SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE100602

Course/Subject Name: Entrepreneurship and E-business

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Open Elective - 2

Prerequisite:	**Nil**
Rationale:	Entrepreneurship and e-business subject is introduced with motive to develop entrepreneurial attitude in today's competitive environment. Further this subject creates awareness about adopted technologies in the business.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE(V)	
3	0	0	3	60	40	00	00	100

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE100602

Course/Subject Name: Entrepreneurship and E-business

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Entrepreneurship:** • Concept, Knowledge and skills requirement; • Characteristics of successful entrepreneurs; • role of entrepreneurship in economic development; • Entrepreneurship process; • factors impacting emergence of entrepreneurship; • managerial vs. entrepreneurial approach and emergence of entrepreneurship.	4	10
2	**Starting the venture:** • Generating business idea–sources of new ideas, • methods of generating ideas, creative problem solving, • opportunity recognition; environmental scanning, • competitor and industry analysis. **Feasibility study:** • Market feasibility, Technical / operational feasibility, • Financial feasibility; drawing business plan; • preparing project report; • presenting business plan to investors.	8	20
3	**Functional plans:** **Marketing plan –** • marketing research for the new venture, • steps in preparing marketing plan, • contingency planning. **Organizational plan –** • Form of ownership, • designing organization structure, • job design, manpower planning. **Financial plan –** • cash budget, working capital, • Performa income statement Performa cash flow, • perform balance sheet, break even analysis.	6	15
4	**Sources of finance and Legal Issues:** • Debtor equity financing, commercial banks, venture capital; • financial institutions supporting entrepreneurs. • Intellectual property rights patents, trademarks, copyrights, trade secrets, licensing, Franchising.	4	10

5	**Overview of E – business and Collaborative Partnerships:** • Concept of E-business, Business Success through adoption of technology, • information management for business Initiatives, Performance improvement through e-business. • Introduction to various collaborative partnerships, • E-commerce: Sectors of e-commerce, B to C, B to B and C to C ecommerce, E-commerce success factors, • clicks and Bricks in e-commerce, collaborative commerce. • E-Marketplace, M-commerce, E-Government; • Various E-business Models, • Challenges of the E-Business Models, Globalization of E-business.	**8**	**15**
6	**Strategic Initiatives for Technology** **Customer Relationship Management** • The evolution of CRM, functional areas of CRM, • contemporary trends - SRM, PRM AND ERM, • Future Trends of CRM **Enterprise Resource Planning** • Core and Extended ERP; • components of ERP system; • Benefits and Risks of ERP implementation	**5**	**10**
7	**Business Technologies and Decision Support Systems** • Introduction to different business technologies: Cloud computing, and • Artificial Intelligence. • Business and Decision support, • Components of DSS, Benefits, • Geographic Information and Data Visualization Systems, • Group Decision Support System	**5**	**10**
8	**Ethics** • Ethics and Information, • Ethical Computer Use Policy, • Information • Privacy Policy, • E-mail Privacy Policy, • Internet Use Policy, • Employee Monitoring Policies	**5**	**10**
	Teaching hours	**45**	**100**

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE100602

Course/Subject Name: Entrepreneurship and E-business

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
22	18	20	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Distinguish Entrepreneur and Entrepreneurship starting and feasibility study.	Understand
CO2	Demonstrate Entrepreneurship functional plan with source of finance and legal issues.	Apply
CO3	Describe E business, collaborative partnership and strategic technology.	Understand
CO4	Describe business technology and decision support system.	Understand
CO5	Understand importance of Ethics in Entrepreneurship and E business.	Understand

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	2	1	2	1	0	3	2	3	2	3
CO2	3	3	2	2	2	1	0	2	3	3	2	3
CO3	2	2	2	1	3	0	0	2	2	3	1	3
CO4	1	2	2	1	3	0	0	2	2	2	1	3
CO5	1	1	1	0	1	0	0	3	1	1	0	2

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply fundamental and advanced engineering concepts to solve real
PSO2	Demonstrate proficiency in modern business technologies and decision

CO-PSO MAPPING:

CO \ PSO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	3
CO4	2	3
CO5	1	2

References/Suggested Learning Resources:

(a) Books:

1. Entrepreneurship (Fifth Edition 2002); Robert Hisrich, Michael Peters; Tata McGraw Hill Publication
2. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
3. Business Driven Technology – Haag/Baltzan/Philips – Tata McGraw Hill Publication
4. Management of Information Technology – Carroll W. Frenzel and John C. Frenzel, Thomson Press
5. e-Business 2.0 Roadmap for Success by Dr. Ravi Kalakota, Marcia Robinson, Pearson Education
6. E-commerce – A Managerial Perspective- P. T. Joseph, Prentice Hall India Publications.

(b) Open-source website:

1. https://nptel.ac.in/courses/

Suggested Course Practical List:

List of Laboratory/Learning Resources Required:

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE100603

Course/Subject Name: Industry 4.0

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Open Elective - 2

Prerequisite:	**Nil**
Rationale:	**Nil**

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE(V)	
3	0	0	3	60	40	00	00	100

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE100603

Course/Subject Name: Industry 4.0

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Introduction to Industry 4.0:** • Introduction, core idea of Industry 4.0, • origin concept of industry 4.0, • Industry 4.0 production system, • current state of industry 4.0, Technologies, • How is India preparing for Industry 4.0	7	15
2	**A Conceptual Framework for Industry 4.0:** • Introduction, Main Concepts and Components of Industry 4.0, • State of Art, • Supportive Technologies, • Proposed Framework for Industry 4.0.	7	15
3	**Technology Roadmap for Industry 4.0 :** • Introduction, • Proposed Framework for Technology Roadmap, • Strategy Phase, • Strategy Phase, • New Product and Process Development Phase	7	15
4	**Advances in Robotics in the Era of Industry 4.0:** • Introduction, • Recent Technological Components of Robots- Advanced Sensor Technologies, • Internet of Robotic Things, Cloud Robotics, and • Cognitive Architecture for Cyber-Physical Robotics, • Industrial Robotic Applications- Manufacturing, • Maintenance and Assembly.	8	20
5	**The Role of Augmented Reality in the Age of Industry 4.0**: • Introduction, • AR Hardware and Software Technology, • Industrial Applications of AR.	6	15
6	**Obstacles and Framework Conditions for Industry 4.0 :** • Lack of A Digital Strategy alongside Resource Scarcity, • Lack of standards and poor data security, • Financing conditions, availability of skilled workers, • comprehensive broadband infra- structure, • state support, legal framework, protection of corporate data, • liability, handling personal data	7	20

7	**Teaching hours**	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	40	10	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Describe Industry 4.0 and scope for Indian Industry.	Understand
CO2	Demonstrate conceptual framework and road map of Industry 4.0.	Apply
CO3	Describe Robotic technology and Augmented reality for Industry 4.0.	Understand
CO4	Demonstrate obstacle and framework conditions for Industry 4.0.	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
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	2	1	2	1	0	3	2	3	2	3
CO2	3	3	2	2	2	1	0	2	3	3	2	3
CO3	2	2	2	1	3	0	0	2	2	3	1	3
CO4	2	3	2	1	2	0	0	3	2	2	2	3
CO5	3	2	2	1	2	1	0	3	2	3	2	3

