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**SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE**

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

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**Department Of Mechanical Engineering**

**Course Plan**

**Academic Year: 2023-2024**

**ODD Semester (REGULATION-2021)**

SUB NAME : **ME3351 ENGINEERING MECHANICS**

YEAR/SEM : **II /III**

STAFF NAME: **Mr.VEERAPANDIAN.K**

# ME3351 ENGINEERING MECHANICS L T P C

# 3 0 0 3

**COURSEOBJECTIVES:**

1. To Learn the use scalar and vector analytical techniques for analyzing forces in statically

Determinate structures

1. To introduce the equilibrium of rigid bodies, vector methods and free body diagram
2. To study and understand the distributed forces, surface, loading on beam and intensity.
3. To learn the principles of friction, forces and to determine the apply the concepts of frictional force at the contact surfaces of various engineering systems.
4. To develop basic dynamics concepts – force, momentum, work and energy

# UNITI STATICS OF PARTICLES 9+ 3

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 ofa Force, Unit Vectors. Equilibrium of a Particle- Newton’s First Law of Motion, Space and Free-BodyDiagrams, Forces in Space, Equilibrium of a Particle in Space.

# UNITII EQUILIBRIUM OF RIGID BODIES 9 +3

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about aPoint, Varignon’s Theorem, Rectangular Components of the Moment of a Force, Scalar Product of TwoVectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of aCouple, 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.

# UNITIII DISTRIBUTED FORCES 9+3

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids byIntegration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three Dimensional 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.

# UNITIV FRICTION 9+ 3

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

# UNITV DYNAMICS OF PARTICLES 9+ 3

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. **TOTAL:60PERIODS**

**COURSEOUTCOMES:** At the end of the course, students would:

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| **CO-1** | Illustrate the vector and scalar representation of forces and moments |
| **CO-2** | Analyze the rigid body in equilibrium |
| **CO-3** | Evaluate the properties of distributed forces |
| **CO-4** | Determine the friction and the effects by the laws of friction |
| **CO-5** | Calculate dynamic forces exerted in rigid body |

**TEXTBOOK**

TEXT BOOK-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.

TEXT BOOK-2:

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

# REFERENCES:

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

**RB.2.**Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition,Prentice Hall, 2013..

**RB.3.**Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition,Pearson Education Asia Pvt. Ltd., 2005

**UNIT I: STATICS OF PARTICLES**

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| **Sl. No.** | **TOPICS** | **Lecture Hours** | **Book /**  **Chapter/**  **Pages** | **Teaching Aids/ Method** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 1.1 Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions | 1 | RB1/ch2/Pg-3-9 | BB | Remember | CO1 | PO1/  PSO1 |
|  | 1.2 Statics of Particles Forces in a Plane, Resultant of Forces, Resolution of a Force into Components | 2,3 | RB1/ch2/ Pg-11-16 | BB | Understand | CO1 | PO1/  PSO1 |
|  | 1.3 Rectangular Components of a Force, Unit Vectors | 4,5 | RB1/ch2/ Pg-16 | BB | Understand | CO1 | PO1/  PSO1 |
|  | 1.4 Equilibrium of a Particle- Newton’s First Law of Motion | 6,7 | RB1/ch2/ Pg-17-22 | BB | Understand | CO1 | PO1/  PSO1 |
|  | 1.5 Space and Free-Body Diagrams | 8,9 | RB1/ch2/ Pg-22-29 | BB | Understand | CO1 | PO1/  PSO1 |
|  | 1.6 Forces in Space | 10 | RB1/ch2/ Pg-30-37 | BB | Understand | CO1 | PO1/  PSO1 |
|  | 1.7 Equilibrium of a Particle in Space. | 11 | RB1/ch2/ Pg-37 | BB | Apply | CO1 | PO1/ PSO1 |
|  | ACTIVITY | 12 | WITH AID OF BALLS, THEAD MAKING WEIGHT DEMO | | | | |

**UNIT II: EQUILIBRIUM OF RIGID BODIES**

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| **Sl. No.** | **TOPICS** | **Lecture hours** | **Books/ Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 2.1 Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon’s Theorem | 13,14 | RB1/ch4/ Pg-41 | BB | Remember | CO2 | PO1/ PSO1 |
|  | 2.2 Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors | 15 | RB1/ch4/ Pg-42-45 | BB | Understand | CO2 | PO1/ PSO2 |
|  | 2.3 Moment of a Force about an Axis, Couple | 16,17 | RB1/ch1/ Pg-45-46 | BB | Remember | CO2 | PO1/ PSO1 |
|  | 2.4 Addition of Couples, Resolution of a Given Force into a Force | 18 | RB1/ch5/ Pg-41-42 | BB | Understand | CO2 | PO1/ PSO2 |
|  | 2.5Couple system, Further Reduction of a System of Forces | 19,20 | RB1/ch1/ Pg-47-58 | BB | Understand | CO2 | PO1/ PSO2 |
|  | 2.6Equilibrium in Two and Three Dimensions | 21,22 | RB1/ch10/ Pg-47-58 | BB | Understand | CO2 | PO1/ PSO2 |
|  | 2.7Reactions at Supports and Connections | 23 | RB1/ch10/ Pg-47-58 | BB | Apply | CO2 | PO1/ PSO2 |
|  | ACTIVITY | 24 | THERMA COAL BASED RECTANGULAR , | | | | |

