B. Tech with

HONORS

in

MECHANICAL ENGINEERING

Academic Regulations, Course Structure and Syllabus

Effective from 2023-24 admitted batches

Offered by

Department of Mechanical Engineering

KSRM College of Engineering (A) – Kadapa

(Approved by AICTE, Accredited by NAAC with A+ Grade and NBA and Affiliated to JNTUA, Anantapuramu)

ELIGIBILITY / REGISTRATION / AWARD OF HONORS

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The program is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) Those students with **at least 7.0 CGPA without any course backlogs up to III Semester in the major degree are only eligible to register for Honor degree**.

iii) A student shall earn **additional 18 credits for award of Honors** from same branch / department / discipline registered for major degree. This is in addition to 163 credits by a regular student and 123 Credits by a Lateral Entry student for the award of Major degree.

iv) A student is permitted to register for Honors in IV Semester after the results of III Semester are declared. Students shall register and pass in all the courses prescribed and being offered from V semester under the respective Honor degree.

v) Students have to attend classwork for courses under Honor degree beyond regular academic hours meant for major degree. Students can also undergo the courses under Honor through any proctored online platforms with the prior approval of the BoS Chairman and the HoD of the respective department offering Honor degree.

vi) The attendance for the registered courses under Honors and regular courses offered for Major degree in a Semester will be considered separately.

vii) A student shall have an aggregate of 75% attendance in all courses registered under Honors in that particular semester to become eligible for attending Semester-End examinations.

viii) The registration for the Honor will be cancelled, if the student is detained due to lack of attendance in Major,

ix) The registration for the Honor will be cancelled, if the student fails in any course of either Honor / Major in any semester from V to VIII Semester.

x) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) will be awarded for Honors degree program.

xi) A separate grade sheet will be issued for the Honor degree courses semester-wise.

xii) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra.

xiii) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical

Engineering.

xiv) There shall be a minimum enrolment of 20% OR 20 enrollments from the list of eligible students to offer Honors program.

xv) There is no fee for registration of courses for Honors program offered.

xvi) A student can register for either Minor / Honor but not both.

xvii) Student shall submit an application for either Minor / Honor at least one week before the commencement of the V Semester.

HONORS PROGRAMS OFFERED

Offering Department	Title	Who can Register
Civil Engineering	Civil Engineering	B.Tech. CE
	Tunnel Engineering	
	Interior Design	
Mechanical Engineering	Mechanical Engineering	B.Tech. ME
Electrical and Electronics Engineering	Electric Vehicles	B.Tech. EEE
Electronics and Communication Engineering	VLSI	B.Tech. ECE
	Embedded Systems and IoT	
Computer Science and Engineering	Computer Science and Engineering	B.Tech. CSE, B.Tech. AIML, B.Tech. CSE(DS), B.Tech. CSE(AIML)
	Artificial Intelligence and Machine Learning	
	Data Science	
	CSE-Artificial Intelligence and Machine Learning	

COURSE STRUCTURE

for

HONORS

in

MECHANICAL ENGINEERING

S. No	COURSE CODE	COURSE TITLE	Semester Offered	L	T	P	IM	EM	CR
1	2303571H	Automotive Thermal Systems	V	3	0	0	30	70	3
2	2303572H	Simulation and Modelling of Manufacturing Systems	V	3	0	0	30	70	3
3	2303671H	Materials Management	VI	3	0	0	30	70	3
4	2303672H	Advanced Mechanism Design	VI	3	0	0	30	70	3
5	2303771H	Bio-Mechanics	VII	3	0	0	30	70	3
6	2303772H	Applied Project Work	VII	0	0	6	60	140	3
Total				**15**	**0**	**6**	**210**	**490**	**18**

2303571H	HONORS IN MECHANICAL ENGINEERING AUTOMOTIVE THERMAL SYSTEMS (ME)	L	T	P	C
		3	0	0	3

Pre-requisites: Thermodynamics and Heat Transfer

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Apply energy, heat, and work principles; use thermodynamic laws for analyzing and designing thermal systems with optimization and constraints.
CO2. Analyze automotive engine performance using the first and second laws of thermodynamics, energy, and energy analysis.
CO3. Evaluate automotive climate control using psychometrics, refrigerant choice, load analysis, and A/C system design with fan types, cabin models, and two-phase flow.
CO4. Analyze and design heat exchangers based on heat transfer, materials, size, and cost.
CO5. Implement EV thermal management by analyzing battery heat, thermal runaway, and power electronics.