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply advanced engineering knowledge to solve industry-oriented problems.
PSO2	Utilize modern tools and technologies for industrial automation.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
2. Bartodziej, Christoph Jan,"The Concept Industry 4.0".
3. Klaus Schwab,"The Fourth Industrial Revolution".
4. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

(b) Open-source website:

1. www.nptel.ac.in/

Suggested Course Practical List:

List of Laboratory/Learning Resources Required:

Nil

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101601

Course/Subject Name: Computer Aided Design

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Core

Prerequisite:	**Nil**
Rationale:	**Nil**

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	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: - BE101601

Course/Subject Name: Computer Aided Design

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Introduction:** • A typical product cycle, CAD tools for the design process of product cycle, • CAD / CAM system evaluation criteria, Input / Output devices; • Graphics Displays: Refresh display, DVST, Raster display, • pixel value and lookup table, • estimation of graphical memory, LCD, LED fundamentals. • Concept of Coordinate Systems: Working Coordinate System, • Model Coordinate System, Screen Coordinate System. • Line and Curve generation algorithm: DDA, Bresenham's algorithms. • Graphics exchange standards and Database management systems	5	10
2	**Curves and Surfaces:** • Parametric representation of lines: Locating a point on a line, • parallel lines, perpendicular lines, distance of a point, • Intersection of lines. Parametric representation of circle, Ellipse, parabola and hyperbola. • Synthetic Curves: Concept of continuity, • Cubic Spline: equation, properties and blending. • Bezier Curve: equations, properties; • Properties and advantages of B-Splines and NURBS. • Various types of surfaces along with their typical applications.	7	20
3	**Mathematical representation of solids:** • Geometry and Topology, Comparison of wireframe, • surface and solid models, Properties of solid model, • properties of representation schemes, Concept of Half-spaces, • Boolean operations. Schemes: B-rep, CSG, Sweep representation, • ASM, Primitive instancing, Cell Decomposition and Octree encoding.	4	10
4	**Geometric Transformations:** • Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D; • Orthographic and perspective projections. • Window to View-port transformation.	5	10
5	**Finite Element Analysis:** • Review of stress-strain relation and generalized Hooke's Law, • Plane stress and Plane strain conditions; Concept of Total Potential Energy; • Basic procedure for solving a problem using Finite Element Analysis. • 1-D Analysis: Concept of Shape function and natural coordinates,	18	40

	• strain - displacement matrix, derivation of stiffness matrix for structural problems, properties of stiffness matrix. • 1-D structural problems with elimination and penalty approaches, 1-D thermal and fluid problems. • Trusses and Beams: Formulation of stiffness matrix, • simple truss problems to find displacement, • reaction and stresses in truss members. • Structural analysis using Euler-Bernoulli beam element.		
6	**Engineering optimization:** • Introduction to optimization techniques design of Machine Elements, • Johnson's method	**4**	**10**
	Teaching hours	**43**	**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	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Demonstrate basic concepts of computer-aided design and its applications.	Understand
CO2	Make use of various concepts and characteristics in geometric modeling.	Apply
CO3	Analyze geometric transformations in 2D and 3D space.	Understand
CO4	Determine stress and strain in structural elements through finite element analysis (FEA).	Apply
CO5	Summarize optimization techniques for design of machine elements.	Understand

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101601

Course/Subject Name: Computer Aided Design

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

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	0	2
CO2	3	2	3	0	3
CO3	3	2	3	0	3
CO4	3	3	3	3	3
CO5	3	3	3	2	3

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply CAD tools and techniques for solving engineering design problems.
PSO2	Use finite element analysis and optimization methods in designing and analyzing machine components.

CO-PSO MAPPING:

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

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101601

Course/Subject Name: Computer Aided Design

References/Suggested Learning Resources:

(a) Books:

1. Ibrahim Zied, CAD / CAM: Theory and Practice, McGraw-Hill
2. Hearn E J and Baker M P, Computer Graphics, Pearson. Internal Combustion Engines by Ganeshan, McGraw-Hill Education
3. Chandrupatla T A and Belegundu A D, Introduction to Finite Elements in Engineering, PHI.
4. Logan D, A First Course in the Finite Element Method, Cengage
5. David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", McGraw-Hill.
6. S.S.Rao, "Engineering Optimization", A wiley –Interscience.

(b) Open-source website:

- http://nptel.ac.in/

Suggested Course Practical List:

1. Prepare a programme for plotting lines and curves using algorithms learned.
2. Introductory exercise for 3-D modeling.
3. Exercise for advanced 3-D modeling.
4. Exercise for 3-D editing options.
5. Exercise for Assembly modeling.
6. Exercise for FEA of 1-D structural problems.
7. Exercise for FEA of trusses.
8. Exercise for FEA using Beam Element.
9. Exercise for FEA of 1-D thermal problems.
10. Exercise for FEA of 2-D structural problems.
11. Exercise for developing the optimization model of machine element using Johnson Method.

List of Laboratory/Learning Resources Required:

1. Computers / Workstations
2. CAD Software
3. FEA Software

SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Design of Heat exchangers

w.e.f. Academic Year:	2024-25
Semester:	6TH Semester/ 3 Year
Category of the Course:	Professional Elective -1

Prerequisite:	**Nil**
Rationale:	The course is design to provide fundamental knowledge of different type of heat exchangers used for various thermal applications and to learn the sizing of heat exchangers, thermal analysis for various heat exchange applications.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Different classification and basic design methodologies for heat exchanger:** Classification of heat exchanger, selection of heat exchanger, overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology	**11**	**25**
2.	**Design of double pipe heat exchangers:** Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop	**8**	**20**
3.	**Design of Shell & tube heat exchangers:** Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method	**10**	**25**

4.	**Design of compact heat exchangers**: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, plate heat exchanger, heat transfer and pressure drop	**10**	**20**
5.	**Heat Transfer Enhancement and Performance Evaluation:** Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.	**6**	**10**
	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
8%	23%	27%	17%	15%	10%

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC: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 appropriate heat exchanger for the given application and to measure the performance degradation of heat exchangers subject to fouling	Evaluating (E)
2	To analyse thermal and hydraulic performance of different types of compact heat exchangers.	Applying (A)
3	To compare various heat transfer enhancement techniques and to apply process optimization techniques for heat exchanger design	Applying (A)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping			
PO \ CO	CO-1	CO-2	CO-3
PO-1 Basic Engg Knowledge	3	3	3
PO-2 Problem Analysis	2	3	2
PO-3 Design/Development	2	3	3
PO-4 Investigations	2	2	2
PO-5 Modern Tool Usage	2	1	2
PO-6 Engineer & Society	1	1	1

PO-7 Environment & Sustainability	1	1	1
PO-8 Ethics	1	1	1
PO-9 Individual & Team Work	1	2	2
PO-10 Communication	2	2	3
CO-PSO Mapping			
PSO \ CO	**CO-1**	**CO-2**	**CO-3**
PSO1 (Automobile Manufacturing Skills)	3	2	3
PSO2 (Design and Analysis)	2	3	3
PSO3	2	2	3

References/Suggested Learning Resources:

(a) Books:

1. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press
2. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication
3. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill
4. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
5. Heat Exchanger Design Hand Book by Schunder E.U., Hemisphere Pub.
6. Process Heat transfer by Donald Q Kern, McGraw Hill

(b) Open source software and website:

- http://nptel.ac.in/
- www.learnerstv.com
- http://auto.howstuffworks.com/

(C) Suggested Course Practical List:

1. Design of heat exchange equipment by using LMTD method.
2. Design of heat exchange equipment by using effectiveness– NTU method.
3. Measure the effectiveness of shell and tube heat exchanger.
4. Design and analysis of Parallel flow and Counter flow heat exchanger.