**UNIT III: DISTRIBUTED FORCES**

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| **Sl. No.** | **TOPICS** | **Lecture Hours** | **Books / Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 3.1 Centroids and centre of mass– Centroids of lines and areas | 25,26 | RB1/ch8/ Pg-175 | BB | Remember | CO3 | PO3/ PSO1 |
|  | 3.2 Rectangular, circular, triangular areas by integration | 27,28 | RB1/ch8/ Pg-175-176 | BB | Understand | CO3 | PO3/ PSO2 |
|  | 3.3 T section, I section, - Angle section, Hollow section by using standard formula | 29,30 | RB1/ch8/ Pg-176-177 | BB | Apply | CO3 | PO3/ PSO2 |
|  | 3.4 Theorems of Pappus | 31 | RB1/ch8/ Pg-177-198 | BB | Understand | CO3 | PO3/ PSO2 |
|  | 3.5 Area moments of inertia of plane areas | 32 | RB1/ch8/ Pg-230-236 | BB | Apply | CO3 | PO3/ PSO2 |
|  | 3.6 Parallel axis theorem and perpendicular axis theorem | 33 | RB1/ch8/ Pg-249-250 | BB | Apply | CO3 | PO3/ PSO1 |
|  | 3.7 Principal moments of inertia of plane areas | 34 | RB1/ch8/ Pg-250-253 | BB | Apply | CO3 | PO3/ PSO2 |
|  | 3.8 Relation to area moments of inertia. | 35 | RB1/ch8/ Pg-253-255 | BB | Apply | CO3 | PO3/ PSO2 |
|  | ACTIVITY | 36 | THERMACOAL T , L SECTION DEMO | | | | |

**UNIT IV: FRICTION**

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| **Sl.**  **No.** | **TOPICS** | **Lecture Hour** | **Books referred/ Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/**  **PSO** |
|  | 4.1 The Laws of Dry Friction | 37 | RB2/app B/ Pg-112 | BB | Remember | CO4 | PO3/  PSO1 |
|  | 4.2 Coefficients of Friction | 38,39 | RB2/app B/ Pg-112 | BB | Understand | CO4 | PO3/  PSO2 |
|  | 4.3 Angles of Friction | 40,41 | RB2/app B/ Pg-113 | BB | Understand | CO4 | PO3/  PSO2 |
|  | 4.4 Wedge friction | 42 | RB2/app B/ Pg-124 | BB | Apply | CO4 | PO3/ PSO2 |
|  | 4.5 Wheel Friction | 43,44 | RB2/app B/ Pg-113-124 | BB | Apply | CO4 | PO3/ PSO2 |
|  | 4.6 Rolling Resistance | 45,46 | RB2/app B/ Pg-130-134 | BB | Apply | CO4 | PO3/  PSO2 |
|  | 4.7 Ladder friction | 47 | RB2/ ch16/ Pg-130-134 | BB | Apply | CO4 | PO3/ PSO2 |
|  | ACTIVITY | 48 | DEMO ON LADDER  ROLLING FRICTION | | | | |

**UNIT V: DYNAMICS OF PARTICLES**

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| **Sl. No.** | **TOPICS** | **Lecture Hour** | **Books / Chapter** | **Teaching Aids/ Methods** | **Instructional Delivery Level** | **CO** | **PO/**  **PSO** |
|  | 5.1 Kinematics - Rectilinear Motion and Curvilinear Motion of Particles | 49 | RB2/ch14/ Pg-259-261 | BB | Remember | CO5 | PO3/ PSO1 |
|  | 5.2 Newton’s Second Law of Motion -Equations of Motions, Dynamic Equilibrium | 50,51 | RB2/ch14/ Pg-265-286 | BB | Remember | CO5 | PO3/ PSO2 |
|  | 5.3 Energy and Momentum Methods | 52,53 | RB2/ch14/ Pg-265-286 | BB | Remember | CO5 | PO3/ PSO2 |
|  | 5.4 Work of a Force, Kinetic Energy of a Particle | 54,55,56 | RB2/ch14/ Pg-365-384 | BB | Remember | CO5 | PO3/ PSO2 |
|  | 5.5 Principle of Work and Energy | 57,58 | RB2/ch14/ Pg-365-384 | BB | Apply | CO5 | PO3/ PSO2 |
|  | 5.6 Principle of Impulse and Momentum, Impact of bodies | 59 | RB2/ch14/ Pg-388-431 | BB | Remember | CO5 | PO3/ PSO2 |
|  | ACTIVITY | 60 |  | Video |  |  |  |

**Activities if any:**

**Different Types of problem given an discuss about the problems.**

**Step 1:** Discuss about different types of problems in all units.

**Step 2:** From the whole unit the different types of questions based upon exam point are given to

all the students.

**Step 3:** The students have to prepare the questions and done the problems.

**Step 4:** The teacher will correct their assignments and discuss about their mistakes.

**Content beyond syllabus**

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| **S. No** | **Topics** | **Lecture hours** | **Books / Chapter** | **Teaching aids** | **Instructional Delivery Level** | **PO / PSO** |
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| 1 | BELT FRICTION | 45 | RB2/ch8/ Pg-130 | BB | Applying | PO3/  PSO2 |  |  |

**Signature of the Staff Signature of the HOD**