SGT University, Chandu-Budhera, Gurugram
Faculty of Engineering & Technology
Department of Mechanical Engineering

M. Tech. Mechanical Engineering
Scheme & Syllabus (2021-22)

Vision of SGT University

"Driven by Research & Innovation, we aspire to be amongst the top ten Universities in the Country by 2022"

Vision of the Department

Department endeavors to be recognized globally through outstanding education & research that produces qualified engineers who are ready to cater the everchanging industrial and social demands.

Mission of the department

- To create environment conducive for the quality teaching-learning interdisciplinary research and innovation.
- To establish academic system facilitating real learning in Mechanical Engineering.
- To prepare the graduates be leader in the profession.
- To inculcate universal human values, professional ethics and life-long learning attitude.
- To empower the learners to device their own unique path of education for acquiring multi specializations and skills.

Program Specific Outcomes

- **PSO1** To broaden and deepen the knowledge base with philosophical temperament and attitude by providing research environment for mechanical and allied engineering. To equip the students with integrity and ethical values so that, they become responsible technocrats around the globe.
- **PSO2** To brace the students with latest development and trends of technology in the area of interest by making the M. Tech. teaching scheme elective to facilitate the students to decide on the broad area of specialisation.
- **PSO3** To develop and enhance the research approach with a fair degree of novelty by practical skills to design experimentation, data acquisition and presentation, data reduction and interpretation by a full semester dissertation work based on a research problem.

Program Educational Objectives (PEOs)

- **PEO1** Acquire in depth knowledge in optimisation techniques for various manufacturing process.
- **PEO2** Achieve expertise in industrial automation design and development.
- **PEO3** Foster frontier technological research in thermal science and engineering area.
- **PEO4** Undertake design of machines/components/process to meet desired specifications of need and constraints.
- **PEO5** Undertake challenges in design and development related to industrial engineering put forth by the academia and industry.

Program Outcomes (POs)

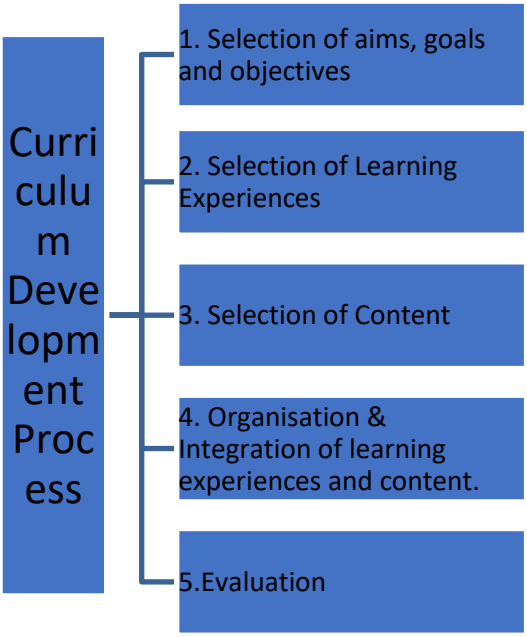
- **PO1** An ability to independently carry out research /investigation and development work to solve practical problems of Mechanical Engineering.

- **PO2** An ability to write and present a substantial technical report/document
- **PO3** Students should be able to demonstrate a degree of mastery in the area of Mechanical Engineering. The mastery should be at a level higher than the requirements in the bachelor program of Mechanical Engineering
- **PO4** An ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data for the solution of complex problems of manufacturing industries/institutions
- **PO5** An ability to develop and apply computer-based software and hardware tools for the analysis of problems related to mechanical design, manufacturing and automation fields.
- **PO6** An ability to apply the acquired knowledge to assess societal, safety, ethical issues and subsequently design / develop mechanical equipment's and systems

Curriculum Design & Development Process

Engineering Science is a new concept of multidisciplinary program that emphasizes enhanced understanding and integrated application of engineering, science and mathematics. B. Tech. in Mechanical Engineering gaining greater acceptance from the employers, as student are industry ready possessing greater skills. The B.Tech. courses are being carefully crafted after integrating inputs from leading national and international experts both from industries as well as academia. Here are some of the highlights of the program.

- Departmental subjects are introduced from 3rd semester onwards. The curriculum is based on a unique mix of basic sciences, humanities, core engineering, and discipline-specific subjects.
- There are many choices of elective subjects, which may or may not be related to the parent discipline comes under open elective.
- The Choice based credit system is introduced. CBCS provides a "cafeteria" type approach in which the students can take courses of their choice, learn as per interest, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.
- Huge emphasis is given on the industrial projects to address real-life issues and problems faced by the industries. Students are encouraged and facilitated to undergo training and internship during summer vacation to industries and/or national and international universities/research laboratories



List of programs being offered by the Department (with broad credit distribution)

A. M. Tech. Program

1. M. Tech. Mechanical Engineering

Note:

1. A student will be eligible to get Post Graduate degree with **Honours**, if he/she completes an additional 18-20 credits. These can be acquired through SWAYAM MOOCs. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.
2. Student can opt for any of the Value-Added Course subject outside from the Parent Institute leading to Holistic Development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc. These courses as mentioned in the curriculum can be opted from the University Pool which is circulated before the commencement of semester classes.

Curriculum for M. Tech. (Mechanical Engineering) Program

Semester Wise Course Structure

First Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.		Computer Aided Engineering	3	0	0	3	40	60	100
2.		Research Methodology and IPR	3	0	0	3	40	60	100
3.		Advanced Fluid Mechanics	3	0	0	3	40	60	100
4.		Elective-I	3	0	0	3	40	60	100
5.		Value Added Courses-I	2	0	0	2	40	60	100
6.		Computer Aided Engineering Lab	0	0	2	1	60	40	100
7.		Research Methodology and IPR Lab	0	0	2	1	60	40	100
8.		Seminar	0	0	2	1	-	100	100
		Total	**14**		**6**	**17**	**320**	**480**	**800**

S. No.	Elective-I	
1.		Advanced Design of Mechanical Systems
2.		Statistics for Decision Making
3.		Numerical & Optimization Methods
4.		Design of Solar and Wind System

Curriculum for M. Tech. (Mechanical Engineering) Program

Semester Wise Course Structure

Second Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.		Finite Element Analysis	3	0	0	3	40	60	100
2.		Vibration and Condition Monitoring	3	0	0	3	40	60	100
3.		Advance Heat Transfer	3	0	0	3	40	60	100
4.		Elective II	3	0	0	3	40	60	100
5.		Manufacturing Simulation Lab	0	0	2	1	60	40	100
6.		Vibration and Condition Monitoring Lab	0	0	2	1	60	40	100
7.		Seminar	0	0	2	1	-	100	100
		Total	**12**	**0**	**6**	**15**	**280**	**420**	**700**

S. No.	Elective-II	
1.		Advanced Mechanics of Solids
2.		Analysis of Manufacturing Processes
3.		Production & Operations Management
4.		Energy Conservation and Management

Curriculum for M. Tech. (Mechanical Engineering) Program

Semester Wise Course Structure

Third Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.		Computer Integrated Manufacturing System	3	0	0	3	40	60	100
2.		Elective-III	3	0	0	3	40	60	100
3.		Elective IV	3	0	0	3	40	60	100
4.		Elective V	3	0	0	3	40	60	100
5.		Value Added Courses-II	2	0	0	2	40	60	100
6.		Computer Integrated Manufacturing System Lab	0	0	2	1	60	40	100
7.		Identification of Research Problem	0	0	2	1	60	40	100
		Total	**14**	**0**	**4**	**16**	**320**	**380**	**700**

S. No.	Elective- III		S. No.	Elective-IV	
		Industrial Automation and Robotics	1.		Advance Operation Research
		Reliability Based Design	2.		Artificial Intelligence in Automation
		Technology & Manufacturing Strategies	3.		Machine Learning for Applications in Mechanical Engineering
		Thermodynamics and Combustion	4.		Air Conditioning & System Design

S. No.	Elective-V	
1.		Advance Tribology
2.		Hydraulic & Pneumatic Systems
3.		I.C. Engines Process Modeling
4.		Gas Turbines

Curriculum for M. Tech. (Mechanical Engineering) Program

Semester Wise Course Structure

Fourth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.		**Dissertation**	**-**	**-**	**20 W**	**20**		**100**	**100**
	Overall Total Credits = I to IV= 68								

1st Semester

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Computer Aided Engineering**	**L**	**T**		**P**	
3.Course Code		3	0		0	
4.Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5.Pre-requisite (if any)	**Basic of CAD**	**6.Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. Students learn the importance of CAD/CAM principles in the Product development, programs related to manufacturing using codes and analyze the importance of networking in manufacturing environment.

9. Learning objectives:

- **i)** To understand the basics of CAD/CAM and concepts of computer graphics.
- **ii)** To learn about the geometric issues concerned to the manufacturing and its related areas.
- **iii)** To understand the latest advances in the manufacturing perspectives and their applications.
- **iv)** To Understand the importance of CAD/CAM integration principles in the Product development

10. Course Outcomes (COs): On completion of this course, the students will be able to

- **i)** To understand the importance of CAD/CAM system.
- **ii)** To develop programs related to manufacturing using geometric modelling and graphics concept.
- **iii)** To analyze the of design application
- **iv)** To understand the importance of CAD/CAM integration principles in the Product development

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Overview of CAD/CAM Systems**

CAD/ CAM contents and tools, CAD/ CAM market trends, definition of CAD/ CAM tools, Industrial look at CAD/ CAM, CAD/ CAM Hardware, CAD/ CAM Software, Microcomputer Based CAD/CAM.

Unit – 2	**Number of lectures = 12**	**Title of the unit: Geometric Modeling & Graphics Concepts**

Types and Mathematical Representations of Curves, Parametric representation, Mathematical Representations of surfaces and Solids, Two- and Three-Dimensional Graphics Concepts: Geometrical Transformations, Visual Realism, CAD/ CAM Data Exchange.

Unit – 3	Number of lectures = 10	Title of the unit: Design Applications
Introduction of Finite Element Modeling and Analysis, General procedure of FEM, Development of integral equations, Discretization, Elements equations and Assembly, Imposing boundary conditions and applied loads, Solution of Global Equations, Convergence of FE solutions, Iso-parametric element matrices, shape functions, FE modeling, design and engineering applications.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: CAD and CAM Integration**
Review of NC and CNC Technology, Part Programming and Manufacturing, Integration requirements, Process Planning: Manual, Variant, Generative and hybrid approach, Geometric modeling for Process Planning, Part Programming: fundamentals of NC, Basics of NC programming, NC programming languages, Tool Path generation and verification		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book

i) M. Groover and E. Zimmer, CAD/ CAM Computer-Aided Design and Manufacturing,2014, ISBN:8177584162.

Reference Books

i) Mathematical Elements for computer Graphics by David F. Rogers and J. Alan Adams, McGraw Hill, New York, ISBN- 978-0070535305

ii) P N Rao , CAD/CAM Principles and Applications , TMG(McGraw Hill Education),2017,ISBN: 978-0070681934

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Research Methodology and IPR**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE ()**		**EAS (✔)**	
5. Pre-requisite (if any)	**None**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials =0**	**Practical = 0**			
8. Course Description						

This course is designed to help students to identify research problems in various fields. It aims at giving potential researchers the knowledge of effectively analyzing and interpreting results and presenting the findings to the scientific and technological community of the world. This course also aims at motivating students to bring about their creative ideas for innovation and establishing research impact in the global foray through intellectual ownership.

9. Learning objectives:

i) To develop the ability to perform research related activities.

ii) To recognize and ensuring the knowledge as a property.

iii) To understand the intellectual property rights and its constituents.

iv) To perform documentation and administrative procedures relating to IPR in India as well as abroad.

10. Course Outcomes (COs): On completion of this course, the students will be able:

i) To perform the formulation of research problem.

ii) To understand the plagiarism and follow research ethics.

iii) To understand the idea, concept and creativity in the research protected by copyright.

iv) To understand various forms of IPR, its relevance and impact on International Investments.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Introduction**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit – 2	**Number of lectures = 11**	**Title of the unit: Research Writing**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit – 3	**Number of lectures = 10**	**Title of the unit: IPR**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit – 4	**Number of lectures = 10**	**Title of the unit: IPR Today**

Unit-IV:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Kumar, R. (2010), "Research Methodology: A Step-by-Step Guide for Beginners", United Kingdom: SAGE Publications, ISBN: 9781446244777, 1446244776.

ii) Kothari, C. R. (2004), "Research Methodology: Methods and Techniques", India: New Age International (P) Limited, ISBN: 9788122415223, 8122415229

Reference Books:

i) Sinha, S.C. and Dhiman, A.K., (2002), "Research Methodology (set of Two Vol.)", India: Ess Ess Publications, ISBN: 9788170003243, 8170003245.

ii) Trochim, W. M. K. (2001), "Research Methods Knowledge Base", Germany: Atomic Dog Publication, ISBN: 9780970138590, 0970138598.

iii) Wadehra, B. L. (2004), "Law Relating to Patents, Trade Marks, Copyright, Designs and Geographical Indications", India: Universal Law Publication, ISBN: 9788175343825, 8175343826.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Advanced Fluid Mechanics**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite	**Fluid Mechanics & Machines**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 00**	**Practical = 00**			

8. Course Description:

This is an advanced course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the

fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. There is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance.