5. Design and analysis of Shell and tube type heat exchanger.
6. Design and analysis of Plate type heat exchanger.

(D) List of Laboratory/Learning Resources Required:

1. Shell and tube heat exchanger,
2. Plate type heat exchanger,
3. Tube and tube heat exchanger,
4 Compact heat exchanger.

Suggested Project List:

1. Design and Fabrication of a Shell and Tube Heat Exchanger
2. Thermal Performance Analysis of Plate Type Heat Exchangers
3. Comparison of LMTD and NTU Methods in Heat Exchanger Design
4. Design Optimization of Compact Heat Exchanger for Automotive Applications
5. Effect of Fouling on Heat Exchanger Efficiency and Its Control Techniques
6. Design of Double Pipe Heat Exchanger for Industrial Cooling Systems
7. Simulation of Heat Exchanger Performance Using ANSYS/CFD Tools
8. Performance Evaluation of Heat Transfer Enhancement Techniques
9. Economic and Thermal Comparison of Different Heat Exchanger Types
10. Pinch Analysis-Based Optimization of Heat Exchanger Networks

SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

w.e.f. Academic Year:	2024-25
Semester:	6TH Semester/ 3 Year
Category of the Course:	Professional elective-2

Prerequisite:	**Nil**
Rationale:	This course introduces students to renewable energy sources and their applications. It helps them understand solar, wind, bio, and other energy systems, along with their design, performance, and economic analysis. The course supports the shift towards sustainable and clean energy solutions.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Scenario of Renewable Energy (RE) Sources:** Need of RE, advantages and limitations of RE, present energy scenario of conventional and RE sources.	1	10
2.	**Solar Energy:** Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation on horizontal, radiation on and tilted surface. Solar energy conversion into heat, types and working of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, losses in liquid flat plate collector, thermal analysis of liquid flat plate collector, air heater and cylindrical parabolic concentrating collector, solar energy thermal storage, Solar space heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air-conditioning, solar pond, heliostat, solar furnace, photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages.	19	30

3.	**Wind Energy:** Energy available from wind, basics of lift and drag, basics of wind energy conversion system, Betz limit theory, effect of density, angle of attack and wind speed, wind mill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm, Safety and environmental aspects, wind energy potential and installation in India	**8**	**20**
4.	**Bio Energy:** Biomass energy – modern energy carrier, energy plantation, gasification, types and applications of gasifiers, types of biogas plants, design of biogas plant, factors affecting biogas generation. advantages and disadvantages.	**4**	**10**
5.	**Ocean Energy:** OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations **Wave energy**: Wave energy conversion devices, advantages and disadvantages, Present scenario. **Geothermal energy:** Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications. **MHD Power generation:** concept and working principle.	**7**	**10**
6.	**Economic Analysis:** Initial and annual cost, Basic definitions Fundamentals of economic analysis, time value of money, payback period, present worth calculations, repayment of loan in equal annual installments, annual solar savings, cumulative saving and life cycle cost analysis, economic analysis of solar system, clean development mechanism	**6**	**20**
		45	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	**25%**	**30%**	**15%**	**10%**	**10%**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	To design and develop solar systems for various applications .	Create (C)
2	To estimate solar radiation on the various surfaces and its applications for thermal and photovoltaic system.	Apply (A)
3	To analyze the performance of various solar collectors	Analyze (N)
4	To evaluate the potential of wind energy conversion systems	Evaluate (E)
5	To illustrate Bio energy, Wave energy, Ocean energy and Geothermal Energy.	Understand (U)
6	To evaluate the life cycle cost and carry out economic analysis of renewable energy sources.	Create (C)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping						
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**	**CO-6**
PO-1 Basic Engg Knowledge	2	2	2	2	2	2
PO-2 Problem Analysis	2	3	2	2	2	3
PO-3 Design/Development	3	3	3	3	2	2
PO-4 Investigations	2	2	3	2	1	3
PO-5 Modern Tool Usage	2	2	1	2	1	1
PO-6 Engineer & Society	1	1	1	1	1	2
PO-7 Environment & Sustainability	2	2	1	2	2	2
PO-8 Ethics	0	0	0	0	1	0
PO-9 Individual & Team Work	1	1	1	1	1	1
PO-10 Communication	2	1	1	1	1	2
CO-PSO Mapping						
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**	**CO-6**
PSO1 (Automobile Manufacturing Skills)	3	3	2	2	2	3
PSO2 (Design and Analysis)	2	3	3	2	2	2

References/Suggested Learning Resources:

(a) Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, McGrawHill Education
2. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley, New York
3. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill
4. Non-Conventional Resources of Energy, G. S. Sawhney, PHI
5. Non-conventional energy resources, Shobh Nath Singh, Pearson India
6. Solar Energy Engineering, Soteris Kalogirou, Elsevier/Academic Press.
7. Principles of Solar Energy, Frank Krieth & John F Kreider, John Wiley, New York

(b) Open source software and website:

- http://nptel.ac.in/
- www.learnerstv.com
- http://auto.howstuffworks.com/

(C) Suggested Course Practical List:

1. To study and measure the solar radiation on horizontal and tilted surface using solar radiation measuring instruments.
2. To evaluate the performance of solar liquid flat plate collector.
3. To evaluate the performance of solar air heater.
4. To evaluate the performance of concentrating collectors.
5. To evaluate the performance of solar still.
6. To evaluate the performance of box type solar cooker.
7. To study the various types of wind mill and evaluate the performance parameter of wind. mill.
8. To study the various types of gasifier and biogas plant.
9. To study the ocean energy, wave energy, geothermal energy conversion systems.
10. To estimate the economics of the solar energy conversion equipment.
11.

