(M)	(I)	(V)	
3	0	0	3	60	40	0	0	100

Course Content:

Unit	Content	Hours	% of Weightage
1	Basic Elements of Nano-science and Nanotechnology: Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.	12	20
2	Nanotechnology and Ceramics : Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods	8	10
3	Tools to characterize Nanomaterials:	6	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

	X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV/Visible Spectroscopy		
4	Surface Engineering: Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.	6	20
5	Different methods for surface modifications: Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.	10	20
6	Case studies based on coatings and surface modification of important engineering components.	5	10
Total		47	100

Suggested Specification Table with Marks (Theory):

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

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
1	To comprehend basics of nano-science and technology and their applications in the domain of engineering.	Apply
2	To impart fundamental knowledge of various methods used in the field of nano-technology	Apply
3	To impart basics of various characterization tools/methods in the field of Nano-Technology.	Apply
4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.	Apply

CO-PO Mapping



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

PO/CO	CO1	CO2	CO3	CO4
PO-1 Basic Engg Knowledge	3	3	3	2
PO-2 Problem Analysis	2	2	2	2
PO-3 Design/Development	2	2	3	3
PO-4 Investigations	1	2	3	3
PO-5 Modern Tool Usage	1	2	2	2
PO-6 Engineer & Society	0	0	0	0
PO-7 Environment & Sustainability	0	0	0	0
PO-8 Ethics	1	1	1	1
PO-9 Individual & Team Work	1	1	1	1
PO-10 Communication	1	1	1	1
PO-11 Project Management	1	1	1	1
PO-12 Lifelong Learning	1	1	1	1

CO-PSO Mapping



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: U.G

Course/Subject Code: BE101712

Course / Subject Name: Nanotechnology and surface Engineering

PSO	CO1	CO2	CO3	CO4
PSO1	3	3	3	2
PSO2	2	2	2	2
PSO3	1	1	1	1

References/Suggested Learning Resources:

Books:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, Imperial College Press, 2004.
2. Nanoscale Science and technology by Robert Kelsall (editor), Ian W. Hamley (co-editor), Mark Geoghegan (co-editor), ISBN: 978-0-470-85086-2
3. The Chemistry of Nanomaterials: Synthesis, Properties and Applications by C. N. R. Rao, A. Muller, A. K. Cheetham, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 3-527-30686-2.
4. Nanoscale Materials in Chemistry Edited by Kenneth J. Klabunde, John Wiley & Sons, Inc., ISBNs: 0-471-38395-3 (Hardback); 0-471-22062-0.
5. Textbook of Nanoscience and Nanotechnology, B.S. Muty, P. Shankar, Baldev Raj, B.B Rath and James Murday, University Press, IIM (ISBN-978 81 7371 738 3).
6. Introduction to Nanotechnology by Charles P. Poole Jr and Frank J. Owens, Wiley-Inter science, 2003.
7. James A. Murphy- Surface Preparation and Finishes for Metal, McGraw-Hill, New York 1971
8. Surface Engineering Hand Book, edited by Keith Austin, London : Kogan Page, 1998

Open source software and website:

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

Suggested Course Practical List:

1. Introduction to Finite Element Analysis software.
2. Solve 1D – Structural, thermal and fluid problems using FEA software and manually.
3. Solve Plane truss problems, using FEA software and manually. Include problems with symmetry.
4. Solve Beam problems with different boundary and loading conditions using FEA software and manually.
5. Solve planar problems.
6. Solve axis symmetric problems.

Suggested Equipment list:



SWAMINARAYAN UNIVERSITY

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1. Electronics Microscope, XRD, UV

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Swaminarayan University

Teaching & Examination Scheme
Course – Faculty of Engineering (Degree)
Branch – Mechanical Engineering
Semester – 7th

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100701	Summer Internship	Project	0	0	0	2	00	00	20	80	100
BE101701	Power Plant Technology	Professional Core	3	0	0	3	60	40	00	00	100
BE101702	Design of Machine Elements	Professional Core	3	0	2	4	60	40	20	30	150
BE101703	Refrigeration and Air conditioning Engineering	Professional Elective - 4	3	0	2	4	60	40	20	30	150
BE101704	Automation in Manufacturing		3	0	2	4	60	40	20	30	150
BE101705	Finite Element Methods		3	0	2	4	60	40	20	30	150
BE101706	Internal Combustion Engine	Professional Elective - 5	3	0	2	4	60	40	20	30	150
BE101707	Principles of Combustion		3	0	2	4	60	40	20	30	150
BE101708	Advanced Machine Design		3	0	2	4	60	40	20	30	150
BE101709	Turbo Machines	Professional Elective - 6	3	0	2	4	60	40	20	30	150
BE101710	Design of Material Handling Equipment		3	0	2	4	60	40	20	30	150
BE101711	Quality and Reliability Engineering		3	0	2	4	60	40	20	30	150
BE101712	Nanotechnology and surface Engineering	Open Elective - 3	3	0	0	3	60	40	0	0	100
BE105712	Fundamentals of IoT		3	0	0	3	60	40	0	0	100
	Total		18	0	8	24					

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