SYLLABUS:

UNIT - I: **FUNDAMENTALS AND SYSTEMATIC APPROACH TO HEAT TRANSFER CONCEPTS (09Periods)**

Energy, Heat & Work, First Law of Thermodynamics, Heat Engines, Refrigerators, and Heat Pumps, Second Law of Thermodynamics, Carnot Cycle, Conduction, Convection-Parallel flow on an Isothermal Plate, A cylinder in cross flow, Flow in Ducts, Free Convection, Radiation. Formulation of Thermal System Design-Requirement and Specifications, Design Variables, Constraints. Designing a workable system, Optimization methods -overview and significance

UNIT- II: **AUTOMOTIVE ENGINE THERMAL MANAGEMENT (09 Periods)**

Fundamentals of First & Second Law of Thermodynamics to the engine performance (Volumetric efficiency and Thermal Efficiency), heat balance equation, Fundamentals of Exergy, Energy analysis, Thermal Models and Operating Strategy- smart valve, variable speed pump, variable speed fan. Applications of Thermoelectric generators and Thermoelectric coolers, Applications of heat pipes and heat sink.

UNIT- III: **FUNDAMENTALS OF AUTOMOTIVE CLIMATE CONTROL (09 Periods)**

Psychometric properties, use of psychrometric chart, coefficient of performance, Refrigerants Types of refrigerants, Properties and Selection of refrigerants, Factors

affecting the air flow, Types of fans, Axial and Centrifugal fans, Load calculations, Winter air-conditioning, Two-phase flow effects in the Evaporator and Condenser, air side heat transfer on the Evaporator and Condenser, System mass effects, Simplified cabin thermal model. Convective thermal interaction-cabin air and atmosphere.

UNIT- IV: FUNDAMENTALS OF HEAT EXCHANGERS (09 Periods)

Functions of radiator, compressor, Functions of condenser, evaporator, expansion valve, Classification of heat exchangers – According to transfer process, Number of fluids, surface compactness, Construction features, flow arrangements, heat transfer mechanisms, Selection and design of heat exchangers based on – Types, heat transfer rate, cost, pumping power, size and materials. Coolant- function, types, and required properties. Advanced cooling system with smart valve, variable speed pump, variable speed fan, engine block, radiator, and sensors (temperature, mass flow rate and power).

UNIT- V: THERMAL MANAGEMENT IN EV SYSTEMS (09 Periods)

Temperature sensitivity and heat generation of batteries- electro-thermal, Internal heat generation, Rate of Discharge, Battery ageing, Thermal runaway, battery heat transfer medium. Role of thermal management in power electronics and controllers, heat sink design and configuration, Application of microfluidics and Nano fluids

Total Periods: 45

TEXT BOOKS:

T1. Heat and Mass Transfer, Yunus A Cengel, Afshin J Ghajar, Tata McGraw Hill Education Private Limited, New Delhi, 2018, Third Edition.

T2. Design of Thermal Systems, W. F. Stocker, Tata McGraw Hill Education Private Limited, New Delhi, 2011, Third Edition.

REFERENCE BOOKS:

R1. Design and Optimization of Thermal Systems, Yogesh Jaluria, CRC Press, Taylor & Francis Group, New York, 2018, Second Edition.

R2. Automotive Air Conditioning Optimization, Control and Diagnosis, Quansheng Zhang, Shengmo Eben Li, Kun Deng, Springer International Publishing, 2016, Second Edition.

R3. Electric Vehicle Technology, James Larminie and John Lowry, A John Wiley & Sons Ltd., Publication, 2010, Second Edition.

R4. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, Taylor Francis Group, New York, 2010, Second Edition.

WEB RESOURCES:

1. **https://nptel.ac.in/courses/107106088**

2303572H	HONORS IN MECHANICAL ENGINEERING SIMULATION AND MODELING FOR MANUFACTURING SYSTEMS (ME)	L	T	P	C
		3	0	0	3

Pre-requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Define the state of system with respect to specified performance measures.
CO2. Develop simulation model for the said system
CO3. Generate random variants and learn various simulation languages.
CO4. Analyze through simulation the model and present the results to specified confidence level.
CO5. Apply simulation for flow shop systems and jobs hop systems.