(D) List of Laboratory/Learning Resources Required:

1. Pyranometer
2. Sunshine Recorder
3. Solar Power Meter

4. Solar Liquid Flat Plate Collector
5. Solar Air Heater
6. Cylindrical Parabolic Collector
7. Compound Parabolic Collector
8. Box-type Solar Cooker
9. Solar Drier
10. Solar Still

Suggested Project List:

1. Design and Fabrication of a Portable Solar Water Heater
2. Performance Analysis of a Box-type Solar Cooker
3. Development of a Low-cost Solar Dryer for Agricultural Use
4. Design and Testing of a Solar-Powered Mobile Charging Station

SWAMINARAYAN UNIVERSITY
THE RESERVOIR OF ALL KNOWLEDGE

Faculty of Engineering (Degree)

Semester – 6th

Course Title – Energy Conservation and Management

Course Code - BE101604

Types of Course - Professional Elective -3

Prerequisite - Nil

Rationale -

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		
L	T	P		E	M	I	V	150
3	0	2	4	60	40	20	30	

Detailed Syllabus –

Unit	Content	Hours
1	**Energy Scenario:** Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. **Energy Conservation Act 2001 and related policies:** Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction.	5
2	**Financial Management, Energy Monitoring and Targeting:** Investment-need, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity	6

	analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) **Energy Monitoring and Targeting:** Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)	
3	**Energy Management & Audit:** Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	**5**
4	**Energy Efficiency in Thermal Utilities and systems:** **Boilers:** Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation. **Steam System:** Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment of steam system, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers. **Furnaces:** Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery. Forging furnace heat balance, Cupola, non-ferrous melting, Induction furnace, performance evaluation of a furnace. **Insulation and Refractories:** Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss. Cold insulation. **Heat Exchangers:** Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc. **Waste Heat Recovery:** Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. **Cogeneration:** Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine. **Heating, ventilation, air conditioning (HVAC) and Refrigeration System:** Factors affecting Refrigeration and Air conditioning system performance and savings Opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system and saving potential, heat pumps and their applications, section on ventilation system, and performance assessment of window and split room air conditioners and star labels	**22**
5	**Energy and environment, air pollution, climate change:** United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).	**4**
	Teaching hours	**42**

Course Outcomes –

- To summarized the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation
- To infer the concept of financial management, energy monitoring and targeting.
- To apply the knowledge of energy audit for the energy management and operation of energy audit instruments.
- To analyze the energy saving area and improvement in efficiency of various thermal utilities and systems.
- To evaluate the net present worth in financial management and performance assessment of various thermal utilities and systems.

Reference Books –

- Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
- Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press.
- Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4.
- Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication.
- Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited byE J Wilson and D Gerard, Blackwell Publishing.
- Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994.

List of Practical –

- To study the various Acts and policy for the energy conservation.
- To study the financial analysis techniques, energy performance contracts, role of energy service companies and evaluate net present worth for the finance.
- To study the elements of energy monitoring and targeting, techniques, CUSUM and Energy Management Information Systems (EMIS).
- To study and perform the use of energy audit instruments and prepare the energy audit report.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the boiler.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the steam system.
- To study the types of insulation and refractories, economic thickness of insulation and selection criteria for the insulation and refractories.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the furnace.
- To study and performance evaluation and energy saving opportunities for the window and split air-conditioner.
- To study the framework for climate change, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures and case of CDM

Open Sources –

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

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101605

Course/Subject Name: Applied Thermodynamics

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Core

Prerequisite:	**Nil**
Rationale:	**Nil**

Teaching and Examination Scheme:

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

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101605

Course/Subject Name: Applied Thermodynamics

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Properties of gases and gas mixtures**: • Avogadro's law, equation of state, Vander Waal's equation, • reduced properties, law of corresponding states, • compressibility chart, internal energy; • enthalpy and specific heat of a gas mixtures.	04	10
2	**Psychrometry:** • Dalton's law of partial pressure, Properties of moist air, • temperature and humidity measuring instruments, • psychometric chart, psychometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification, • chemical dehumidification, adiabatic.	8	13
3	**Refrigerant and Refrigeration cycles:** • Classification, nomenclature and desirable properties of refrigerant, • secondary refrigerants, ODP and GWP, • Compound compression with intercooler, • flash gas removal and flash intercooler, • Desirable characteristics of refrigerant absorbent pair for vapor absorption cycle, • Simple H_2O -NH_3 cycle, $LiBr_2$ – H_2O cycle and its working	8	13
4	**Fuel Air and Actual Cycles:** • Assumptions for fuel–air cycles, reasons for variation of specific heats of gases, • change of internal energy and enthalpy during a process with variable specific heats, • isentropic expansion with variable specific heats, • effect of variable specific heats on Otto, Diesel and Dual cycle, dissociation, • comparison of air standard and fuel air cycles, effect of operating variables, • comparison of air standard and actual cycles, • effect of time loss, • heat loss and exhaust loss in petrol and diesel engines,	8	13
5	**IC engine performance and Emissions**: • Measurement of indicated power, brake power, friction power, • fuel consumption and emission, calculation of brake thermal efficiency, • brake power and brake specific fuel consumption, • variable compression ratio engines, heat balance sheet, • principal engine emissions, source of engine emissions,	10	18

	• emission measurement instruments like five gas analyzer and smoke meter, • Euro and Bharat standards of emissions of I.C. Engines, • Emission control methods like Air injection, • Exhaust gas recirculation, Catalytic converter, • Evaporative emissions control.		
6	**Fundamentals of compressible flow**: • Ideal gas relationship, Adiabatic energy equation, • Mach number and its significance, Mach waves, Mach cone and Mach angle, • static and stagnation states, relationship between stagnation temperature, • pressure, density and enthalpy in terms of Mach number, • stagnation velocity of sound, reference speeds, • various regions of flow, Effect of Mach number on compressibility, • Area velocity relationship.	**8**	**13**
7	**Reciprocating Compressors:** • Construction and working, Multistage conditions for minimum work, • Intercooling, Efficiency and control of air compressors **Centrifugal Compressors:** • Essential parts, Static and total head properties, • Velocity diagram, Degree of reaction, surging and choking, • Losses in centrifugal compressor **Axial Flow Compressors:** • Construction of an axial flow compressor, • Aerofoil blading, Lift and drag, • Performance characteristics	**10**	**20**
	Teaching hours	**56**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
18	24	18	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101605

Course/Subject Name: Applied Thermodynamics

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Apply various gas laws of real gases and their mixtures, and use psychometric properties to identify basic processes.	Apply
CO2	Experiment with vapor compression and vapor absorption systems.	Understand
CO3	Explain fuel-air and actual cycles for IC engines and develop understanding of IC engine testing and emission norms.	Understand
CO4	Apply fundamentals of compressible fluid flow.	Apply
CO5	Demonstrate various air compressors and experiment with them.	Understand

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

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	0
CO2	3	3	2	3	2
CO3	3	3	3	2	0
CO4	3	2	2	0	0
CO5	3	2	2	2	3

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: BE101605

Course/Subject Name: Applied Thermodynamics

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply thermodynamic and fluid flow principles in mechanical engineering systems.
PSO2	Use simulation tools and experimental techniques for analyzing thermal systems and components.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
3. Internal Combustion Engines by Ganeshan, McGraw-Hill Education
4. Turbines, Compressors and Fans by S.M. Yahya., TMH Publishers
5. Fundamentals of Internal Combustion engine by H.N.Gupta, PHI Learning
6. Internal Combustion Engine Fundamentals by John B. Heywood, McGraw Hill Education Pvt Ltd.

(b) Open-sourcewebsite:

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

Suggested Course Practical List:

1. To understand different components of VCR system and to determine its COP.
2. To perform different psychometric processes and analyze the same using psychrometric chart.
3. To understand construction and working of window air-conditioner/ split air-conditioner and to determine its capacity.
4. To determine COP and apparatus dew point of an air conditioning test rig.
5. To determine $(COP)_C$ and $(COP)_H$ of heat pump.
6. To determine saturation efficiency of air cooler/air washer.