9. Learning Objectives:

- **i)** Understand how to apply the fundamentals of fluid mechanics in real life problems.
- **ii)** Enhanced understanding of fluid mechanics, including the equations of motion in differential form, and turbulence.
- **iii)** Understand turbulent flow and compressible flow fundamentals and applications.
- **iv)** Brief introduction to CFD analysis and current trends in fluid flow analysis.

10. Course Outcomes (COs):

- **i)** The students will have a strong fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.
- **ii)** Will get a review of basic principles of fluid mechanics.
- **iii)** Will be able to model compressible flow and turbulent flow
- **iv)** Will be able to model viscous flow in ducts
- **v)** Familiarize with the concept of CFD and its application in industry.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Review of Basic Concepts**

Conservation of mass, Reynolds s transport theorem, including the stream function, streamlines, examples. Momentum balance (Navier-Stokes Equations), including the definition of a Newtonian fluid, examples. Vorticity, velocity potential, Euler and Bernoulli's equation revisited, examples.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Turbulent Flow**

Introduction, growth of instability and transition from laminar to turbulent flow, effects of turbulence, classification of turbulence, Intensity and scale of turbulence, turbulent Intensity, scale of turbulence , Isotropic and Homogenous turbulence, Reynolds Equations of turbulence. Turbulence modeling; Boussinesq Eddy Viscosity concept, Prandtl mixing length concept, von – Karman similarity concept, Empirical correlations for coefficient of Friction, Average velocity distribution for smooth and rough pipes. Friction factor for smooth and rough pipes.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Compressible Flow**

Introduction, Wave propagation and sound velocity, Mach number and compressible flow regimes. Mach Core, Mach angle and mach Line. Basic equations for one dimensional compressible flow: continuity equation, momentum equation, Energy equation, Isentropic flow relations. Compressibility correction factor, Flow from a reservoir. Variation of velocity with Area ratio. Discharge through a convergent nozzle. Nozzles of the design pressure ratio. Normal Shock Waves.

Unit - 4	**Number of lectures = 10**	**Title of the unit: Viscous Flow in Ducts**

Stress deformation relations, Back to Navier- Stokes equations, Reynolds number Regimes, Internal Vs. External Viscous flow, Flow in circular pipes, Alternate forms of Moody Charts, Flow in Non-Circular ducts, Minor losses in pipe system, Fluid meters venturi, nozzles and orifices meters. Introduction to CFD and current industrial trends in fluid flow analysis.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) R.K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publication (P) Ltd. New Delhi. ISBN- 978-8-131-80815-3.

Reference Books:

i) Yunus A. Çengel (2010), Fluid Mechanics, Tata McGraw Hill, ISBN: 978-0-070-70034-5.

ii) Frank M. White (2011), Fluid Mechanics, 7th edition, Tata McGraw-Hill Education, ISBN-978-0-071-33312-2.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Advanced Design of Mechanical Systems**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE ()**	**OE ()**	**Specialization (✔)**	
5. Pre-requisite (if any)	**Mechanical Machine Design**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Design of Machine Elements is a required course for mechanical engineering students. This course is an introduction to the basic principles of modern engineering. It provides the students with fundamental skills of engineering and the ability to apply the theories of science to practice and understand the factors; such as stresses, deformations, and failure criteria, influencing the machine elements like shafts, springs, belts, bearings, gears etc. The main objective of design of machine element is that the machine should function properly to satisfy the needs of the customer and it should be safe against the predicted modes of failure.

9. Learning objectives: Students undergoing this course are expected to**:**

- **i)** To analyze the transformation of stresses and strains in 3D.
- **ii)** To study engineering properties of materials, force-deformation, and stress-strain relationship.
- **iii)** To study and differentiate between the static and fluctuation load considerations in design.
- **iv)** To understand various consideration of engineering Design.

10. Course Outcomes (COs): On course completion students will be able to:

- **i)** Solve the advanced practical problems related to the theory of elasticity, concepts of stress and strain, strain energy, and failure criteria.
- **ii)** To Propose materials and machine elements to the analysis of complex parts.
- **iii)** To apply the concept of fluctuating load consideration in the design of machine elements.
- **iv)** To identify and include the design considerations among various design philosophies.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Appreciative Review of Mechanics of Solids**

State of stress at a point and stress tensor; Transformation of stresses using elementary tetrahedran, principal stresses and 3D Mohr s circle; stress equations of equilibrium. Srain- displacement relations,

srain tensor, transformation equations for strains; strain Rossetes; Compatibility concept, need and physical significance, equations of compatibility; plane stress and plane strain.

Unit – 2	**Number of lectures = 11**	**Title of the unit: Appreciative Review of Strength of Materials**

Generalized Hook s law, elastic constants and their interrelationship; constitutive equations. Genesis of Factor of Safety and static failure theories with simple applications. Critical review of pure torsion, simple bending, buckling and deflection formulae with simple applications.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Design against Fluctuating Load**

Fluctuating Stresses: S-N diagram and endurance limit; Modified endurance limit estimation- notch sensitivity, surface finish, size, reliability factors etc. Design for finite and infinite life for reversed stresses as well as Fluctuating Stresses: Soderberg and modified Goodman diagrams; equivalent completely reversed stress for a given fluctuating load; cumulative fatigue damage and minor s equation.

Unit – 4	**Number of lectures = 11**	**Title of the unit: Engineering Design Philosophy**

Definition of engineering design; design Vs discovery; phases of engineering design problem identification and need analysis, feasibility analysis, preliminary and detailed design with simple illustrations depicting each phase; constraints, specifications and standardization in design, creativity and invention in design; brain storming, system design approach, concurrent engineering design.

Material Considerations in Design

Material consideration: Performance characteristics of engineering materials, material selection process and evaluation techniques.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Bhandari, V. B. (2016), "Design of Machine Elements", India: McGraw-Hill Education (India), ISBN: 9789339221126, 9339221125

ii) Shrinath L.S. (2009), "Advanced Mechanics of Solids", India: Tata McGraw-Hill Publishing Company Limited, ISBN: 9780070139886, 0070139881

Reference Books:

i) Jiang, W. (2019), "Analysis and Design of Machine Elements", Singapore: Wiley, ISBN: 9781119276104, 1119276101

ii) N. Krishna Raju (2018), "Advanced Mechanics of Solids and Structures", (n.p.): McGraw-Hill Education, ISBN: 9789353161682, 9353161681

iii) Rattan S.S. (2011), "Strength of Materials", India: McGraw-Hill Education (India) Pvt. Limited, ISBN: 9780071072564, 007107256X

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Statistics for Decision Making**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is designed to introduce the student to statistical methodology useful for data analysis and managerial decision-making. Emphasis will be placed on applications through working examples and computer-assisted data analysis in lab sessions.

9. Learning objectives:

- **i)** This course will give students a working knowledge of the ideas and tools of practical statistics.
- **ii)** Students will develop the skills of Graphical presentation of data (histograms, stem and leaf display, scatter plots).
- **iii)** Sampling distributions of various statistics with application of statistical inferences based on descriptive statistics.
- **iv)** Students will be able to learn Statistical inferences (hypothesis testing, confidence intervals).

10. Course Outcomes (COs): After the completion of the course, the student shall be able to

- **i)** explain basics of numerical summaries (mean, median, variance, standard deviation, correlation, regression) .
- **ii)** know the basics in probability theory (probability rules, independence and conditional probability, distributions, continuous distributions and density functions, random variables and their expected values).
- **iii)** perform statistical analyses, including one-way ANOVA, two-way ANOVA, simple and multiple regression, time-series analysis, chi-square tests, and nonparametric methods.
- **iv)** identify the limitations of statistical analyses and when they should or should not be used and Student can utilize statistical software to carry out appropriate statistical analyses.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Basics of Statistics**

Introduction to Statistics, Averages and Variation, Measures of Central Tendency (Mode, Median, Mean), Measures of Variation, Percentiles and Box-and-Whisker Plots, Correlation and Regression , Scatter Diagrams and Linear Correlation, Linear Regression and Coefficient of Determination, Elementary Probability Theory.

Unit – 2	Number of lectures = 10	Title of the unit: Probability
Introduction to Probability, Some Probability Rules—Compound Events, Tree Diagrams and Counting Techniques, The Binomial Probability Distribution and Related Topics, Introduction to Random Variables and Probability Distributions, Binomial Probabilities, Additional Properties of the Binomial Distributions.		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Distribution**
Normal Curves and Sampling Distributions, Continuous Random Variables, Graphs of Normal Probability Distributions, Standard Units and Areas Under the Standard Normal Distribution, Areas Under Any Normal Curve, Sampling Distribution, The Central Limit Theorem, Normal Approximation to the Binomial Distribution and to $\hat{p}$ Distribution,		
Unit – 4	**Number of lectures = 12**	**Title of the unit: Hypothesis Testing**
Hypothesis Testing, Introduction to Statistical Tests, Testing the Mean μ , Testing a Proportion p , Inferences about Differences , Tests Involving Paired Differences (Dependent Samples) Inferences about the Difference of Two Means $\mu 1 - \mu 2$, Inferences about the Difference of Two Proportions $p1 - p2$		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

http://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Understanding Basic Statistics (2015), C.H. Brase and C.P. Brase, Seventh Edition..ISBN-13: 978-1305254060

Reference Books:

i) Business Statistics, a Decision-Making Approach, 6th ed., David Groebner, P. Shannon, P. Fry, K. Smith, Prentice Hall, NJ, 2005, ISBN: 0130477850

ii) Statistics for Making Decisions(2021) by Nicholas T. Longford first edition ISBN 9780367342678

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Numerical and Optimization Methods**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**Engineering Mathematics**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Numerical methods are extremely powerful problem-solving tools. These tools are capable of handling large system of equations, nonlinearities and complicated geometries that are not uncommon in engineering practice and that are often impossible to solve analytically. Numerical methods are an efficient vehicle for learning to use computer. The course starts with the introduction of various types of errors and their sources that are encountered in implementation of these techniques. Students learn various methods in solving nonlinear equations and very large system of linear equations in the situation when analytical methods fail. They also learn to apply various interpolating methods along with the trade off in using them. Various available techniques for differentiation and integrations are discussed. Numerical solution of differential equations (Ordinary as well as Partial), that are often encountered when a dynamic system is modeled, is explained with special emphasis on standard equations such as heat equation, wave equation and Laplace equation. The practice session in computer Lab gives students an opportunity to learn the development of the code in C/C++ for implementation of these methods on a variety of problems.

9. Learning objectives:

To enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical method. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

10. Course Outcomes (COs): After the completion of the course, the student shall be able to

- **i)** Apply various numerical methods and appreciate a trade off in using them.
- **ii)** Understand the source of various types of errors and their effect in using these methods.
- **iii)** Distinguish between Numerical and Analytical methods along with their Merits and demerits.
- **iv)** Understand the use of digital computers in implementation of these methods.
- **v)** Develop a code in C/C++ for the solution of problems that may not be solved by analytical methods.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Errors in Numerical Calculations & Interpolation and Curve Fitting**
Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula. Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, Least squares line, curve fitting, Interpolation by spline functions.		
Unit – 2	**Number of lectures = 10**	**Title of the unit: Numerical Differentiation and Integration & Solution of Linear Systems and Nonlinear Equations**
Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cote's formula, Gaussian-Quadrature Direct Methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization, iterative methods for linear systems, bracketing methods for locating a root, Initial approximations and convergence criteria, Newton-Raphson and Secant methods		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Solution of Differential Equations & Partial Differential Equations, Eigen Values and Eigen Vectors**
Introduction to differential equations, Initial value problems, Euler s methods, Runge-Kutta methods, Taylor series method, Predictor- Corrector methods, Finite-difference method Solution of hyperbolic, parabolic and elliptic equations, eigen value problem, Power and inverse power methods, Jacobi s method for eigen value problems.		
Unit – 4	**Number of lectures = 12**	**Title of the unit: Optimization Methods & Multi-Variable Optimization Algorithms**
Optimal problem formulation, Engineering optimization problems; optimization algorithms: Single-variable optimization algorithms, optimality criteria, Bracketing methods, Region-elimination methods, Point estimation method, Optimality criteria, Uni-directional search, Direct search methods: Evolutionary methods, Simplex search method, Gradient based methods: Cauchy s method, Newtons method, Application to Mechanical Engg. Problems, Non- traditional optimization algorithms, Genetic algorithms (GA), GA for constrained optimization, other GA operators, Multi objective Optimization, Concept of Pareto Optimality, Global optimization.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. http://sgtlms.org Journal papers; Patents in the respective field.		
13. Books Recommended		
Text Book:		

i) Numerical Methods for Mathematics, Science and Engineering by John H.Mathews, PHI New Delhi.
Reference Books:
i) Applied Numerical Methods Carnahan, B.H., Luthar, H.A. and Wilkes, J.O., Pub.- J. Wiley, New York **ii)** Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York. **iii)** Introductory Methods of Numerical Analysis by S.D. Sastry, Published by Prentice Hall of India. **iv)** Numerical Methods Hornbeck, R.W., Pub.- Prentice Hall, Englewood Cliffs, N.J. **v)** Optimization for Engineering Design : Algorithms and Examples by Kalyanmoy Deb, PHI new Delhi **vi)** Numerical Optimization Techniques for Engineering Design: With Applications by Garret.