SYLLABUS:

UNIT - I: MODELING, SIMULATION, AND INFERENCE (10 Periods)

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis - steps – types 1& 2 errors – Framing – strong law of large numbers.

UNIT - II: SIMULATION MODEL DEVELOPMENT AND VALIDATION

(10 Periods)

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT - III: RANDOM VARIATE GENERATION AND SIMULATION TOOLS

(10 Periods)

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables –exponential – uniform – weibull – normal Bernoullie's – Binomial – uniform – poison. Simulation languages – comparison of simulation languages with general purpose languages– Simulation languages vs Simulators–

software features –statistical capabilities–GPSS–SIMAN-SIMSCRIPT–Simulation of M/M/1queue – comparison of simulation languages.

UNIT - IV: OUTPUT DATA ANALYSIS IN SIMULATION (08 Periods)

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT - V: SIMULATION APPLICATIONS (07 Periods)

Applications of Simulation – flow shop system – jobs hop system –M/M/1 queues within finite and finite capacities – Simple fixed period inventory system – New boy paper problem.

Total Periods: 45

TEXT BOOKS:

T1. Simulation Modeling and Analysis, Averill M. Law, Mc Graw Hill 2024, Sixth Edition.
T2. Discrete Event System Simulation by Banks J. & Carson J.S., Pearson Education India, 2013, Fifth Edition.

REFERENCE BOOKS:

R1. Simulation of Manufacturing Systems by Carrie A., Wiley, NY,1990, First Edition.
R2. A Course in Simulation by Ross, S.M., Mc Millan, NY,1990, Second Edition.
R3. Simulation Modelling and Analysis by Law, A.M. & Kelton, Mc Graw Hill, New York, 1991, Second Edition

WEB RESOURCES:

1. https://www.youtube.com/watch?v=GkLakmNaXB0
2. https://www.youtube.com/watch?v=MotriP4v3a8
3. https://www.youtube.com/watch?v=z64Ef2d5SEE

2303671H	HONORS IN MECHANICAL ENGINEERING MATERIALS MANAGEMENT (ME)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1: Apply ethical, organizational, procedural, and strategic aspects of domestic and international purchasing.
CO2: Analyze vendor evaluation factors, processes, and recent trends for effective vendor management.
CO3: Apply materials handling principles to optimize cost, flow, equipment selection, and safety performance.
CO4: Apply inventory control methods and planning tools to manage stock levels, costs, and demand forecasting.
CO5: Explain the use of computers in materials planning and management, along with their benefits and limitations.

SYLLABUS:

UNIT - I: PURCHASE MANAGEMENT **(09 Periods)**

Overview, Purchase organization, Ethical Concepts in purchases, Purchase Parameters, purchase Methods. International Purchasing, International purchasing procedure.

UNIT - II: VENDOR MANAGEMENT **(08 Periods)**

Vendor Evaluation - factors, advantages and disadvantages, parameters. Vendor management process. Recent trends in Vendor management

UNIT - III: MATERIALS HANDLING **(07 Periods)**

Handling Principles, handling costs, unit load concept, flow pattern, material handling equipment's, evaluation of materials handling performance, safety in materials handling.

UNIT - IV: INVENTORY MANAGEMENT **(13 Periods)**

Types of Inventory, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, ABC Analysis, Safety Stocks, Inventory Management Systems, Forecasting Techniques, Material Requirement Planning.

UNIT - V: COMPUTER IN MATERIALS MANAGEMENT (08 Periods)

Introduction, Role of Computers in Materials Management, Advantages and Disadvantage of Computer in Materials Management, Materials Planning: Need for Materials Planning, Techniques of Materials Planning.

Total Periods: 45

TEXT BOOKS:

T1. Materials Management, K. Shridhara Bhat, Himalaya Publishing House, 2011, First Edition.

T2. Materials Management: Procedures, Text and Cases, A.K. Datta, PHI, 2020, Second Edition.

REFERENCE BOOKS:

R1. Purchasing and Materials Management, P. Gopalakrishnan, M. Sundaresan, Tata McGraw-Hill Education, 2008, Second edition.

R2. Materials Management: An Integrated Systems Approach, Prem Vrat, G.D. Sardana, B.S. Sahay, Springer India, 2014, First edition.