7. Performance test of 4 stroke Petrol Engine.
8. Performance test of 4 stroke Diesel Engine.
9. Determination of friction power of multi cylinder petrol engine using Morse Test Method.
10. Performance test on Reciprocating compressor.
11. To study the constructional details of axial flow compressor and draw its characteristics curve.
12. Performance test on Centrifugal compressor

List of Laboratory/Learning Resources Required:

1. VCR cycle test rig,
2. Mechanical heat pump,
3. psychometric processes apparatus,
4. window/split air conditioners,
5. air conditioning test rig,
6. air cooler/air washer,
7. 4 stroke petrol engine,
8. 4 stroke diesel engine,
9. Morse test apparatus,
10. reciprocating compressor test rig,
11. axial flow compressor test rig,
12. centrifugal compressor test rig

SWAMINARAYANUNIVERSITY

Program Name:

Engineering

Level: UG

Course/ Subject Code: BE101606

Course/Subject Name: Basics of Industrial Engineering

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Core

Prerequisite:	**Nil**
Rationale:	**Nil**

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	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: BE101606

Course/Subject Name: Basics of Industrial Engineering

CourseContent:

Unit No.	Content	No.of Hours	% of Weightage
1	**Location Selection and Plant Layout**: ● Nature of Location Decision, Importance of Plant Location, ● Dynamic Nature of Plant Location, Choice of site for selection, ● Comparison of location. Principles of Plant layout and Types, ● factors affecting layout, methods, factors governing flow pattern, ● travel chart, analytical tools of plant layout, ● layout of manufacturing shop floor, repair shop, services sectors and process plant. ● Quantitative methods of Plant layout: CRAFT and CORELAP, Relationship diagrams.	04	8
2	**Production Planning and Control**: ● Types of Production systems and their Characteristics, ● functions and objectives of Production Planning and Control, ● Sales forecasting: Techniques and Applications, ● Steps of Production Planning and Control: Process planning, Loading, ● Scheduling, Dispatching and Expediting with illustrative examples, ● Introduction to line of balance, assembly line balancing, and progress control	08	18
3	**Productivity and Work Study**: ● Definition of productivity, application and advantages of productivity improvement tools, reasons for increase and decreases in productivity. ● Areas of application of work study in industry. ● Reaction of management and labour to work study. **Method Study**: ● Objectives and procedure for methods analysis, ● Recording techniques, Operations Process Chart, Flow Process Chart, ● Man-Machine , Multiple Activity Chart, Travel Chart, ● and Two Handed process chart, String Diagram, Therbligs. ● Micro motion and macro-motion study: Principles of motion economy, ● Normal work areas and work place design. **Work Measurement:** ● Objectives, Work measurement techniques – time study, ● work sampling, pre-determined motion time standards (PMTS) Determination of time standards.	08	18

	• Observed time, basic time, normal time, • rating factors, allowances, and standard time. • Introduction to ergonomics		
4	**Job Evaluation and Wage Plan**: • Objective, Methods of job evaluation, job evaluation procedure, • merit rating (Performance appraisal), method of merit rating, • wage and wage incentive plans.	**10**	**18**
5	**Industrial Legislation**: • Need for Industrial legislation, Factories act 1948, • Industrial dispute act 1947, The Indian trade unions act 1926, • Industrial employment act 1946, Payment of wage act 1936, • Workmen compensation act 1923, • Payment of bonus act 1965, • Employees provident fund scheme 1952	**04**	**10**
6	**Entrepreneurship**: • Concept, product identification, infrastructure facilities, • preparation of project report, sources of industrial finance, • Resources allocation, Government incentives to entrepreneurs.	**04**	**10**
7	**Inspection and Quality Control**: • Inspection – functions, types, objectives and benefits, • quality control principles, Concepts of quality circles, • Total quality management, Quality assurance, Quality audit, • Basic Concept ISO 9000, ISO 14000 and QS 9000, • Six sigma: Concept, Principle, Methodology, Scope, • Advantage and limitations. **Statistical Quality Control**: • SQC Concept, variable and attributes, • normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability. • Acceptance sampling, sampling plans, OC curves and AOQ curves.	**05**	**10**
8	**Waste Management:** • Introduction and Meaning, • Reasons for generation and accumulation of obsolete, • Surplus and scrap Items, Identification and control of waste, • disposal of scrap	**03**	**8**
	Teaching hours	**45**	**100**

SWAMINARAYANUNIVERSITY

Program Name:

Engineering

Level: UG

Course/ Subject Code: BE101606

Course/Subject Name: Basics of Industrial Engineering

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	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Describe location decision, site selection and plant layout.	Apply
CO2	Demonstrate Production Planning and Control.	Apply
CO3	Analyse productivity, work study techniques, job evaluation and wage plans.	Apply
CO4	Illustrate Statistical Quality Control and inspection methods.	Understand
CO5	Understand Industrial Legislation, Entrepreneurship and Waste Management.	Understand

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

SWAMINARAYANUNIVERSITY

Program Name:

Engineering

Level: UG

Course/ Subject Code: BE101606

Course/Subject Name: Basics of Industrial Engineering

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	0	0
CO2	3	3	3	2	0
CO3	3	3	3	2	0
CO4	3	2	3	3	2
CO5	3	2	2	0	0

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply industrial engineering principles for improving productivity and efficiency in manufacturing systems.
PSO2	Utilize statistical tools and management techniques to enhance quality and decision-making processes.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Work study by International Labour Organization, ILO
2. Manufacturing Organization and Management, Harold Amrine, John Ritchey, Moodie, Kmec, 6ht Ed., Pearson
3. Industrial Engineering and Management, by Praveenkumar, Pearson

4. Production System, Planning, Analysis and Control – By J.L. Riggs 3rd ed. Wiley
5. Production and Operations Management – By R. Panneerselvam, PHI Private Ltd

(b) Open-source website:

1. https://nptel.ac.in/courses/

Suggested Course Practical List:

1. Case study demonstration on location decision and site selection
2. Tutorials on Production Planning and Control
3. Case study on plant layout problem
4. Exercise on OPC, FPC, Travel chart
5. Exercise on Method study, Motion Study and work measurement
6. Problems on wage and incentive plans
7. Exercise on statistical quality control techniques
8. Case study analysis of Entrepreneurship
9. Exercise on Waste management

List of Laboratory/Learning Resources Required:

Nil

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101607

Course/Subject Name: Computer Aided Manufacturing

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Elective - 2

Prerequisite:	**Manufacturing Processes, Manufacturing Technology**
Rationale:	**Nil**

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	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: - BE101607