1. Name of the Department: Mechanical Engineering						
2. Course Name	**Design of Solar and Wind System**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Prerequisite	**Basic of Physics, Chemistry and Mathematic**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 00**			

8. Course Description:

According to many renewable energy experts, a small "hybrid" electric system that combines home wind electric and home solar electric (photovoltaic or PV) technologies offers several advantages over either single system. Many hybrid systems are stand-alone systems, which operate "off-grid" not connected to an electricity distribution system. For the times when neither the wind nor the solar system are producing, most hybrid systems provide power through batteries and/or an engine generator powered by conventional fuels, such as diesel. If the batteries run low, the engine generator can provide power and recharge the batteries.

However, Solar Energy System Design builds upon the introduction to PV systems from the Solar Energy Basics course, which included basic system components and functions, as well as some basic system sizing using simplifying assumptions. You should at this point have a basic understanding of electrical power and energy, be able to calculate the energy needs of a site as well as energy production potential for a PV system at a given location under optimal conditions. Much of this course will focus on incorporating on the ground conditions into energy production considerations, and how to account for these conditions in system design and equipment selection. By the end of this course you should be able to incorporate losses in irradiance due to array setups with less than optimal positioning and/or shading, and account for variations in module output due to temperature variations in your system design.

Additionally, at the end of this course you should be able to identify the concepts of other sources of renewable energy in the form of biomass and hydropower energies.

9. Course Objectives:

i) To identify renewable energy sources and their utilization.

ii) To provide basic knowledge of different renewable energy conversion principles.

iii) To harness the environment friendly Resources and to enhance their contribution to socio-economic development.

10. Course Outcomes (COs): At the end of this course, the learner will be:

i) Outline the principles of energy conversion from alternate sources.
ii) Outline the energy scenario in India and the world.
iii) Apply different methods to harness renewable energy sources.
iv) Analyze the performance of different renewable energy conversion machines.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Fundamentals of Solar Energy System**

Introduction, Energy science and Technology, Forms of Energy, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Roles and responsibility of Ministry of New and Renewable Energy Sources, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources, Non Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.

Introduction, Solar Radiation, Sun path diagram, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation on horizontal and tilted surfaces, Principle of Conversion of Solar Radiation into Heat, Collectors, Collector efficiency, Selective surfaces, Solar Water Heating system, Solar Cookers, Solar dryers, Solar Still, Solar Furnaces, Solar Green Houses. Solar Photovoltaic, Solar Cell fundamentals, Characteristics, Classification, Construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications. Government schemes and policies.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Wind Energy**

Introduction, History of Wind Energy, Wind Energy Scenario of World and India. Basic principles of Wind Energy Conversion Systems (WECS), Types and Classification of WECS, Parts of WECS, Power, torque and speed characteristics, Electrical Power Output and Capacity Factor of WECS, Stand alone, grid connected and hybrid applications of WECS, Economics of wind energy utilization, Site selection criteria, Wind farm, Wind rose diagram.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Biomass Energy**

Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Urban waste to Energy Conversion, Biomass Gasification, Types and application of gasifiers, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass, Biomass programs in India.

Unit - 4	**Number of lectures = 11**	**Title of the unit: Hydropower Energy**

Hydropower: Introduction, Capacity and Potential, Small hydro, Environmental and social impacts. Tidal Energy: Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of geothermal energy.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text books:

i) D. Y. Goswami, Principles of Solar Engineering, Third Edition, CRC Press, Taylor and Francis, 2015. ISBN- 13: 978-1-4665-6379-7.

ii) Garg and Prakash, Solar Energy, Fundamentals and Applications, Tata McGraw Hill, 2017. ISBN-13: 978-0074631416.

Reference Books:

i) Sukhatme. S.P, Solar energy: principles of thermal collection and storage. Tata McGraw Hill Publishing Company Ltd., 1997. ISBN- 0074624539 9780074624531.

ii) B. H. Khan, Non-Conventional Energy Resources, Third Edition, The McGraw Hill, 2017. ISBN-13: 978-9352601882.

iii) Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006. ISBN-13: 978-0415584388.

iv) Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 2012. ISBN-13: 978-0199681273.

v) Khandelwal, K.C., Mahdi, S.S., Biogas Technology – A Practical Handbook, Tata McGrawHill, 1986. ISBN-0074517236, 9780074517239.

vi) Tiwari. G.N., Solar Energy – Fundamentals Design, Modelling & Applications, Narosa Publishing House, New Delhi, 2002. ISBN-13: 978-0849324093.

1. Name of the Department- Mechanical Engineering							
2. Course Name	**Computer Aided Engineering Lab**	**L**		**T**		**P**	
3. Course Code		**0**		**0**		**2**	
4. Type of Course (use tick mark)		**Core (✔)**	**EAS ()**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)	**Basics of CAD**	**6. Frequency (use tick marks)**		Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 0		**Tutorials = 0**		**Practical = 28**			

8. Course Description

CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. Students learn the importance of CAD/CAM principles in the Product development, programs related to manufacturing using codes and analyze the importance of networking in manufacturing environment.

9. Learning objectives:

To provide the necessary foundation for students, in advance understanding of design and manufacturing problems in a systematic manner

- **i)** The course aims to deal with the concept of handling Finite Element Analysis software.
- **ii)** The course aims to deal with the concept of Structural analysis in a systematic manner.
- **iii)** The course aims to deal with the concept of CNC part programming.
- **iv)** The course aims to deal with the concept of CNC code generation.

10. Course Outcomes (COs): On completion of this course, the student will be able to:

- **i)** Gain practical experience in handling Finite Element Analysis software.
- **ii)** Understand and handle Structural analysis in a systematic manner.
- **iii)** Understand the concepts of CNC part programming.
- **iv)** Understand the concepts of CNC code generation.

11. Lab Component

Sr. No.	**Title**	**CO covered**
1	To study the Finite Element Analysis software	**i)**
2	To study the Structural analysis of Trusses	**ii)**
3	To study the Structural analysis of Beams.	**ii)**
4	To study of Plane stress/Plane strain analysis.	**ii)**
5.	To study the CNC part programming for Turning, External Thread Cutting and Drilling.	**iii)**

6	To study the CNC part programming for milling machine of Linear Interpolation, Circular Interpolation.	**iii)**
7	To study the CNC part programming for Facing, contour Tool and Groove Tool.	**iii)**
8	To study the CNC part programming for milling machine of Linear Interpolation, Circular Interpolation.	**iii)**
9	To study the CNC code generation using MASTER CAM mill.	**iv)**
10	To study the CNC code generation using MASTER CAM lathe.	**iv)**

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Research Methodology and IPR Lab**	**L**	**T**		**P**	
3. Course Code		0	0		2	
4. Type of Course (use tick mark)		**Core ()**	**PE ()**		**EAS (✔)**	
5. Pre-requisite (if any)	**English as language**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 00		**Tutorials =0**	**Practical = 28**			

8. Course Description

This course focuses on the composition of research papers as well as critical textual analysis and synthesis in academic discourse. Students will receive instruction and practice in conceiving, drafting, revising and completing papers based upon sources that challenge them to seek new information and to reflect upon its relevance to their own observations and experience. This course provides students with a variety of research and writing skills. Activities include writing assignments, readings on composition techniques, readings of literature and criticism, online discussions, and lessons on relevant grammar issues and formatting sound arguments.

9. Learning objectives:

i) To understand the general definition of research design.
ii) To understand the primary characteristics and issues of quantitative research and qualitative research.
iii) To conduct the step-by-step Literature review process.
iv) To acquire the writing skills by connecting and evaluating the quality of study.

10. Course Outcomes (COs): On completion of this course, the students will be able:

i) To distinguish between problem statement, hypothesis and research objective.
ii) To conduct the step-by-step Literature review process.
iii) To identify the dependent and independent elements involved in qualitative data collection.
iv) To structure and present the research findings with the conventions of scholarly writing.

11. Lab component

Sr. No.	**Title**	**CO covered**
1	Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	**i)**
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.	**i), ii)**

3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**ii), iii)**
4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	**iii)**
5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	**iv)**
6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**iv)**

2nd Semester

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Finite Element Analysis**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite	**Mechanics, Strength of Materials & Engineering Maths**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures = 42	**Tutorials = 00**	**Practical = 00**

8. Course Description

The finite element analysis (FEA) is among one of the most powerful tools for the numeric solution of wide range of engineering problems. The application ranges from deformation and stress analysis of civil and mechanical structures, automotive components, aircraft designs, heat flux analysis, fluid flow problems, electrical magnetic flux problem. Upon completion, students should be able to solve the problems in solid mechanics and heat transfer using FEA.

9. Learning Objectives:

i) To enable the students, understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis.

ii) To understand the characteristics of various finite elements.

iii) To develop finite element equations for simple and complex domains.

10. Course Outcomes (COs):

i) Will be introduced to the concepts of Mathematical Modeling of Engineering Problems.

ii) Will appreciate the use of FEM to a range of Engineering Problems.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction**

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Discretization of the problem**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration

frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

Unit - 3	**Number of lectures = 12**	**Title of the unit: FEM Analysis**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements. Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

Unit - 4	**Number of lectures = 10**	**Title of the unit: FEM problems**

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

Current trends in Finite element analysis applied to various industrial applications.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005, ISBN 13: 9780070607415.

Reference Books:

ii) Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007, ISBN-10: 8120323157.

iii) Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002, ISBN-13: 978-0471356059.

iv) Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 4th Edition, 2015, ISBN-10: 9332551820.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Vibration and Condition monitoring**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)	**Mechanical Vibrations**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

A structure or a body is said to vibrate if it has a to and fro motion. A greater proportion of human activities involve vibration in one form or the other. We hear because our eardrums vibrate. The cause and effects of vibration must be clearly understood. The structures designed to support the high-speed machines are subjected to inherent unbalance which causes problems. The unbalance may be due to faulty design or poor manufacture. Because of cyclic vibration, the material of the structure or the machine component may undergo fatigue failure. Vibration causes fasteners such as nuts of the machine to become loose. In metal machining processes, vibration may cause chatter, which results in poor surface finish. If the natural frequency of vibration of a machine or structure equals the forced frequency caused by external excitation, resonance occurs which causes dangerously large oscillations and the structure fails. A bridge can collapse due to wind-induced vibration. Critical instruments mounted on machines may loose their accuracy due to excessive vibrations. Vibrations can be used for useful works such as vibration testing equipments, vibratory conveyors, hoppers, sieves, compactors, washing machines.

9. Learning objectives:

i) To learn the basics of vibrations including causes and effects of vibrations.
ii) To study the undamped and damped free and forced vibration
iii) To study multi degrees of freedom system.
iv) To study vibration measuring instruments.

10. Course Outcomes (COs): At the end of the course, the student will be able to,

i) To understand basic concepts and one degree freedom system
ii) To study damped single degree freedom system-free and forced vibrations.
iii) To study multi degree freedom system and numerical techniques.
iv) To learn the working and applications of vibration measurement instruments**.**

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Basic Concepts and One Degree Freedom System**

Concept of free and forced vibration using spring mass model, governing equation and response to an initial disturbance for an undamped spring mass system; Concept of linear and non-linear vibratory system. Natural frequency and its determination using the concept of equivalent system and energy

methods - Average energy principle, principle of conservation of energy; principle of virtual work - Hamilton s principle and Lagrange s equation.		
Unit – 2	**Number of lectures = 10**	**Title of the unit: Damped Single Degree Freedom System-Free and Forced Vibrations**
Damping models with stress on viscous damping; Governing equation and response for over damped, critically damped and under damped systems; Logarithmic decrement and its practical significance; negative damping self exited vibration. Governing equation under harmonic excitation and response using technique of calculus and phasor diagram; Active and passive vibration isolation, transmissibility; bending critical speeds of simple staffs; Support motion; seismometer, accelerometer;		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Multi Degree Freedom System and Numerical Techniques**
Concept of mode shape through 2- DOF system governing equations and response under general initial conditions; vibration absorber; Eigen value problems close coupled system and far coupled system; orthogonality of mode shapes. Dunkley's lower bound approximation, Rayleigh s upper bound approximation; Myklestad- Prohl method for far coupled system; finite element method for far coupled system as well as closed coupled system.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Vibration Measurement and Condition Monitoring**
Basic vibration measuring set up amplitude and phase measurement; vibration pick- ups general construction and working principle of piezoelectric accelerometer and eddy current based displacement probe; filters- unfiltered and filtered signals; Display devices- vibration analyzer and oscilloscope; general construction and working principle of electro-dynamic vibration shaker. Fourier series &Fourier Transforms, Fast Fourier Transform (FFT), concept of time domain and frequency domain. Condition Monitoring Philosophy its need and types; concept of 1X, 2X, 3X, --- vibration signals in a rotating machine; Time domain analysis- time waveform, orbit analysis, phase analysis; Frequency domain analysis: frequency spectrum, bode plot, cascade plot; Recent techniques of condition monitoring, Current industry trends.		
12. Brief Description of self learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://sgtlms.org Journal papers; Patents in the respective field.		
13. Books Recommended		
Textbook		
i) Theory and Practice of Mechanical Vibrations by Rao J S and Gupta K (edition 2); New Age Publication, ISBN: 978-8122412154		
Reference Books		
i) William T. Thomson (2005), Theory of vibration with applications, 5th Edition, Pearson Education India. ISBN: 978-8-131-70482-0.		
ii) Mechanical Vibrations by S. S. Rao (2018) Pearson Education; Sixth edition, ISBN: 978-		

9353062569.

iii) G K Grover (2009), Mechanical Vibrations, Nem Chand & Bros. Roorkee , ISBN 978-8185240565

1. Name of the Department	**Mechanical Engineering**					
2. Course Name	**Advanced Heat Transfer**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		Core (✔)	PE ()		OE ()	
5. Prerequisite (if any)	**Heat and Mass Transfer**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials = 0	Practical = 0			

8. Course description

An introductory course in heat and mass transfer covering conduction, convection and radiation heat transfer, principles of heat exchanger and mass transfer. Heat transfer and mass transfer are kinetic processes that may occur and be studied separately or jointly. Studying them apart is simpler, but both processes are modelled by similar mathematical equations in the case of diffusion and convection (there is no mass-transfer similarity to heat radiation), and it is thus more efficient to consider them jointly. Besides, heat and mass transfer must be jointly considered in some cases like evaporative cooling and ablation.