R3. Materials and Logistics Management, L.C. Jhamb, Everest Publishing House, 2013, First edition.

WEB RESOURCES:

1. nptel.ac.in/courses/110105095
2. DMGT525_MATERIALS_MANAGEMENT.Pdf
3. https://onlinecourses.nptel.ac.in/noc20_me30/preview?utm_source=chatgpt.com

2303672H	HONORS IN MECHANICAL ENGINEERING ADVANCED MECHANISM DESIGN (ME)	L	T	P	C
		3	0	0	3

Pre-Requisites: Theory of Machines

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Compute and interpret mobility, degrees of freedom, and motion parameters for planar mechanisms.

CO2. Apply analytical and graphical methods such as Hall and Ault's method, Goodman's indirect method, Chase solution, and Bubblier construction to evaluate velocity and acceleration in mechanisms, including the use of the instant center of acceleration and Euler-Savory equation.

CO3. Perform two- and three-position kinematic synthesis of mechanisms; apply Chebyshev. Spacing principles and identify/design cognate linkages.

CO4. Analyze static and dynamic forces acting on planar mechanisms and determine their Equilibrium conditions.

CO5. Model and analyze the kinematics of RSSR and similar mechanisms using Denavit - Hartenberg (D–H)

SYLLABUS:

UNIT - I: INTRODUCTION (10 Periods)

Introduction – review of fundamentals of kinematics - analysis and synthesis – terminology, Definitions and assumptions – planar, spherical and spatial mechanisms‟ mobility – classification of mechanisms –kinematic Inversion – Grashoff`s law Position and displacement – complex algebra solutions of planar vector equations – coupler curve generation velocity – analytical methods - vector method – complex algebra methods – Freudenstein‟s theorem

UNIT - II: PLANAR COMPLEX MECHANISMS (09 Periods)

Planar complex mechanisms - kinematic analysis - low degree complexity and high degree complexity, Hall and Ault`s auxiliary point method – Goodman‟s indirect method for low degree of complexity mechanisms Acceleration – analytical methods – Chase solution - Instant centre of acceleration. Euler-Savory equation - Bobillier construction.

UNIT - III: SYNTHESIS OF MECHANISMS (10 Periods)

Synthesis of mechanisms: Type, number and dimensional synthesis – function generation – two position synthesis of slider crank and crankrocker mechanisms with optimum transmission angle – three position synthesis – structural error –

Chebychev spacing - Cognate linkages – Robert- Chebychev theorem – Block‟s method of synthesis, Freudenstein‟s equation

UNIT - IV: STATIC FORCE ANALYSIS (08 Periods)

Static force analysis of planar mechanism – static force analysis of planar mechanism with friction – method of virtual work Dynamic force analysis of planar mechanisms - Combined static and inertia force analysis

UNIT - V: KINETIC ANALYSIS (08 Periods)

Kinematic analysis of spatial revolute-Spherical-Spherical-Revolute mechanism – Denavit- Hartenberg parameters – forward and inverse kinematics of robotic manipulators.

Total Periods: 45

TEXT BOOKS:

T1. Theory of Mechanisms and Machines, Amitabh Ghosh and Ashok Kumar Mallik, EWP, New Delhi, 1999, Third Edition.

T2. Mechanism Design: Enumeration of Kinematic Structures According to Function Lung-Wen Tsai, CRC Press (Taylor & Francis), 2000, First Edition.

REFERENCE BOOKS:

R1. Theory of Machines and Mechanism , Shighley Joseph Edwards and Quicker John Joseph, 2e, McGraw Hill,2023, Sixth Edition.

R2. Advanced Mechanism Design: Analysis and Synthesis, Arthur G. Erdman and G.N. Sandor, Vol. I, PHI, 1984, First Edition.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105268/
2. https://www.cs.cmu.edu/~motionplanning/
3. https://books.google.com/books?id=DRjSBwAAQBAJ

2303771H	HONORS IN MECHANICAL ENGINEERING BIO MECHANICS (ME)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Identify and describe the anatomy and biomechanical roles of bones, muscles, and synovial joints

CO2. Analyze human gait using 3D motion capture systems and interpret joint biomechanics based on captured data.

CO3. Calculate joint moments and muscle forces using inverse dynamics and musculoskeletal modelling tools.