Course/Subject Name: Computer Aided Manufacturing

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Computer Aided Manufacturing:** • CAM Concepts, Objectives & scope, • Nature &Type of manufacturing system, Evolution, • Benefits of CAM, Role of management in CAM, • Concepts of Computer Integrated Manufacturing, • Impact of CIM on personnel, Role of manufacturing engineers, • CIM Wheel to understand basic functions.	**05**	**10**
2	**NC and CNC Technology**: • Types, Classification, Specification and components, • Construction Details, Controllers, Sensors and Actuators, • CNC hardware: Re circulating ball screw, anti friction slides, • step/servo motors. Axis designation, NC/CNC tooling. • Fundamentals of Part programming, Types of format, • Part Programming for drilling, • lathe and milling machine operations, subroutines, do loops, canned Cycles, parametric subroutines.	**10**	**20**
3	**Programmable Logic Controllers:** • Relay Device components, • Programmable controller architecture, • programming a programmable controller, • tools for PLC logic design	**08**	**20**
4	**Group Technology and CAPP:** • Introduction, part families, • part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, • composite part concepts, Benefits of group technology. • Approaches to Process Planning, Different CAPP system, • application and benefits.	**07**	**20**
5	**Flexible Manufacturing System:** • Introduction & Component of FMS, • Needs of FMS, general FMS consideration, • Objectives, Types of flexibility and FMS, • FMS lay out and advantages. • Automated material handling system: Types and Application,	**04**	**10**

	• Automated Storage and Retrieval System, • Automated Guided Vehicles, Cellular manufacturing, • Tool Management, • Tool supply system, • Tool Monitoring System		
6	**Robot Technology**: • Introduction: Robot Anatomy, Laws of Robot, • Human System and Robotics, Coordinate system, • Specifications of Robot. Power sources, actuators and Transducers, • Robotic Sensors, Grippers, Robot Safety, • Robot Programming and Robot Applications, • Economic Considerations of Robotics system, • Robot Kinematics and Dynamics, Robot Arm Dynamics. • Concepts of Computer Vision and Machine Intelligence.	**05**	**10**
7	**Integrated Production Management System**: • Introduction, PPC fundamentals, Problems with PPC, • Introduction to ERP. • Just in Time philosophy: JIT & GT applied to FMS, • concepts of Expert System in Manufacturing and Management Information System.	**04**	**10**
	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	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101607

Course/Subject Name: Computer Aided Manufacturing

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Illustrate Computer Aided Manufacturing with NC, CNC, and PLC technology for industry applications.	Apply
CO2	Describe Group Technology and Computer Aided Process Planning (CAPP).	Apply
CO3	Explain Flexible Manufacturing Systems (FMS) with tools and equipment.	Understand
CO4	Describe Robot Technology for Computer Aided Manufacturing systems.	Apply
CO5	Demonstrate Integrated Production Management Systems.	Analyzing (An)

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

Course Outcome to Programme Outcome (CO-PO) Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	0	3
CO2	3	3	2	0	2
CO3	3	2	3	2	2
CO4	3	2	3	2	3
CO5	3	3	3	2	3

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101607

Course/Subject Name: Computer Aided Manufacturing

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply CAM tools and technologies for designing and implementing modern manufacturing systems.
PSO2	Utilize automation and integration techniques such as CNC, PLC, Robotics, and FMS in manufacturing systems.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Computer Aided Manufacturing by Tien Chien Chang, Pearson Education.
2. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P Groover, Pearson Education.
3. Robotics Technology and Flexible Automation, by S R Deb, S Deb, McGraw Hill Education Private Limited.
4. Flexible Manufacturing Cells and System -William. W. Luggen Hall, England Cliffs, Newjersy.
5. P.Radhakrishnan, “Computer Numerical Control ", New Central Book Agency, 1992.
6. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.
7. System Approach to Computer Integrated Manufacturing. Nanua Singh, Wiley and sons Inc, 1996.
8. Computer Aided Manufacturing- Rao, Tewari, Kundra, McGraw Hill, 1993.

(b) Open-source website:

1. www.nptel.ac.in
2. Videos on CNC programming, PLC, Robotics and FMS

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101607

Course/Subject Name: Computer Aided Manufacturing

Suggested Course Practical List:

1. Study of Computer Integrated System: Basics, Types of Manufacturing, role of management and CIM wheel
2. NC/CNC technology: Definition, Classification, Specification, Construction details, Sensors and Actuators, and different controllers.
3. CNC part Programming: Lathe and Milling jobs
4. Exercise on PLC for Simple problems.
5. PrOblems on GT and Industrial case problems on coding
6. Problems on CAPP and Industrial case problems
7. Study of Flexible Manufacturing system
8. Study of Robotics Technology
9. Study of Expert System in Manufacturing and MIS

List of Laboratory/Learning Resources Required:

1. CNC Machine
2. Industrial Robot
3. Programming Software.
4. CAD on Cloud Free software like Fusion 360

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101608

Course/Subject Name: Product Development and Entrepreneurship

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Elective - 2

Prerequisite:	**Nil**
Rationale:	Students will develop skills for evaluating, articulating, refining, and pitching a new product or service offering, either as a start-up business or a new initiative within an existing firm. This course is appropriate for all students interested in innovation and design as necessary components of new businesses today. The aims to acquaint the students with challenges of starting new ventures and enable then to investigate, understand and internalize the process of setting up a business.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	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: - BE101608

Course/Subject Name: Product Development and Entrepreneurship

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Product Development Processes:** • Characteristics of Successful Product development, • Generic development process, • Concept development: Concept generation process, • Concept selection, Concept Embodiment, Process flows. • Product life cycles, The challenges of Product development. • Reverse Engineering and Redesign Product development Processes.	6	15
2	**Product Planning and Customer Need:** • Identifying Opportunities, Evaluate and Prioritize, • Allocate resources and scheduling tools. • Identifying customer need: Types of customer needs, • Customer need models. • Gathering Customer needs: Need Gathering Methods, • Conducting Interviews: Like Dislike Method, Articulated-Use Method, • Product feel and Industrial Design. • Organizing and Prioritizing Needs: Grouping Interpreted needs, • Affinity Diagram, Determining need Importance, Customer use patterns, • Customers need Documentation	7	15
3	**Product Configuration and Design for Function:** • Design for function techniques, Function analysis, and function family tree. • Design Evaluation: Design for manufacturing methodology, • Design for assembly methodology, • Additional Assembly evaluation methods. • Product evaluation: Product design for disassembly, • Evaluation of Product for disassembly aspects in products, • Design for Product maintenance. Product specifications.	8	15
4	**Product Architecture and virtual Product Prototyping**: • Product Architectures type, Product Modularity and types, • Modular design and methods. • Advance functional methods: Function dependency, • Module heuristics and application. • Introduction to virtual reality, Design using virtual prototyping, • Application of digital tools, Introduction to Additive manufacturing.	6	15

5	**Entrepreneurship:** • Concept, knowledge and skills requirement; • characteristic of successful entrepreneurs; • role of entrepreneurship in economic development; • entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. • entrepreneurial approach and emergence of entrepreneurship.	**4**	**10**
6	**Starting the venture:** • Competitor and industry analysis; • feasibility study: market feasibility, technical/operational feasibility, • financial feasibility; drawing business plan; • preparing project report; presenting business plan to investors.	**4**	**10**
7	**Functional plans:** • marketing plan – marketing research for the new venture, • steps in preparing marketing plan, contingency planning; • organizational plan: form of ownership, designing organization structure, • job design, manpower planning; • Financial plan: cash budget, working capital, • Performa income statement, Performa cash flow, • Performa balance sheet, break even analysis.	**6**	**10**
8	**Issues related to Product development and Entrepreneurship:** • Legal issues: intellectual property rights patents, • trademarks, copy rights, • trade secrets, • licensing; franchising.	**4**	**10**
	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	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101608

Course/Subject Name: Product Development and Entrepreneurship

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Interpret Product design and development process.	Understand
CO2	Frame customer specifications to configure product with function.	Apply
CO3	Select product architecture and apply virtual prototyping.	Understand
CO4	Classify entrepreneurship for starting a venture.	Apply
CO5	Develop entrepreneurship functional plans with legal considerations.	Analyzing (An)

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

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101608

Course/Subject Name: Product Development and Entrepreneurship

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	0	0	0	2	1	0	0	0
CO2	3	3	2	3	0	0	0	0	1	2	0	0
CO3	2	2	3	3	3	2	0	0	2	1	0	0
CO4	1	1	2	1	0	0	0	3	2	2	1	0
CO5	1	2	2	1	0	0	0	3	3	3	3	0

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply principles of design and innovation to develop mechanical systems and products.
PSO2	Demonstrate entrepreneurship and management skills for establishing engineering ventures.