9. Learning objectives:

i) To comprehend and evaluate various modes of heat and mass transfer.
ii) To design fin enhanced systems, evaporators, condensers and heat exchangers.
iii) To understand boundary layer theory, condensation and boiling.
iv) To determine effectiveness of heat exchangers using LMTD and NTU.

10. Course Outcomes (COs): On completion of this course, the students will be able to

i) Apply basic principles of fluid mechanics, thermodynamics, heat transfer for designing heat and mass transfer systems.
ii) Model heat, mass and momentum transport systems and develop predictive correlation.
iii) Assess and evaluate various designs for heat and mass transfer and optimize the solution.
iv) Apply the basic principles of heat exchanger applications.

11.Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Title of the unit: Conduction**

Introduction
Reviews of basic laws of Conduction, Convection and Radiation

Steady State Heat Conduction
Thermal insulation problem, Extended surfaces- Fins with uniform cross-sectional area, Fins variable cross-sectional area- circumferential, triangular and parabolic shape, Fin effectiveness and efficiency, thermal contact resistance. Methods for the solution of the Multi-Dimensional heat conduction problem: Analytical Method, Graphical Method, Electrical Analogy, Numerical Methods, Numerical.

Unit – 2	**Number of lectures = 11**	**Title of the unit: External Flow and Forced Convection**

External Flow and Forced Convection
Introduction, Exact and approximate integral solutions for the flow over flat plate, hydrodynamic & thermal boundary layer, boundary layer thickness, drag coefficient, mean drag coefficient, The local & average heat transfer coefficient, mass flow through the boundary, Turbulent flow over flat plate, Reynolds analogy, Reynolds-Colburn analogy, Drag & heat transfer in mixed boundary layer, Flow over curved surfaces, Cylinder, Sphere, Cross flow over banks of tubes, Numericals.

Unit – 3	**Number of lectures = 11**	**Title of the unit: Convection and Phase Heat Transfer**

Internal Flow and Forced Convection
Introduction, Entrance region, Fully developed region, Mean velocity, Mean temperature, Governing differential equation and velocity profile for fully developed laminar tube flow, Hagen-Poiseuille equation, Fanning friction coefficient, Heat transfer for fully developed laminar tube flow: Governing differential equation, heat transfer coefficient for constant wall temperature and constant wall heat flux boundary conditions, Velocity distribution in turbulent flow through pipe, Fluid friction, Convection Correlations for turbulent flow in tubes: Reynolds Analogy, Reynolds-Colburn analogy, Dittus- Boelter equation, Sieder and Tate equation, Petukhov expression, Numerical.

Two Phase Heat Transfer
Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Nucleate and film boiling, Heat pipe.

Unit – 4	**Number of lectures = 11**	**Title of the unit: Radiation and Heat Exchanger**

Heat Exchangers
Classification and selection of heat exchangers, Some important definitions, Heat Exchanger Analysis: Use of LMTD, Multipass heat exchangers, Effectiveness NTU Method, Plate heat exchanger, evaporative tubular heat exchanger, Evaporative Effectiveness, Dryout heat flux, Design of Shell and Tube Heat Exchanger, Simulation of heat exchangers, Pressure drop and Pumping power, Optimisation of heat exchanger size, Numericals.
Thermal Radiation
Review of basic laws for radiation-, Black body concept, gray body radiation, Solar radiations, Radiation between surfaces- Shape factor and correlations, Radiation exchange between surfaces in

black enclosure, Network representation, Radiation exchange in gray enclosure, apparent emissivity of a cavity, Radiation shields, Radiations in emitting and absorbing media.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Books:

i) R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd. ISBN: 978-8-122-40076-2.

ii) P. K. Nag (2005), Heat Transfer, Tata McGraw Hill Publishing Company Limited. ISBN: 978-0-070-60653-1.

Reference Books:

i) J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.

ii) Dewitt Lavine, Bergmann and Incropera (2010), Fundamentals of Heat and Mass Transfer, 6th Edition, John Wiley & Sons, ISBN: 978-8-126-52764-9.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Advanced Mechanics of Solids**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**	**OE ()**	**Specialization ()**	
5. Pre-requisite (if any)	**Engineering Mechanics**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Advanced Mechanics of Solids (also known as Mechanics of Materials) is the study of the internal effect of external forces applied to structural member. Stress, strain, deformation deflection, torsion, flexure, shear diagram, and moment diagram are some of the topics covered by this subject. The knowledge of this subject is a must in Civil Engineering, Mechanical Engineering,

The main part in this subject is

1. Focuses on the strength of materials and structural components subjected to different types of force and thermal loadings.
2. Investigates materials subjected to different types of force and thermal loadings
3. Emphasizes actual operating conditions.

9. Learning objectives: Students undergoing this course are expected to**:**

i) To impart concepts of stress and strain analysis in a solid.
ii) To understand the effect of torsion on shafts and springs.
iii) To study the methodologies in theory of elasticity.
iv) To acquaint with the solution of advanced bending problems.

10. Course Outcomes (COs): On course completion students will be able to:

i) Thorough understanding of the fundamental concepts of stress and strain in mechanics of solids and structures.
ii) A sufficient knowledge in designing shafts to transmit required power and also springs for its maximum energy storage capacities.
iii) To apply the principles of solid mechanics to solve engineering problems and to design systems or thick and thin components to meet desired needs.
iv) To know the mechanism of load transfer in beams, the induced stress resultants and deformations.

11. Unit wise detailed content

Unit-1	Number of lectures = 10	Title of the unit: Three-Dimensional Stress & Strains

State of stress at a point, Determination of stresses on plane of general position, Principal axes and principal stresses, Various types of state of stress, state of strain, Generalized Hooks law geometric representation, the three-dimensional Mohr s circle, stress strain relationship.

Stress Concentration

Stress concentration in tension and compression members, Stresses in a plate with a circular hole, Stress concentration in torsion and bending, Circular shafts of variable diameter, investigation of stress concentration, Geometric stress raisers and the mitigation of stress concentration.

Unit – 2	Number of lectures = 11	Title of the unit: Torsion

Pure shear and its characteristics, Torsion of rods of non-circular and hollow cross-sections, Membrane analogy, Thin-walled tubes and rectangular sections, Thin-walled open sections, Warping of sections.

Theory of Fatigue

General considerations, Basic characteristics of a cyclic loading and the fatigue limit, Effects of stress concentration on fatigue strength, Effect of surface finish and dimensions of a part on fatigue strength, Factor of safety in cyclic loading, Goodman diagrams.

Unit – 3	Number of lectures = 10	Title of the unit: Plates and Shells

Determination of stress in symmetrical shells by the membrane theory, bending of symmetrically loaded circular and rectangular plates, Bending of cylindrical shells under symmetrical loading.

Thin-Walled Bars:

Typical features of thin-walled bars, shear stresses in thin-walled bars under transverse bending, Shear center, General loading case of thin-walled bars.

Unit – 4	Number of lectures = 11	Title of the unit: Plastic Theory of Bending

Assumptions in plastic theory, Collapse load and load factor, Plastic moment of resistance, Plastic modulus and shape factor, Derivation of formulae and their application for simply supported beams, Cantilevers and fixed beams.

Beams on Elastic Foundations:

The infinite beam, Bending moments and deflections with
concentrated forces and couples, non-uniformly distributed loads, Semi-infinite beams, Finite beams, Applications to rail-road tracks.

12. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

iii) Shrinath L.S. (2009), "Advanced Mechanics of Solids", India: Tata McGraw-Hill Publishing Company Limited, ISBN: 9780070139886, 0070139881

iv) Rattan S.S. (2011), "Strength of Materials", India: McGraw-Hill Education (India) Pvt. Limited, ISBN: 9780071072564, 007107256X

Reference Books:

iv) N. Krishna Raju (2018), "Advanced Mechanics of Solids and Structures", (n.p.): McGraw-Hill Education, ISBN: 9789353161682, 9353161681

v) Hartog, J. P. D. (2014), "Advanced Strength of Materials", United States: Dover Publications, ISBN: 9780486138725, 0486138720

vi) Boresi, A. P., Schmidt, R. J. (2019), "Advanced Mechanics of Materials", United States: Wiley, ISBN: 9781119667018, 1119667011

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Analysis of Manufacturing Processes**	**L**	**T**		**P**	
3.Course Code		3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5.Pre-requisite (if any)	**Pre-requisites: Manufacturing Technology**	**6.Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The Course includes the different types of materials, machinability and economics of machining. Stress strain relationship and deformation processes. It includes casting and welding metallurgy

9. Learning objectives: The course aims to aware the students about the tool materials, Merchant and Lee Shaffer theories. Deformation process and yield criteria. The casting process and the problems. It also aims welding metallurgy

- **i)** Understand the basic concept of advances in cutting tool material.
- **ii)** Understand the basic concept of economics of metal machining.
- **iii)** Understand the basic concept of bulk deformation process and behavior of materials.
- **iv)** Understand the basic concept of casting process and gated system and the problems.
- **v)** Understand the basic concept of different welding technologies and metallurgy behind the processes.

10. Course Outcomes (COs): On completion of this course, the students will be able to:

- **i)** Acquire knowledge of the advances in cutting tool material.
- **ii)** Acquire knowledge of the economics of metal machining.
- **iii)** Acquire knowledge of the bulk deformation process and behavior of materials.
- **iv)** Acquire knowledge of the casting process and gated system and the problems.
- **v)** Acquire knowledge of the different welding technologies and metallurgy behind the processes.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Competitive Cutting Tool Material, Machinability and Economics of Machining**

Characteristics of tool material, advances in cutting tool material, role of coating.
Need for rational approach to the problem .of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers, Machinability, evaluation of Machinability, mechanism of tool failure, tool wear mechanism, tool life and tool life equation, factors affecting. Machinability surface finish and surface integrity. Economics of machining, cost of turning operation, optimum cutting speed for minimum cost and maximum rate of production.

Unit – 2	Number of lectures = 12	Title of the unit: Bulk Deformation Process
Stress-Strain relations in Elastic and plastic deformations, Yield criteria for ductile metals, work hardening and anisotropy in yielding Flow curves. Slip Line Field Theory, Effects of temperature and strain rate in metal working, friction and Lubrication in Hot and Cold working. Technology and analysis of important metal forming processes - Forging, Rolling, Extrusion, Wire drawing, Sheet metal forming processes		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Casting process and Gated system**
Casting Introduction, Features of Casting problems, Survey and Scope of Foundry Industry, Solidification of pure metals, Nucleation and growth in alloys, Solidification of actual casting, Progressive and directional solidification, Centre-line feeding resistance, Rate of solidification, Chvorinov s rule. **Gating and Risering Systems:** Gating systems and their characteristics, Effects of gates on aspiration, Turbulence and dross trap, recent trends, Riser design, Risering curves, NRL method of riser design, Feeding distance, Risering of complex casting, Risering of alloys other than steel, Riser design by geometrical programming.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Welding Metallurgy**
Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, cast iron and aluminum and alloys, Weld testing standards, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials. Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament		

12. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) M.C. Shaw ,Metal Cutting Principles Oxford Clarendon Press,2019,ISBN: 978-0198086116.

