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**SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE**

(Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai)

**SEMBODAI – 614 809 VEDRANYAM TAMILNADU INDIA**

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**DEPARTMENT OF**

**MECHANICAL ENGINEERING**

**COURSE FILE**

**III SEMESTER**

**ME3351 ENGINEERING MECHANICS**

**(Regulation 2021-Anna University)**

**VEERAPANDIAN.K**

**Assistant Professor / MECH**

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**SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE**

**Vision of Institution**

Striving willfully with might to develop and nurture the younger generation to emerge as better technocrats for development of the state and the country as a whole.

**Mission of Institution**

Minting out skillfully competent, Socially-Committed and Versatile Knowledge personalities to encounter the challenges of the society in the field of Engineering and Technology as a whole.

**DEPARTMENT OF MECHANICAL ENGINEERING**

**Vision of Department**

To create excellent professionals in the field of Mechanical Engineering and to uplift the quality of technical education on par with the International Standards.

**Mission of Department**

1. To reinforce the fundamentals of Science and Mathematics to Mechanical Engineering and critically and relatively investigate complex mechanical systems and processes.

2. To engage in the production, expansion and practice of advanced engineering applications through knowledge sharing activities by interacting with global communities and industries.

3. To equip students with engineering ethics, professional roles, corporate social responsibility and life skills and apply them for the betterment of society.

 **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

1. Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.
2. Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.
3. To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.
4. To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.
5. To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

**PROGRAMME OUTCOMES (POs)**

1 **Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2 **Problem analysis :** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3 **Design/development of solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4 **Conduct investigations of complex problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5 **Modern tool usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6 **The engineer and society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7 **Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8 **Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAMME SPECIFIC OUTCOMES (PEOs)**

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

1. Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.

2. Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.

3. Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

**COURSE SYLLABUS:**

**ME3351 ENGINEERING MECHANICS** L T P C

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**COURSE OBJECTIVES:**

1 To learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures

2 To introduce the equilibrium of rigid bodies, vector methods and free body diagram

3 To study and understand the distributed forces, surface, loading on beam and intensity.

4 To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.

5 To develop basic dynamics concepts – force, momentum, work and energy;

**UNIT I STATICS OF PARTICLES** 9

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton’s First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

**UNIT II EQUILIBRIUM OF RIGID BODIES** 9

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon’s Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

**UNIT III DISTRIBUTED FORCES** 9

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a ThreeDimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

**UNIT IV FRICTION**  9

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

**UNIT V DYNAMICS OF PARTICLES**  9

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton’s Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

 **TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course the students would be able to

1.  Illustrate the vector and scalar representation of forces and moments

2.  Analyse the rigid body in equilibrium

3.  Evaluate the properties of distributed forces

4.  Determine the friction and the effects by the laws of friction

5.  Calculate dynamic forces exerted in rigid body

**TEXT BOOKS:**

1.Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.

2.Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018.

**REFERENCES:**

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.

2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics,

13th edition, Prentice Hall, 2013.

3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics Statics and Dynamics,

4thEdition,Pearson Education Asia Pvt. Ltd., 2005.

4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition,

Mcraw Hill Higher Education, 2013.

**CO,PO,PSO MAPPING**

|  |  |  |
| --- | --- | --- |
| **CO** | **PO** | **PSO** |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | 3 | 2 | 2 | 1 | 2 |  |  |  |  |  |  | 2 | 3 | 1 | 1 |
| **2** | 3 | 2 | 2 | 1 | 2 |  |  |  |  |  |  | 2 | 3 | 1 | 1 |
| **3** | 3 | 2 | 3 | 1 | 2 |  |  |  |  |  |  | 2 | 3 | 1 | 2 |
| **4** | 3 | 2 | 3 | 1 | 2 |  |  |  |  |  |  | 2 | 3 | 1 | 2 |
| **5** | 3 | 2 | 3 | 1 | 2 |  |  |  |  |  |  | 2 | 3 | 1 | 2 |
| Low (1); Medium (2); High (3) |