CO-PSO MAPPING:

CO \ PSO	PSO1	PSO2
CO1	3	0
CO2	3	0
CO3	2	1
CO4	0	3
CO5	0	3

References/Suggested Learning Resources:

(a) Books:

1. Product Design for Engineers, By Devdas Shetty, Cengage Learning
2. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.
3. Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill
4. Product Development, by Chitale & Gupta, Tata McGraw Hill
5. The Mechanical Process Design, by David Ullman, McGraw hill Inc
6. Engineering Design Process, by Yousef Haik, T M M Shahin, Cengage Learning
7. Product design & process Engineering by Niebel & deeper, McGraw hill
8. New Product Development Timjones. Butterworth Heinmann, Oxford.
9. Assembly automation and product design – by Geoffrey Boothroyd, CRC Taylor & Francis
10. Entrepreneurship, Hisrich, Robert D., Michael Peters and Dean Shepherded, , Tata McGraw Hill, ND
11. Entrepreneurship, , Brace R., and R., Duane Ireland, , Pearson Prentice Hall, New Jersy (USA).

12. Entrepreneurship Development and Small Business Enterprises, Charantimath, Poornima, Pearson Education, New Delhi.

(b) Open-source website:

1. www.nptel.ac.in

Suggested Course Practical List:

List of Laboratory/Learning Resources Required:

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101609

Course/Subject Name: Advanced Manufacturing Processes

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Elective - 3

Prerequisite:	**Nil**
Rationale:	**Nil**

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	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: - BE101609

Course/Subject Name: Advanced Manufacturing Processes

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Unconventional Machining Processes:** **Mechanical Energy Based Processes** • Abrasive Jet Machining (AJM), • Water Jet Machining (WJM), • Abrasive Water Jet Machining (AWJM), • Ultrasonic Machining (USM). • Working Principles – equipment used – Process parameters – MRR- Applications. **Electrical Energy Based Processes** • Electric Discharge Machining (EDM)- working Principle- equipment used - Process Parameters - Surface Finish and MRR - electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications. **Chemical and Electro-Chemical Energy Based Processes** • Chemical machining and Electro - Chemical machining (CHM and ECM) - Etchants – Maskant - techniques of applying mask ants - Process Parameters – Surface finish and MRR - Applications. • Principles of ECM - equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications. **Thermal Energy Based Processes** • Laser Beam machining and drilling (LBM), • Plasma Arc machining (PAM) and Electron Beam Machining (EBM). • Principles – Equipment –Types - Beam control techniques – Applications.	**25**	**50**
2	**Rapid Prototyping** **Introduction Stereo Lithography Systems** • Introduction: Need for the compression in product development, • history of RP systems, Survey of applications, Growth of RP industry, and • classification of RP systems. • Stereo Lithography Systems: Principle, Process parameter, • Process details, Data preparation, data files and machine details, Application. **Selective Laser Sintering Fusion Deposition modeling** • Selective Laser Sintering: Type of machine, Principle of operation, • process parameters, Data preparation for SLS, Applications. • Fusion Deposition Modelling: Principle, Process parameter, • Path generation, Applications.	**10**	**25**

	Solid Ground Curing • Principle of operation, Machine details, Applications. • Laminated Object Manufacturing: Principle of operation, • LOM materials. • Process details, application. **Concepts Modelers** • Principle, Thermal jet printer, Sand		
3	**Glass Science** • Glass and Glassy State, • Glass Compositions and Properties, • Raw Materials, Glass Melting, • glass furnace and furnace types, • Glass Forming Processes, • Glass processing, Application of Glass	**5**	**12**
4	**Composite Materials** • Introduction, Classification of composites, • Manufacturing methods : Spray Lay-Up, Wet/Hand Lay-up, • Vacuum Bagging, Filament Winding, Pultrusion, • Resin Transfer Moulding (RTM), Resin Film Infusion (RFI), • Mechanical Properties -Stiffness and Strength	**5**	**13**
	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**
30	10	20	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101609

Course/Subject Name: Advanced Manufacturing Processes

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Demonstrate the principles of advanced manufacturing processes.	Apply
CO2	Distinguish various metal removing processes based on surface finish.	Apply
CO3	Select appropriate advanced manufacturing processes as per raw materials and surface finish.	Understand
CO4	Identify appropriate advanced material processing techniques for different requirements and applications.	Analyzing (An)
CO5	Compare different advanced material processing techniques for industry applications.	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
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

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101609

Course/Subject Name: Advanced Manufacturing Processes

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	2	3	0	0	1	2	0	0	1
CO2	3	3	3	2	3	0	0	1	2	0	0	-
CO3	3	2	3	2	3	0	0	1	1	0	0	1
CO4	3	2	3	2	3	0	0	1	2	0	0	1
CO5	3	2	2	2	3	0	0	1	2	0	0	1

Program Specific Outcomes (PSOs)

PSO No.	Program Specific Outcome
PSO1	Apply modern machining and manufacturing technologies in mechanical engineering applications.
PSO2	Integrate advanced material processing techniques in product design and development.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Unconventional Machining process, Dr. Senthil, A R S Publishers
2. Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw-Hill
3. Design for Advanced Manufacturing: Technologies and Processes, LaRoux K. Gillespie, McGraw-Hill Education
4. Advanced Machining Processes / Non Traditional and Hybrid Machining Processes, Hassan El-Hofy,McGraw-Hill
5. The Handbook of Glass Manufacture, F.Tooley, Tooley, New York : Books for Industry, [1974]
6. 3D Printing and Additive Manufacturing: Principles and Applications, Chee Kai Chua and Kah Fai Leong, World Scientific

(b) Open-source website:

1. https://nptel.ac.in/courses/

Suggested Course Practical List:

1. Case Studies/ Brain storming for selection criteria for different manufacturing processes.
2. Case studies for cost estimation of various advanced manufacturing processes.
3. Case study of 3D Printing
4. Case study of design for advance machining processes.
5. 5 Case study of Rapid Prototyping

List of Laboratory/Learning Resources Required:

1. Lathe Machine,
2. Abrasive Jet Machining (AJM),
3. Water Jet Machining (WJM),
4. Abrasive Water Jet Machining (AWJM),
5. Ultrasonic Machining (USM).
6. Electric Discharge Machining (EDM),
7. Chemical machining and Electro - Chemical machining (CHM and ECM),
8. Laser Beam machining and drilling (LBM),
9. Plasma Arc machining (PAM)
10. Electron Beam Machining (EBM)
11. 3D Printer

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101610

Course/Subject Name: Machine Tool Design

w.e.f. Academic Year:	2024-25
Semester:	6th SEM / 3rd year
Category of the Course:	Professional Elective - 3

Prerequisite:	**Nil**
Rationale:	To develop comprehensive knowledge and understanding of working principles of machine tools. Students will be able to analyze the speed and feed regulation mechanisms of machine tools. Students will be able to design machine structures and guide ways for better stability and precision.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			**Total Credits L+T+(PR/2)**	**Assessment Pattern and Marks**				**Total Marks**
				Theory		**Tutorial / Practical**		
L	**T**	**PR**	**C**	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: - BE101610

Course/Subject Name: Machine Tool Design

CourseContent:

Unit No.	Content	No.of Hours	% of Weigh tage
1	**Introduction to Machine Tool Drives:** • Types and capabilities of machine tools, • Constructional and operational features, • General Requirements of Machine Tool Design, • Working and Auxiliary Motions in Machine Tools, • Kinematics of Machine Tools, Motion Transmission, • mechanical, hydraulic and electric drives.	3	8
2	**Regulation of Speed and Feed Rates:** • Speed and Feed Regulation, Layout of Speed Change Gears, • Saw Diagrams for Arithmetic, Geometric, • Harmonic and Logarithmic Progression of spindle speeds. • Establishment of Gear Ratios, • Layout of the Intermediate Reduction Gears, • Calculation of Transmission Ratios, Pulley Diameter, • Gear Wheel Diameters and Number of Teeth. Ray Diagram. Speed Chart., • Design of Speed Gear Boxes, Feed Drives, Feed Box Design	10	20
3	**Design of Machine Tool Structures:** • Functions of Machine Tool Structures and Their Requirements, • Design criteria for Machine Tool Structures, • Materials of Machine Tool Structures, Static and Dynamic Stiffness, • Profiles of Machine Tool Structures, • Basic Design Procedure of Machine Tool Structures, • Design of Beds, Columns, saddles, carriages, Bases and Tables.	6	15
4	**Design of Guideways and Power Screws :** • Functions and Types of Guide ways, Design of Slide ways, • clearance adjustment in slideways. • Design of Anti-Friction Guide ways, • Combination Guide ways and Aerostatic guideways. • Design of Power Screws and Recirculating ball screws	6	15
5	**Design of Spindles and Spindle Supports:** • Functions of Spindles and Requirements, • Effect of Machine Tool Compliance on Machining Accuracy, • Design of Spindles, • Antifriction Bearings	5	12

6	**Dynamics of Machine Tools:** • Machine Tool Elastic System, • Static and Dynamic Stiffness, Effects of vibration, • stability analysis. • Methods to reduce instability in machine tool like dampers, • vibration absorbers, • Machine Tool Chatter.	**5**	**12**
7	**Control Systems in Machine Tools:** • Machine tool control systems, • Control Systems for Speed and Feed Changing, • Adaptive Control Systems,	**4**	**10**
8	• Ergonomics and aesthetic design of machine tool, • Recent trends of machine tool.	**3**	**8**
	Teaching hours	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
22	28	10	-	-	-

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

Course Outcome:

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

No	Course Outcomes	RBT level
CO1	Summarize principles of machine tool kinematics, motion transmission, and control systems in machine tools.	Apply
CO2	Examine various possible speed charts and select appropriate combinations of gears to obtain various speeds and feeds in machine tools.	Analyzing (An)
CO3	Apply machine design fundamentals to design the machine tool structure, guideways, and spindle.	Apply
CO4	Evaluate the effect of machine components' stiffness and dampers on machine tool vibration.	Analyzing (An)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101610

Course/Subject Name: Machine Tool Design

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	3	2	2	3	0	0	1	2	0	0	1
CO2	3	3	3	3	3	0	0	1	2	0	0	-
CO3	3	2	3	3	3	0	0	1	1	0	0	1
CO4	3	2	3	3	3	0	0	1	2	0	0	1

Program Specific Outcomes (PSOs)

SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: UG

Course/ Subject Code: - BE101610

Course/Subject Name: Machine Tool Design

PSO No.	Program Specific Outcome
PSO1	Apply design principles for developing machine tools with enhanced accuracy and stability.
PSO2	Analyze and improve dynamic behavior of machine tools for industrial applications.

CO-PSO MAPPING:

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

References/Suggested Learning Resources:

(a) Books:

1. Machine Tool Design and Numerical Control, N K Mehta, McGraw-Hill.
2. Machine Tool Design Handbook, Central Machine Tool Institute, McGraw-Hill
3. Design of Machine Tools, S.K. Basu, D K Pal, Oxford and IBH Publishing.
4. Principles of Machine Tools, G C Sen, A Bhattacharya, New Central Book Agency.

(b) Open-source website:

1. https://nptel.ac.in/courses/

Suggested Course Practical List:

1. Study of motion transmission mechanisms in various machine tools.
2. Design and drawing of gear box and feed box for speed and feed transmission.
3. Design and analysis of machine structures.
4. Vibration analysis of machine tools.
5. Design and drawing of machine spindles and its supports.
6. Control analysis of machine tools.

List of Laboratory/Learning Resources Required:

1. Mechanical Workshop.
2. Drawing hall

Swaminarayan University

Teaching & Examination Scheme

Course – Faculty of Engineering (Degree)

Branch – Mechanical Engineering

Semester – 6th

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100601	Contributor Personality Development Program	Personality Development (Elective)	2	0	0	2	60	40	20	30	150
BE100602	Integrated Personality Development Course		2	0	0	2	60	40	20	30	150
BE101605	Applied Thermodynamics	Professional Core	4	0	2	5	60	40	20	30	150
BE101606	Basics of Industrial Engineering	Professional Elective - 1	3	0	2	4	60	40	20	30	150
BE101601	Computer Aided Design		3	0	2	4	60	40	20	30	150
BE101602	Design of Heat exchangers		3	0	2	4	60	40	20	30	150
BE101607	Computer Aided Manufacturing	Professional Elective - 2	3	0	2	4	60	40	20	30	150
BE101608	Product Development and Entrepreneurship		3	0	2	4	60	40	20	30	150
BE101603	Renewable Energy Engineering		3	0	2	4	60	40	20	30	150
BE101609	Advanced Manufacturing Processes	Professional Elective - 3	3	0	2	4	60	40	20	30	150
BE101610	Machine Tool Design		3	0	2	4	60	40	20	30	150
BE101604	Energy Conservation and Management		3	0	2	4	60	40	20	30	150
BE100602	Entrepreneurship and E-business	Open Elective - 2	3	0	0	3	60	40	0	0	100
BE100603	Industry 4.0		3	0	0	3	60	40	0	0	100
	Total		**18**	**0**	**8**	**22**					

L=Lecture,T=tutorial,P=Practical,E=TheoryExternal,M=TheoryInternal,I=PracticalInternal, V=Practical External