Reference Books:

i) Bhattacharya ,Metal Cutting Theory and Practice New Central Book Agency29, 2016, ISBN,8173812284

ii) Richard L. Little ,Welding and Welding Technology, Tata McGraw Hill,2017 Ltd.ISBN: 978-0070994096

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Production & Operations Management**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**Production Technology**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Any or every organization is a system of operations, whether or not called 'operations. Ultimate goal or purpose of such a system being production of goods and/or services and to carry them tills the point of time and place of consumption. Therefore, operations management involves everything an organization does and hence every manager is an operations manager. Production and Operations Management (POM) focuses on carefully managing the processes to produce and distribute products and services." Conventionally speaking Major, overall activities under POM, include product creation, development, production and distribution. Major functions of POM include Managing purchases, Inventory control, Quality control, Storage, Logistics and Evaluations. Focus will be efficiency and effectiveness of the processes. Keeping in view profile of the participants in this batch, this course will chart upon a different approach, specially customized for this particular batch of students. Production and Operation Management is a subject relevant to all levels of the hierarchy in an organization, but in this course, in addition to covering usual topics like routine functions of POM which are relevant mainly for the operator level staff/officials; a major amount of effort and time will be spent on high level functions and sub-functions of POM relevant to creating or gearing up the Organizational set-up to the Global standards.

9. Learning objectives:

One of the most critical areas for success in any business enterprise is how Production and Operations are managed. In the 'Productions and Operations Management' course an attempt will be made to integrate the courses studied by the students like statistics, economics, finance, organizational behavior and strategy into a consolidated production and operation related decisions

- **i)** To introduce students concept of Facility Planning and Design.
- **ii)** To introduce students concept of Facility Planning and Design.
- **iii)** To introduce students concept of Operations Planning and Just in Time
- **iv)** To introduce students concept of Supply Chain Management and SC Initiatives

10. Course Outcomes (COs):

On completion of this course, the students will be able to:

- **i)** Understand the Facility Planning and Design.
- **ii)** Understand the Facility Planning and Design.
- **iii)** Understand the Operations Planning and Just in Time
- **iv)** Understand the Supply Chain Management and SC Initiatives

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction and Facility Planning and Design**
Introduction		

Definition of Production and Service systems, Operations management and its domain, Operations strategy and competitiveness, Measures of manufacturing performance, Productivity and its measurement; Types, characteristics and performance matrices of manufacturing systems; Brief review of performance requirement and chronology of developments in manufacturing systems.

Facility Planning and Design

Objectives, parameters and methodology for plant location decision, Methodologies for Process and Product based layout design, Computerized layout Planning and SLP, Assembly line balancing, Group Technology and methodologies for GT based layout planning; Production flow analysis, Design of machining & assembly work cells, Economic analysis of facility alternatives, Numerical Problems.

Unit – 2	**Number of lectures = 11**	**Title of the unit: Product Design and Development and Demand Management**

Product Design and Development

Strategies for new product introduction, Product development process, Modular product design and its advantages, product & process design, Concurrent engineering, Life cycle costs, Quality function development (QFD), Product-Process matrix and decision variables in selection of resources alternatives, Design for manufacture & assembly, Case study on QFD.

Demand Management

Characteristics of Product demand and appropriate manufacturing control policies, Types of forecasting, Components of demand, quantitative technique in forecasting, time series analysis, Regression models, and focus forecasting, Forecasting and Strategic Capacity Planning.

Unit – 3	**Number of lectures = 11**	**Title of the unit: Operations Planning and Just in Time**

Operations Planning

Different Operations Planning Activities, Aggregate planning: Objectives, strategies and models, Classification of Inventory systems, various Inventory costs, Master Production schedule (MPS) and methodologies for MPS, Different operations scheduling techniques, Materials Requirement Planning (MRP) and MRP II and ERP, Theory of constraint & OPT, Case example on simple MRP.

Just in Time

JIT manufacturing philosophy, Simplification, Waste elimination, variation reduction, pull systems, KANBANS production, Withdrawn, Single card, Recorder point system, JIT system design, Pull Vs Push, CONWIP method, Implementation issues of JIT, Concept of lean, agile and leagile manufacturing.

Unit – 4	**Number of lectures = 10**	**Title of the unit: Supply Chain Management and SC Initiatives**

Supply Chain Management

SC and its objectives, decisions domains and phases in SC, Process view of SC, Competitiveness and Supply Chain Strategies, Strategic Fit and Strategic Scope in SC, Obstacles to Achieving Strategic Fit, Drivers of Supply Chain Performance, SC Facilities: Inventory, Transportation, Information, Sourcing, Pricing, Role of Forecasting in Supply Chains, Managing Supply, Demand and product availability in SC.

SC Initiatives

Cycle and Safety Inventory and their role in SC, Issues in SC Logistics, The Role of Sourcing in Supply Chain performance, Third- and Fourth-Party Logistics Providers, Coordination in Supply Chain and Bullwhip Effect, Continuous Replenishment and Vendor-Managed Inventories, Collaborative

Planning, Forecasting, and Replenishment (CPFR), Role of IT in SC Coordination, core competence, customization, outsourcing and postponement as SC initiatives, other SC paradigms.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Panneerselvam, Production & Operations Management, Prentice Hall india learning private limited, New Delhi,2012 ISBN: 9788120345553.

Reference Books:

i) Production and Operations Management B. Mahadevan, Pearson Education Asia, New Delhi,2015, ISBHN: 978-9332547520

ii) S.N Charry, McGraw-Hill New Delhi, Pearson Education Asia, New Delhi , 2019,ISBN: 9353164818

1. **Name of the Department: Mechanical Engineering**

2. Course Name	**Energy Conservation and Management**	**L**	**T**	**P**
3. Course Code		3	0	0

4. Type of Course (use tick mark)	**Core ()**	**PE (✔)**	**OE ()**

5. Prerequisite	**Thermodynamics, Power Plant**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures = 42	**Tutorials = 0**	**Practical = 00**

8. Course Description:

Classification of Energy, Indian energy scenario, Sectoral 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.

9. Course Objectives:

i) The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management
ii) Energy auditing- methodology and analysis.
iii) Energy economics.
iv) To learn about energy efficiency in thermal utilities and systems.

10. Course Outcomes (COs): At the end of this course, the learner will be:

i) The student should acquire insight about the importance of energy.
ii) The student should be capable of analyzing all scenarios from energy consumption.
iii) The student should generate scenarios of energy consumption and predict the future trend.
iv) The students should understand energy efficiency in thermal utilities and systems.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Energy Scenario**

Classification of Energy, Indian energy scenario, Sectoral 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.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Financial Management and Energy Monitoring and Targeting**

Investment-need, appraisal and criteria, financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Energy Monitoring and Targeting.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Energy Management & Audit**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements.

Unit - 4	**Number of lectures = 11**	**Title of the unit: 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.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Textbook:

i) Doctor asamh Muhammad Almardi Suleiman Khayal, Fundamentals of energy conversion engineering, 2017, ISBN 9781477644892

Reference books:

i) D. Yogi Goswami and Frank Kreith, Energy Conversion, Second Edition, CRC Press, Taylor and Francis, 2017, ISBN 9781466584822.

ii) Ibrahim H. Al-Bahadly, "Energy Conversion- Current Technologies and Future Trends", Intech open, 2019, ISBN: 978-1-78984-905-9.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Manufacturing Simulation Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite	**Manufacturing and Simulation**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)		
Lectures = 00	**Tutorials = 00**	**Practical = 28**

8. Course Description:

The objective of this course is to give a sound knowledge of the fundamental aspects of system simulation, which is used in the analysis of complex system and finds applications in a wide range of real life situations. Modeling and Simulation of Manufacturing Systems course is concerned with the concepts of system, system modeling and simulation, has been expanded to include the details of types of models and simulation software. This course covers the mathematical and statistical models. This course provides the knowledge of random number generation and inverse transform techniques. This course also discusses the analysis of simulation data and application of simulation system in manufacturing and material handling systems.

9. Learning Objectives:

- **i)** To introduce modeling, simulation and optimization as it applies to the study and analysis of manufacturing systems for decision support.
- **ii)** To expose students onto a wide range of applications for simulation methods and models and to integrate them with their introduction to operations management.
- **iii)** To learn about Linear programming model for an industrial scenario.
- **iv)** To understand simulation of manufacturing system for different scheduling rules.

10. Course Outcomes (COs):

- **i)** Develop the practical skills necessary to design, implement and analyze discrete-event simulation systems.
- **ii)** Cover the basic theory underlying discrete-event simulation methodologies in order to enable a critical understanding of simulation output in managerial environments.
- **iii)** Build the foundations necessary to quickly adapt for future advances in simulation technology.
- **iv)** To understand simulation of manufacturing system for different scheduling rules.

11. Lab component

Sr. No.	**Title**	**CO covered**
1	Simulation of a single server system	**i)**

2	Simulation of 2 machine n-job system for Johnson job sequencing rules	**i), ii)**
3	Simulation of a multi server system with different dispatching rules	**i), ii)**
4	Simulation of an FMS	**iii)**
5	Simulation of Manufacturing system for different scheduling rules	**ii), iii)**
6	Simulation of a simple supply chain	**i), iii)**
7	To generate Random variates using C	**iii)**
8	To apply Linear programming model for an industrial scenario	**i)**
9	To evaluate material flow in Facilities layouts	**iii)**
10	Simulation of manufacturing systems with different Inventory control policies	**i), ii)**

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Vibration and Conditioning Monitoring Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem ()**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 00		**Tutorials = 00**	**Practical = 28**			
8. Course Description						

A structure or a body is said to vibrate if it has a to and fro motion. A greater proportion of human activities involve vibration in one form or the other. We hear because our eardrums vibrate. The cause and effects of vibration must be clearly understood. The structures designed to support the high speed machines are subjected to inherent unbalance which causes problems. The unbalance may be due to faulty design or poor manufacture. Because of cyclic vibration, the material of the structure or the machine component may undergo fatigue failure. Vibration causes fasteners such as nuts of the machine to become loose. In metal machining processes, vibration may cause chatter, which results in poor surface finish. If the natural frequency of vibration of a machine or structure equals the forced frequency caused by external excitation, resonance occurs which causes dangerously large oscillations and the structure fails. A bridge can collapse due to wind-induced vibration. Critical instruments mounted on machines may loose their accuracy due to excessive vibrations. Vibrations can be used for useful works such as vibration testing equipments, vibratory conveyors, hoppers, sieves, compactors, washing machines

9. Learning objectives:

i) To learn the basics of vibrations including causes and effects of vibrations.
ii) To study the undamped and damped free vibration.
iii) To study the forced vibrations.
iv) To study vibration measuring instruments.

10. Course Outcomes (COs):

i) Write differential equation of the given vibration model.
ii) Calculate the frequencies of free or natural, damped and forced vibrations

iii) Find the response of a vibrating system.
iv) Calculate the natural frequencies and mode shapes of multi degrees of freedom systems.

11. Lab Component

Sr. No.	**Title**	**CO covered**
1	To determine transient and forced response of a vibratory system.	i, ii, iii, iv
2	To determine structural damping of rotor system.	i
3	To determine critical speed of an actual rotor system using bode a plot.	i
4	To study the rotor behavior during its startup period.	i
5	To determine the rotor behaviour during its shut-down period.	ii, iii
6	To diagnose the bearing fault using bearing fault kit.	v
7	To diagnose rotor behaviour after introducing commonly noticed faults.	i, ii, iii, iv
8	To determine bearing stiffness in x and y directions.	i, ii, iii, iv
9	To carry out two-plane rotor balancing calculations using vibratory response.	i, ii, iii, iv

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Computer Integrated Manufacturing Systems**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Brief Syllabus

Manufacturing processes have already found many applications in Mechanical Engineering and with the integration of computers these are projected to be of greater relevance to mechanical systems in future. . Objective of the course is to expose students with emerging manufacturing techniques for producing micro and nano level products with the help of robotics.

9. Learning objectives:

- **i)** To train the PG students to work in the field of computer integrated manufacturing where the students will get detailed insight into automation of manufacturing and manufacturing informatics.
- **ii)** The students will study the latest state of art subjects in the area of C.I.M.
- **iii)** To provide hands on experience to the students on the latest software and hardware and make them to fit ready to the Industries.
- **iv)** To learn the basics of robotics and automation.

10. Course Outcomes (COs): After the completion of the course, the student shall be able to

- **i)** explain fundamental knowledge on manufacturing planning and manufacturing control.
- **ii)** Solve the problems related to MRP & ERP.
- **iii)** Work on technology related to AGV's
- **iv)** Work in the robotics industry with part programming.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Introduction**

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

Unit – 2	Number of lectures = 10	Title of the unit: Process Planning
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) – Simple Problems.		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Flexible Manufacturing System (FMS) & Automated Guided Vehicle System (AGVS)**
Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.		
Unit – 4	**Number of lectures = 11**	**Title of the unit: Industrial Robotics**
Robot Anatomy and Related Attributes, Classification of Robots, Robot Control systems, End Effectors, Sensors in Robotics, Robot Accuracy and Repeatability, Industrial Robot Applications, Robot Part Programming, Robot Accuracy and Repeatability, Simple Problems.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

http://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book

i) Automation, Production Systems and Computer-Integrated Manufacturing (2016) by Mikell P. Groover ISBN-13 : 978-9332572492

Reference Books

i) Manufacturing Engineering and Technology (2018) by Serope Kalpakjia ISBN-13 : 978-9332587908

ii) Robotics and Automation (2005) By Thomas R. Kurfess ISBN 9781498798310

iii) Industrial Automation and Robotics: An Introduction Hardcover – 1 February 2013 by A. K. Gupta (Author) ISBN-13 , 978-1938549304

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Industrial Automation and Robotics**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✓)**		**EAS ()**	**BSC ()**
5. Pre-requisite (if any)	**NIL**	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The course aims to give student a detailed overview of different technologies used in Automation systems. Various components of an Automation system along with their working principles are explained clearly for a better understanding of modern industrial control systems. This course helps students to familiarize with trajectory planning, actuation and control in robots. As robots are the main component of an automation system so an amalgamation of both these fields are present in this course.

9. Learning objectives:

- **i)** To understand various components of state-of-art automation technologies encountered in modern manufacturing industries.
- **ii)** All major parts of a modern industrial control system will be described and their principles explained.
- **iii)** To impart knowledge and analysis skills associated with trajectory planning.
- **iv)** To familiarize with the robot actuation and control system.

10. Course Outcomes (COs): After taking this course the students shall be able to

- **i)** Comprehend and differentiate between various types of automation systems.
- **ii)** Analyze and solve an engineering problem using proper automation technology applicable
- **iii)** Propensity to carry out manipulator kinematics and dynamics.
- **iv)** Ability to plan and analyse the trajectory of robots and understand robot actuation and control system.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Automation Systems**

Types of automation systems – hydraulic, pneumatic, electrical, electronic with comparison. Pneumatic systems and their components, Pneumatic circuit design approach and examples. Electro-mechanical systems, Electro-pneumatic and electro-hydraulic systems and their components, circuit design, relay control, sequence control application with example.		
Unit – 2	**Number of lectures = 10**	**Title of the unit: PLC control**
Introduction to PLCs, inputs and outputs and their types. Interfacing of I/O devices with a PLC. Programming languages and instruction sets, ladder logics, structured text, functional blocks and applications. Example of sensor, actuator and controller integration for common microcontrollers.		
Unit – 3	**Number of lectures = 11**	**Title of the unit: Robotics**
Link-connection Description, Convention for affixing Frames to Links, Manipulator Kinematics, Actuator Space, Joint Space and Cartesian Space, Manipulator Dynamics, Trajectory Planning: Path versus Trajectory, Joint-Space versus Cartesian-Space Descriptions, Basics of Trajectory Planning.		
Unit – 4	**Number of lectures = 11**	**Title of the unit: Robot control systems**
Sensors, Actuators and Drive Systems for Robotics applications, Sensor Characteristics and utilization, Characteristics of Actuating Systems, Basics of Robot Control System, Programming modes, Languages.		
12. Brief Description of self-learning / E-learning component		
The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. http://sgtlms.org Journal papers; Patents in the respective field.		
13. Books Recommended		
Text Books		
i) Introduction to Industrial Automation, Stamatios Manesis and George Nikolakopoulos, CRC press		
ii) Industrial Automation: Hands-On, Frank Lamb, McGraw Hill publisher		
Reference Books		
i) Introduction to Robotics: Analysis, Control, Applications by Saeed Benjamin Niku, John Wiley & Sons, Inc.		
ii) Introduction to Robotics: Mechanics and Control by John J. Craig, Pearson Education International.		

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Reliability Based design**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**	**OE ()**	**Specialization ()**	
5. Pre-requisite (if any)	**Basics of Reliability**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)		
Lectures = 42	**Tutorials = 0**	**Practical = 0**

8. Course Description

Teach the essentiality of SQC, sampling and reliability engineering. Study on various types of control charts, six sigma and process capability to help the students understand various quality control techniques. Reliability engineering focuses on the dependability, failure mode analysis, reliability prediction and management of a system.

9. Learning objectives: Students undergoing this course are expected to**:**

- **i)** Principles of optimization and its need.
- **ii)** Various conventional optimization techniques.
- **iii)** Solving multivariable problems.
- **iv)** Solving problems using Unconventional optimization techniques.

10. Course Outcomes (COs): On course completion students will be able to:

- **i)** Understand the methods and philosophy of statistical process control.
- **ii)** Understand the acceptance sampling problems.
- **iii)** Understand the principles of reliability engineering.
- **iv)** Understand the failure data analysis.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Reliability Concepts and Statistical Models**

Failure data analysis, Reliability function, Hazard rate, Failure rate, Relation among reliability, Hazard rate and Failure rate, Mean time to failure, Mean time between failures, Normal, Long-normal, Weibull, Gamma, Exponential, uniform, Rayleigh, Chauchy, Beta and Poisson distribution.

Design of Mechanical Components and Systems

Deterministic design procedure, Probabilistic design procedure, Reliability based design of gear tains, Reliability analysis of cam-follower and four-bar mechanism.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Design of Mechanical Components and Systems**

Modeling of geometry, Tolerance on finished metal products, Assembly of components, Modeling of material, strength, Statistics of elastic properties, Statistical model of material strength, Model for brittle, Plastic materials and fiber bundles, Constant and variable amplitudes, Fatigue strength, Modeling of dead, lie, wind and earthquake loads.

Unit – 3	**Number of lectures = 11**	**Title of the unit: Modeling of Geometry, Material, Strength and Loads**

General and alternate expressions for reliability and probability of failure, Reliability when strength follows normal exponential, extreme value and type-iii extreme distributions, Reliability in terms of experimentally determine distributions of strength and load, Factor of safety corresponding to given reliability.

Reliability Based Optimum Design

Optimization problem, Reliability allocation problems, Structure and mechanical design problems, Optimum design by graphical optimization, Lagrange multiplier, Penalty function and dynamic programming methods.

Unit – 4	**Number of lectures = 10**	**Title of the unit: Maintainability and Availability**

Concepts, Preventive and imperfect maintenance, Repair time distributions, Un repaired failures, Optimal replacement strategy, Spare parts requirements, Development of availability models, System with a single component.

Failure Modes, Event-Tree and Fault-Tree Analysis

System safety analysis, Failure modes and effects analysis, Event-tree and fault-tree analysis, Minimum cut-sets.

12. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Rao, S. S. (2002), “Reliability-based Design”, United States: McGraw-Hill, ISBN: 9780071136235, 0071136231

Reference Books:

i) Le, X. (2019), “Reliability-Based Mechanical Design. Volume 1: Component Under Static Load”, United States: Morgan & Claypool Publishers, ISBN: 9781681736600, 1681736608

ii)	Srinath, L. S. (2002), "Mechanical Reliability", India: Affiliated East-West Press Private Limited, ISBN: 9788176710299, 8176710296
iii)	Gullo, L. J. (2012). Design for Reliability. Germany: Wiley, ISBN: 9781118310038, 1118310039

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Technology and Manufacturing Strategies**	**L**	**T**		**P**	
3.Course Code		3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5.Pre-requisite (if any)	**Pre-requisites: Production Planning & Control**	**6.Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course includes the strategies adopted for competitive Planning. It includes the new manufacturing philosophy and Competitiveness through Manufacturing Advantage. Different stages of product development cycle and its problems.

9. Learning objectives: The course aims to prepare the student industry ready by giving the knowledge about the planning strategies and new manufacturing philosophy. To study the product life cycle development and the related problems.

- **i)** The course aims to deal with the levels of strategy and customer matrix.
- **ii)** The course aims to deal with the Strategic importance of various Manufacturing systems based on Volume & Variety.
- **iii)** The course aims to deal with the Manufacturing Strategy Competitiveness & activities.
- **iv)** The course aims to deal with the Technology strategy & Technology Management.
- **v)** The course aims to deal with the Managing technology for new product and global strategy

10. Course Outcomes (COs): On completion of this course, the students will be able to

- **i)** Understand the levels of strategy and customer matrix.
- **ii)** Understand the Strategic importance of various Manufacturing systems based on Volume & Variety.
- **iii)** Understand the Manufacturing Strategy Competitiveness & activities.
- **iv)** Understand the Technology strategy & Technology Management.
- **v)** Understand the Managing technology for new product and global strategy

11.Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Competitive Strategy Planning and New Manufacturing Philosophy**

Competitive Strategy Planning

Levels of Strategy, Strategy process, Customer Matrix -Perceived use value, Producer matrix Core Competences, Scenarios planning- PEST analysis, PORTER Five force model, Value Chain Concept, Generic strategy concept.

New Manufacturing Philosophy

Strategic importance of various Manufacturing systems based on Volume & Variety, Three flows of manufacturing systems, Synchronous Manufacturing, Brief concept of JIT, TQM, Simultaneous Engineering & Reverse Engineering, Lean Manufacturing.

Unit – 2	**Number of lectures = 12**	**Title of the unit: Manufacturing Competitiveness And Manufacturing Structure & Strategy**

Manufacturing Competitiveness

Competitiveness through Manufacturing Advantage-Quality, Speed, Dependability, Flexibility and Cost advantages; Internal & External performance, Manufacturing focus & Segmentation, Manufacturing Strategy Competitiveness & activities.

Manufacturing Structure & Strategy

Manufacturing structure, Focused factory, Group technology & its impact on manufacturing Strategy; Experience curve; Objective and characteristics of Manufacturing strategy, Order winning & qualifying objectives, process of formulating & implementing manufacturing strategy.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Strategic Technology Management** and **Technology Development**

Strategic Technology Management: Understanding technology, Business strategy,
Technology strategy & Technology Management, Technology Management philosophy; Brief idea of technology forecasting; Technology Portfolio, Competitive position analysis, Strategic planning &management of technology.

Technology Development

Product development cycle & its problems; Managing technology for new product, Managing product development capability, Context &opportunities, Project & its evaluation, Policy imperatives & strategic issues; Technology fusion- its principles, New R&D collaboration.

Unit – 4	**Number of lectures = 10**	**Title of the unit: International Technology & Operations Strategy and Organizational Support Systems**

International Technology & Operations Strategy

Global strategy, Porter s model of International Strategy, Technology Innovation and Strategy process, Technology accumulation, Global manufacturing, International procurement, Manufacturing strategy, Process development, Organization issues.

Organizational Support Systems

Organization structure, environment & technology, Organization flexibility, Role of Manager in organization design, Five parts of the organization and various configuration - Mintzberg theory; Strategic issues of Organization Culture - Creative Miller's Theory, Learning Organization- SENGE's Theory.

12.Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13.Books Recommended	
Text Book:	
(i)	P.N. Rastogi ,Management of Technology & Innovation -, Sage Publication, New Delhi, 2009 ISBN: 978-8132100836.
Reference Books:	
(i)	Nigel Slack ,Manufacturing Advantage -, Viva Books, New Delhi ,2019 ASIN : B07KMFFQ5M
(ii)	Operations Management - Schroeder, McGraw Hill, ISE, ISBN-13 : 978-1260571431
(iii)	Manufacturing Strategy T.Hill Macimillan, ISBN: 978033576489

1. Name of the Department	**Mechanical Engineering**					
2. Course Name	**Thermodynamics & Combustion**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE()**	
5. Pre-requisite (if any)	**Engg. Thermodynamics**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures = 42	**Tutorials = 0**	**Practical = 0**

8. Brief Syllabus

Two and four stroke engines, air standard cycles, fuels and combustion, fundamental of ignition systems, performance and rating of engines, combustion characteristics and combustion chamber for S.I and C.I engines, supercharging.

9. Learning objectives:

i) To learn about various types of fuels, their composition and properties
ii) To acquire depth knowledge of solid, liquid and gaseous fuels.
iii) To understand the thermodynamics of combustion.
iv) To learn about the types of pollution and its control.

10. Course Outcomes (COs): On completion of this course, the students will be able to

i) Analyze the composition of various types of fuels and their properties.
ii) Estimate the composition of various types of fuels and their properties
iii) Demonstrate the knowledge of combustion thermodynamics.
iv) To learn about the types of pollution and its control.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Fuel Characteristics & Pollution**

Fuels – Types and Characteristics of Fuels – Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination – Calorific Value - Gross and Net Calorific Values - Types of pollution - Combustion-Generated air pollution - Effects of air pollution - Pollution of fossil fuels and its control – Pollution from automobiles and its control.

Unit – 2	**Number of lectures = 11**	**Title of the unit: Solid and Liquid Fuels**
Solid Fuels: Wood and Wood Charcoal-Origin of coal-Composition of coal –Analysis and properties of different grades of coal preparation and storage of coal-coal washing –Briquetting. Liquid coals: Origin of petroleum fuels-Production –Composition-Petroleum Refining-Various grades of Petro-Products-Properties.		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Gaseous Fuels**
Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane – Producer Gas - Gasifies - Water Gas – Town Gas - Coal Gasification – Gasification Efficiency - Non - Thermal Route - Biogas - Digesters -Reactions – Viability - Economics.		
Unit – 4	**Number of lectures = 11**	**Title of the unit: Combustion: Stoichiometry and Kinematics**
Stoichiometry - Mass Basis and Volume Basis – Excess Air Calculation - Fuel and Flue Gas Compositions – Calculations – Rapid Methods - Combustion Processes - Stationary Flame – Surface or Flameless Combustion –Solid - Liquid and Gaseous Fuels Combustion - Flame Temperature - Theoretical - Adiabatic and Actual - Ignition Limits – Limits of inflammability.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Textbook:

i) Stephen Turns, (2011), an Introduction to Combustion: Concepts and Applications, McGraw Hill.

Reference books:

i) John B. Heywood – Internal Combustion Engine, McGraw Hill.

ii) Mishra, D. P, (2000), Fundamentals of Combustion, Prentice Hall of India.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Advance Operation Research**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**Operation Research**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Operation research is having many powerful tools to optimize the real-life problems. The study of this subject will give knowledge to the students regarding transportation and inventory related problems. This also describes the method of sequencing of jobs through different number of machines. Focus is also given to most common problems of waiting of either jobs/machines/people. Emphasis is given to decision models and replacement problems. So, the study of this subject will develop the capability among students to solve effectively many problems arising during their career.

9. Learning objectives:

i) To provide students the knowledge of optimization techniques and approaches.
ii) To enable the students, apply mathematical, computational and communication skills of Games Theory and Goal Programming and Replacement
iii) To introduce students to research methods and current trends in Queuing Models, Network Analysis and Simulation
iv) To introduce students to research methods and current trends of Non-Linear Programming

10. Course Outcomes (COs):

On completion of this course, the students will be able to:

i) Apply operations research techniques in industrial optimization problems.
ii) Understanding the concept of Games Theory and Goal Programming and Replacement
iii) Understanding the concept of Queuing Models, Network Analysis and Simulation
iv) Understanding the concept of Non-Linear Programming.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Advanced Topics in LP**

Duality, Dual simplex method, Revised simplex method, The decomposition method, Sensitivity analysis, Parametric LP, Variants in Transportation problem, Least time Transportation problem, Post optimality analysis in Transportation, Trans-shipment problem, Dual of TP, Variants in Assignment Problem, Sensitivity Analysis in Assignment Problems, The travelling salesman Problems (Shortest Cyclic Route Models)

Unit – 2	**Number of lectures = 11**	**Title of the unit: Games Theory and Goal Programming and Replacement**

Games Theory and Goal Programming

Introduction, Theory of games, Application of Goal Programming

Replacement: Introduction, Replacement of items that deteriorate, Replacement of items that fail suddenly, Group replacement, Mortality and staffing problems, Renewal Theory, Application of Replacement Policy in Real life Problem		
Unit – 3	**Number of lectures = 11**	**Title of the unit: Queuing Models, Network Analysis and Simulation**
Queuing Models Multichannel queuing systems, limited queue length **Network Analysis** Financial Planning through network, Network crashing, Allocation of resources in a Project, Applications of Network Techniques **Simulation** Monte Carlo method, Markov Chains		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Non-Linear Programming**
Introduction, Integer Programming, Non-linear Programming Problem, Quadratic Programming, Separable Programming, Dynamic Programming		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://sgtlms.org Journal papers; Patents in the respective field.		
13. Books Recommended		
Text Book:		
i) DS Gupta ,PK Hira (2015), Operation Research, S.CHAND PUBLISHER; 2011 edition (2015)ISBN-10: 121212184 ISBN-13: 978-1212121844, ISBN: 978-8-120- 30162-7.		
Reference Books:		
i) Hamdy Taha, (2008), Operations Research-An Introduction, 8th Edition, Pearson Education, ISBN: 978-8-131-71104-0.		
ii) R. Panneerselvan (2006), Operation Research, 2nd Edition, Prentice Hall of India Pvt Ltd ISBN: 978-8-120-31743-7.		
iii) J. K. Sharma (2013), Operation Research, 5th Edition, Macmillan Publications, ISBN: 978-9-350-59336-3.		
iv) Kanti Swarup, P.K. Gupta and Manmohan Lal (2010), Operations Research, 15th Edition, S. Chand & Sons, ISBN: 978- 8-180-54771-3.		

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Artificial Intelligence in Automation**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✓)**		**EAS ()**	**BSC ()**
5. Pre-requisite (if any)	**NA**	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
The course aims to develop the students with the knowledge about Artificial Intelligence basics, tools and concepts. This course entails some basic logics used to develop an algorithm for AI like Markov logic, Bayesian network and decision-making theories.						
9. Learning objectives: By the end of this course, students will be able **i)** To understand the basic concepts and theory governing Artificial Intelligence. **ii)** How they can be applied to development of computer intelligence in order to make them learn, plan, and solve problems autonomously. **iii)** To impart knowledge and analysis skills associated with representation and reasoning. **iv)** To familiarize with the Decision Making.						
10. Course Outcomes (COs): After taking this course the students shall be able to **i)** Describe and explain the applications of AI and IA, select search strategies based on application requirement. **ii)** Explain knowledge representation methods, discuss architecture of expert systems. **iii)** Demonstrate self-learning capability. **iv)** Apply the AI for Decision Making.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 10**	**Title of the unit: Artificial Intelligence (AI)**				
What is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, INTELLIGENT AGENTS (IA): Agents and Environments, the Concept of Rationality, The Nature of Environments, The Structure of Agents.						
Unit – 2	**Number of lectures = 10**	**Title of the unit: Knowledge Representation and Reasoning**				

Knowledge representation - Logics – First order logic- Inference in first order logic – Higher order logic - Markov logic.		
Unit – 3	**Number of lectures = 11**	**Title of the unit: Uncertain Knowledge And Probabilistic Reasoning**
Uncertainty Probabilistic reasoning - Semantics of Bayesian network -, Exact inference in Bayesian network- Approximate inference in Bayesian network- Direct sampling methods, Inference by Markov chain simulation - Probabilistic reasoning over time – Hidden Markov Models.		
Unit – 4	**Number of lectures = 11**	**Title of the unit: Decision-Making**
Basics of utility theory, sequential decision problems - decision network– policy -Decision process in infinite horizon: Optimal policy, Value iteration - policy iteration- Partially observable decision process – Decisions in Multi agent system: elementary game theory.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

http://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book

i) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, PrenticeHall.

Reference Books

i) Nils J. Nilsson, Artificial Intelligence: A New Sythesis, Morgan-Kaufmann.

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1. Name of the Department- Mechanical Engineering						
2. Course Name	**Machine learning for applications in Mechanical Engineering**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**None**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
Introduction to Machine Learning, Learning in Artificial Neural Networks, Decision trees, HMM, SVM, and other Supervised and Unsupervised learning methods.						
9. Learning objectives: **i)** To introduce the prominent methods for machine learning **ii)** To study the basics of supervised and unsupervised learning **iii)** To study the basics of connectionist and other architectures **iv)** To gain knowledge of functional programing for building rapid prototypes its deployment.						
10. Course Outcomes (COs): On completion of this course, the students will be able to **i)** Revisit some basic mathematical models. **ii)** Differentiate various learning approaches, and to interpret the concepts of supervised and unsupervised learning. **iii)** Apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points **iv)** Illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 10**	**Title of the unit: Mathematical Basics and Introduction to Machine Learning**				
Introduction to Machine Learning, Linear Algebra, Probability, Numerical computation and optimization, Introduction to Machine Learning packages, Bias/Variance Tradeo, Regularization, Variants of Gradient Descent, MLE, MAP applications. Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension						
Unit – 2	**Number of lectures = 10**	**Title of the unit: Neural Networks**				

Multilayer Perceptron, Backpropagation, Applications, Convolutional Neural Networks 1 – CNN Operations, CNN architectures, Training, Transfer Learning, Applications. RNN, LSTM, GRU, Applications.

Unit – 3	Number of lectures = 12	Title of the unit: Decision Tree

Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART). Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications. k-Means, kNN, GMM, Expectation Maximization, Applications.

Unit – 4	Number of lectures = 10	Title of the unit: Advanced Techniques

Structured Probabilistic Models, Monte Carlo Methods, Autoencoders, Generative Adversarial Networks. Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Density based clustering. Current trends in machine learning persisting in todays' industrial world.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006. ISBN 978-0-387-31073-2

Reference Books:

i) Ethem Alpaydın, Introduction to Machine Learning (Adaptive Computation and Machine Learning), MIT Press, 2004. ISBN 978-0262028189.

ii) Mitchell. T, Machine Learning, McGraw Hill. ISBN 978-0070428072

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Air Conditioning and System design**	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 00**			

8. Course Description

Brief introduction to vapor compression refrigeration and vapor absorption refrigeration system. A study of the properties of air and results of cooling, heating, humidifying or dehumidifying: heat gain and heat loss calculations including equipment selection and balancing the air system.

9. Learning objectives:

i) To review the principles of refrigeration and air conditioning.
ii) To calculate the cooling load for different applications of Refrigeration and Air conditioning.
iii) To revisit the principles of psychrometry.
iv) To develop the knowledge of selecting the right equipment for a particular application of Refrigeration and Air-conditioning.

10. Course Outcomes (COs):

i) Possess the knowledge of design of system components of refrigeration and air conditioning.
ii) Design and implement refrigeration and air conditioning systems using standards.
iii) Apply the knowledge of psychrometry in calculating cooling load and heating load calculations.
iv) Design simple air conditioning spaces with ease.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Vapour Compression Refrigeration**

Performance of Complete vapor compression system. Components of Vapor Compression System: The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP – Load balancing of vapor compression Unit. Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Production of Low Temperature**

Liquefaction system; Cascade System – Applications.– Dry ice system. Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram. Lithium – Bromide system Three fluid system – HCOP.

Unit – 3	**Number of lectures = 12**	**Title of the unit: Air –Conditioning**

Psychrometric properties and processes – Construction of Psychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature. Summer, Winter, and year round air – conditioning systems. Cooling load Estimation: Occupants, equipment, infiltration, duet heat gain fan load, Fresh air load.

Unit – 4	**Number of lectures = 10**	**Title of the unit: Air –Conditioning Systems and design**

All Fresh air, Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP, RSHF, ESHF and GSHF for different systems. Components: Humidification and dehumidification equipment – Systems of Air cleaning – Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

i) Arora, C. P., (2008), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-070-08390-5.

Reference Books:

i) Manohar Prasad, (2003), Refrigeration and Air conditioning, New Age International. ISBN : 978.

ii) W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill. ISBN: 978.

iii) Manohar Prasad, (2003), Refrigeration and Air conditioning, New Age International. ISBN: 978.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Advance Tribology**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**	**OE ()**	**EAS ()**	
5. Pre-requisite (if any)	**Basics of Lubrication & Bearing**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)		
Lectures = 42	**Tutorials = 0**	**Practical = 0**

8. Course Description

This course includes basically different types of wear mechanism. It covers the properties and testing of lubricants and surface properties of target material. It deals with the different types of bearings.

9. Learning objectives: Students undergoing this course are expected to**:**

- **i)** To provide broad based understanding of the subject "Tribology" and its technological significance.
- **ii)** To make the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
- **iii)** To understand the principle of Hydrostatic and gas lubrication and their applications.
- **iv)** To understand the principle and applications of Elasto-hydrodynamic lubrication.

10. Course Outcomes (COs): On course completion students will be able to:

- **i)** To Apply the concepts of tribology for the performance analysis and to get basic idea on consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- **ii)** To understand the theories of hydrodynamic lubrication and different factors affecting the effectiveness of hydrodynamic lubrication.
- **iii)** To apply the knowledge for finding the performance of hydrostatic and gas lubrication with the consideration of various factors.
- **iv)** To understand the theories of rolling friction in rolling elements and significance if Elasto-hydrodynamic lubrication.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Introduction**

Tribology, Historical background; Properties and testing of lubricants, Viscosity, Viscometry, Effect of temperature and pressure on viscosity

Surface Roughness, Friction and Wear

Surface topography, surface characterization, apparent & real area of contract, laws of friction, friction theories with criticism, frictional heating, classification of wear, mechanism of wear, laws of wear: Qualitative & quantitative, wear resistance materials.

Unit – 2	**Number of lectures = 11**	**Title of the unit: Hydrodynamic Bearings**

The generalized Reynold s equation, fundamentals of lubrication and lubrication regims, mechanism of pressure development, Plane slider bearing, Step bearing, Idealized journal bearing: infinitely long & short journal bearing; Petroff equation, oil film thickness: approx. relation, film shape, accurate expression; finite journal bearings, boundary conditions: Sommerfeld condition, Half Sommerfeld condition, Reynold s condition; load carrying capacity and attitude angle, oil flow, friction in journal bearings; Cavitation, oil whirl in journal bearings and methods of cure; bearing materials

Unit – 3	**Number of lectures = 10**	**Title of the unit: Hydrostatic Bearings**

System of hydrostatic lubrication, restrictors, circular step bearings, Rectangular thrust bearings, opposed pad bearings; multi recess journal bearings, hydrostatic lift, hybrid bearings.

Gas Lubricated Bearings

Governing equations, limiting solutions, infinitely long plane slider &journal bearings, externally pressurized gas bearings.

Unit – 4	**Number of lectures = 10**	**Title of the unit: Elasto-hydrodynamic Lubrication & Rolling Element Bearings**

Theoretical consideration, Grubin type solution, film-thickness equation, different regimes in EHL contacts, Geometry and kinematics of ball bearings, stress & deformations, load capacity, prediction of fatigue life of ball bearings and lubrication of ball bearings.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

i) Halling J. (1978), “Principles of Tribology”, United Kingdom: Macmillan Education UK, ISBN: 9781349041381, 1349041386

Reference Books:

i)	Huang, P., Wen, S. (2017), "Principles of Tribology", Germany: Wiley, ISBN: 9781119214915, 1119214912.
ii)	Bhushan, B. (2013), "Principles and Applications of Tribology", Germany: Wiley, ISBN: 9781118403013, 1118403010.
iii)	Batchelor, A. W., Stachowiak, G. (2013). Engineering Tribology. United Kingdom: Elsevier Science, ISBN: 9780123977762, 0123977762.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Hydraulic and Pneumatic Systems**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✓)**		**EAS ()**	**BSC ()**
5. Pre-requisite (if any)	**NA**	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
The course describes the Fundamental principles, Hydraulic pumps and pressure regulation, air compressors, air treatment and pressure regulations, control valves, actuators, hydraulic and pneumatic accessories, process control pneumatics, basic hydraulic and pneumatic circuit design, basics of PLC control and automation.						
9. Learning objectives: By the end of this course, students will be able **i)** The course elaborates principles of hydraulic and pneumatic devices, electro pneumatic components. **ii)** Gives an overview of control systems associated with hydraulic applications. **iii)** To learn the basic principles of Pneumatics. **iv)** To be able to design a Pneumatic circuit for a specified problem at hand.						
10. Course Outcomes (COs): After taking this course the students shall be able to **i)** Explain the similarities and differences of the electrical, pneumatic and hydraulic systems. **ii)** Decide which system is better for a specific application. **iii)** Explain the basic parts of the industrial hydraulic and pneumatic systems and their functions **iv)** Design a hydraulic or pneumatic system circuit by using related software and make simulations						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 10**	**Title of the unit: Artificial Intelligence (AI)**				
Unit-I: The Source of Hydraulic Power Introduction, Pumping Theory, Pump Classification, Gear Pumps, Vane Pumps (Balanced & Unbalanced), Piston Pumps: Axial Piston Pump (Bent-Axis Design), In-Line Piston Pumps (Swash Plate Design), Radial Piston Pumps, Pump Performance, Pump Noise, Pump Selection						

Hydraulic Actuators and Motors

Introduction, Linear Hydraulic Actuators (Hydraulic Cylinders): Single Acting, Double acting (Single rod end, Double rod end, Tandem), Cushing Devices, Sealing Devices: O-ring, Compression packing, Piston Cup packing, Piston Rings, Wiper Rings, Mechanics of Hydraulic Cylinder Loadings: Limited Rotation Hydraulic Actuators: Rotary Actuators: Gear Motors, Vane Motors, Piston Motors, Hydraulic Motor Performance.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Valve & Other Control Components in Hydraulic System**

Introduction: Direction Control Valve: 2/ 2 way, 3/ 2 way, 4/ 2 way, 5/ 2 way, 4/ 3 way, Pressure Control Valve: Pressure Relief Valve, Pressure Reducing Valve, Sequence Valve, Flow Control Valve: Check Valve, Pilot Controlled Check Valve, 2-Way Flow Control Valve, Hydraulic Fuses: Valve Actuation

Electric Controls

Basic Electrical Devices: Push button, Limit switch, Pressure switch, Temperature switch, Timer, Relay & solenoid

Fluid Conditioners

Air Filter, Air Pressure Regulator, Air Lubricator, Pneumatic Indicator, Pneumatic Silencer, After-cooler, Chiller Air Dryer.

Unit – 3	**Number of lectures = 11**	**Title of the unit: Hydraulic Circuit Design and Analysis**

General Types of fluids, ANSI symbols of hydraulic components, The Reservoir System, Filters & Strainers, Power Pack, Control of Single & Double Acting Hydraulic Cylinder, Regenerative Circuit, Double Pump Hydraulic System, Pressure Intensifier Circuit, Hydraulic Cylinder Sequencing Circuits, Automatic Cylinder Reciprocating System, Locked Cylinder Using Pilot Check Valves, Cylinder Synchronizing Circuits, Meter-in flow Control, Meter-outflow Control, Time- Motion Diagram, Circuit Design for a particular Application like Lifting Platforms, Clamping Fixtures, Tool slides working under varying load, Uniform & jerk less feed motion, To lift unevenly loaded plate, To hold the cylinder at a particular position, Accumulator Circuit, Practice to design a circuit on a Software.

Unit – 4	**Number of lectures = 11**	**Title of the unit: Pneumatic Circuit Design and Analysis**

Introduction, Air Control Valves, Pneumatic Actuators, Pneumatic Circuit Design Considerations, Basic Pneumatic Circuit: Operation of Single &Double Acting Cylinder, Air Pilot Control of Double Acting Cylinder, Cylinder Cycle Timing System, Two-Step Speed control System, Two Handed Safety Control System, Control of Air Motor, Deceleration Air Cushion of Cylinder, Practice to design a circuit on a Software.

Electrical Circuit Design and Analysis for Fluid Power Circuits

Introduction, Circuit Diagram, Electro-hydraulic Servo System, Programmable Logic Controller, Electrical Components, Control of a Cylinder Using a Single Limit Switch, Reciprocation of a Cylinder Using Pressure or Limit Switches, Dual-Cylinder Sequence Circuits, Electro-Pneumatic System for Sorting Different-Sized Boxes, An Electro-Hydraulic System for Counting, Timing and Reciprocation of Hydraulic Cylinder, Practice to design a circuit on a Software.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. http://sgtlms.org Journal papers; Patents in the respective field.
13. Books Recommended
Text Books
i) Anthony Esposito, Fluid power with Applications, Prentice Hall, / Pearson.
ii) Andrew Parr, Hydraulics and Pneumatics, (HB), Jaico Publishing House.
Reference Books
i) James A. Sullivan, Fluid Powe-Theory and Application, Prentice Hall.
ii) Bolton, W. Pneumatic and Hydraulic systems, Butterworth Heinneman.
iii) A text Book from FESTO DIDACTIC, Hydraulics Course for Vocational Training.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**I C Engine Process Modeling**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**Manufacturing systems and Statistics**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical =**			

8. Course Description

This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The material for this course will be prepared in such a manner that it will be useful for post-graduate students, teachers, practitioners and final year undergraduate students.

9. Learning objectives:

i) Acquire knowledge about the IC engine cycles, classification and working Principles.
ii) Describe the testing and performance parameters along with heat balance Sheet.
iii) Explain different alternate fuels.
iv) To understand engine cooling, lubrication & analysis.

10. Course Outcomes (COs): On successful completion of this course, the student will be able to:

i) Explain basic concepts of actual cycles with analysis and to describe the fundamental
ii) Concepts of IC engines along with its working principles.
iii) Describe the combustion phenomenon in SI and CI engines.
iv) Evaluate the performance of IC engines and the importance of alternate fuels.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction to Engine & Fuels**

Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram.
Fuels: Fossil fuels, Chemical structure of Petroleum, Properties of SI and CI Engine Fuels,
Fuel Ratings; Octane Number, Cetane Number.

Unit – 2	**Number of lectures = 12**	**Title of the unit: SI Engine**

Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI , Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and its control, combustion chamber design for SI engines. Ignition system requirements; Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit – 3	**Number of lectures = 10**	**Title of the unit: CI Engine**

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timing. Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. Scavenging in 2 Stroke engines, pollution and its control.

Unit – 4	Number of lectures = 10	Title of the unit: Engine Cooling, Lubrication& Analysis
Engine Cooling, Different cooling systems, Radiators and cooling fans. Lubrication ,Engine friction, Lubrication principal, Type of lubrication, Lubrication oils, Crankcase ventilation. Supercharging Effect of altitude on power output, types of supercharging. Testing and Performance ,Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. http://sgtlms.org Journal papers; Patents in the respective field.		
13. Books Recommended		
Text Books:		
i) I.C. Engines/ Gas Turbines / V. Ganesan- Mc Graw Hill		
ii) Internal Combustion Engines /Colin R. Ferguson /Wiley		
Reference Books:		
i) Fundamentals of Internal Combustion Engines / H.N Gupta / PHI		
ii) as Turbine Theory/ HIH Saravanamuttoo, Cohen, Rogers/ Pearson		

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Gas Turbine**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✔)**		**OE ()**	
5. Pre-requisite (if any)	**Manufacturing systems and Statistics**	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course introduces the fundamental concepts, principles, analysis and design Gas Turbines. The material for this course will be prepared in such a manner that it will be useful for post-graduate students, teachers, practitioners and final year undergraduate students.

9. Learning objectives:

i) To understand the compressible fluid flow in turbines.
ii) To understand the compressible fluid flow in compressors.
iii) To understand the thermodynamic cycles of jet engines.
iv) To understand the combustion physics in combustion chambers.

10. Course Outcomes (COs): On successful completion of this course, the student will be able to:

i) Evaluate the performance characteristics of Gas Turbines under different operating conditions.
ii) Interpret the basic principle of Jet Propulsion –for air-breathing Aircraft Engines and their performances
iii) Perform and report preliminary design calculations to size jet engines to meet specific performance goals.
iv) To learn about the working of combustion systems.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Gas Turbine Systems**

Introduction: Relative merits over conventional IC Engines, Introduction to Brayton and Atkinson cycle for Gas turbines, Pressure Ratio, Thermal Efficiency, Specific Output, Optimum pressure ratio, Enhancement of thermal efficiency and/or specific power output using inter cooling, Heat exchangers, Reheat burners.

Unit – 2	**Number of lectures = 12**	**Title of the unit: Compressors**

Centrifugal compressor-major components: Inducer, Impeller, Vaneless diffuser, Vaned diffuser, Volute casing, Velocity & pressure variation in a stage, Pressure rise for radial tipped vanes, Degree of Reaction, Prewhirl and surging, Axial flow compressor: Stage consisting of a rotor and a stator, Pressure rise in a stage, Polytropic efficiency, Losses in a compressor stage, Phenomenon of blade stall & surging and performance curve axial flow turbine, Stage consisting of a rotor and a stator, Pressure rise in a stage, Polytropic efficiency, Losses in a compressor stage, Phenomenon of chocking, Performance curves.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Jet Propulsion Systems**

Introduction: Concept of propulsion and thrust, Variety of propulsion systems for flying vehicles – Turboprop, Turbojet, Ram Jet, Pulse Jet, Scramjets with supersonic combustion, Definition & derivation for pressure thrust, Momentum thrust, Propulsive power, Propulsive efficiency, Thermal and overall efficiency, Thrust augmentation: Water injection, Liquid injection, Afterburning, Bleed air system,

Rocket propulsion: Distinction between turbojets and rockets, Rocket thrust, Specific impulse, Total impulse, Thermal efficiency, Rocket equation and applications.

Unit – 4	**Number of lectures = 10**	**Title of the unit: Combustion Systems**

Concept of flame, Adiabatic flame temperature, Combustion mechanism in a combustor, Activation energy, Arrhenius law, Stoichiometry, Flame propagation, Flame stability, Pressure losses, Combustion intensity, Combustion efficiency, Combustion chamber requirements, Outlet temperature distribution, Gas turbine fuels, Pollution problems, Blade cooling methods, Requirements of the combustion chamber.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

http://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Books:

i) Gas Turbines by V. Ganesan, Tata McGraw-Hill Education.

ii) Gas Turbine Theory by H.I.H. Saravanamuttoo, G.F.C. Rogers, H. Cohen, Paul Straznicky, Pearson education Ltd.

Reference Books:

i) Fundamental of Propulsion by V. Babu, ANE Books.

ii) Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion by S. M. Yahya, New Age Publishers.

1. Name of the Department- Mechanical Engineering						
2. Course Name	**Computer Integrated Manufacturing Systems Lab**	**L**	**T**		**P**	
3. Course Code		0	0		2	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 28**			

8. Course Description

Computer-integrated manufacturing is the manufacturing approach of using computers to control the entire production process. This integration allows individual processes to exchange information with each other and initiate actions. Through the integration of computers, manufacturing can be faster and less error-prone, although the main advantage is the ability to create automated manufacturing processes. This course highlights the practical training on different components of a computer-integrated manufacturing system.

9. Learning objectives:

i) To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.

ii) To educate the students on the usage of CAM packages and cut part on virtual CNC machine simulator.

iii) To make the students understand the importance of automation in industries through exposure to FMS, Robotics etc.

iv) Understand complex parts machining; cutting tools and related cutting parameters; optimize cycle time.

10. Course Outcomes (COs): After the completion of the course, the student shall be able to

i) Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.

ii) Generate CNC Mill Part programming for Point-to-point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.

iii) Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc.

iv) Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.

11. Lab Component

Sr. No.	Title	COs covered
1	Manual CNC part programming for 2 turning and 2 milling parts.	**i)**
2	CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations.	**ii)**
3	Program generation using software. Optimize spindle power, torque utilization, and cycle time.	**iii)**
4	Generation and printing of shop documents like process and cycle time sheets, tool list, and tool layouts.	**iii)**
5	Post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC etc.	**iii)**
6	Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.	**iii)**
7	Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects.	**iv)**