CO4. Evaluate the mechanical behavior of bone and assess implant fixation methods and failure mechanisms in joint replacements.

CO5. Develop and validate finite element models for bone-implant systems and simulate bone remodeling using mechanobiological principles.

SYLLABUS:

UNIT - I: INTRODUCTION TO MUSCULOSKELETAL SYSTEM (10 Periods)

Bone, Muscle, Ligament, Tendon, Cartilage and Meniscus – structure and function Anatomy of Synovial Joints – Hip, Knee, Shoulder, Elbow

UNIT - II: BIOMECHANICS OF HUMAN JOINTS (09 Periods)

Biomechanics of Human Joints: (a) Hip Joint; (b) Knee Joint; (c) Shoulder Joint; (d) Elbow Joint, Biomechanics of Gait cycle Gait Analysis Measurement techniques 3-D Motion analysis system – markers, cameras and force platform Lower extremity – hip musculoskeletal forces

UNIT - III: JOINT KINEMATICS (09 Periods)

Joint Kinematics Principle of Forward and Inverse Dynamics Calculations on joint forces and moments Calculations on muscle forces Model-based estimation of musculoskeletal forces during movements

UNIT - IV: BIOMECHANICS OF JOINT REPLACEMENT (08 Periods)

Concepts of Stresses and Strain Bone structure - Cancellous and Cortical Bone Mechanical behavior of Bone, Bone Adaptation and Viscoelasticity Bone Anisotropy. Biomechanics of Joint Replacement – Hip, Knee, Shoulder, Spine Cemented and Cement less fixation Failure mechanisms of implants Implant Design Considerations.

UNIT - V: BIOMECHANICAL MODELLING (09 Periods)

Biomechanical modelling techniques and analysis Finite Element Analysis of bone and implant Bone remodelling – formulation, algorithm, simulation Experimental validation of numerical models Bone Fracture Healing Tissue Differentiation Mechano regulatory principle Mechanobiology based simulation of bone ingrowth around implants – acetabular and femoral components

Total Periods: 45

TEXT BOOKS:

T1. Basic Biomechanics of the Musculoskeletal System by Margareta Nordin and Victor H. Frankel, Lippincott Williams & Wilkins,2012, Fourth Edition**.**

T2. Biomechanics and Motor Control of Human Movement by David A. Winter, willey Publishers, 2009, Fourth Edition.

T3. Orthopedic Biomechanics by D.L. Bartel, D.T. Davy and T.M. Keaveny, 2006, Pearson, First Edition.

REFERENCE BOOKS:

R1. Biomechanics: Mechanical Properties of Living Tissue by Yuan-Cheng Fung, Spinger-verlag New York Inc, 1993, Second Edition.

R2. Musculoskeletal Biomechanics by Benno M. Nigg and Walter Herzog, Wiley-Blackwell, 1998, Second Edition.

R3. Skeletal Tissue Mechanics by R. Bruce Martin, David B. Burr, and Neil A. Sharkey, 2015, Second Edition.

WEB RESOURCES:

1. https://www.coursera.org/learn/musculoskeletal-biomechanics
2. https://nptel.ac.in/courses/112/106/112106326/
3. https://www.edx.org/course/biomechanics-of-joints-and-muscles
4. https://ocw.mit.edu/courses/mechanical-engineering/2-785j-cellular-biomaterials-spring-2004/
5. https://simtk.org/home/opensim

2303772H	HONORS IN MECHANICAL ENGINEERING APPLIED PROJECT WORK (ME)	L	T	P	C
		0	0	6	3

Pre-Requisites: Nil

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Use engineering knowledge to choose an appropriate topic for study.
CO2. Identify the needs and requirements of a specific Mechanical Engineering task
CO3. Plan and design the task at hand with the help of appropriate conventional and Modern methods/tools.
CO4. Build professional competence and confidence in students to take up Mechanical Engineering assignments.
CO5. Prepare professional documentation for the work carried out.

The project work can be a design project/experimental project/field surveying/computer oriented on any of the topics of Mechanical Engineering/allied domain. The internal assessment will be done through three progress seminars during eight semesters reviewed by internal committee members. A consolidated six to ten pages of typed report based on the progress work done have to be submitted by the batch of students to the assessing committee during each review process. The external assessment of the project will be done at the end of the semester by a committee consisting of both internal and external faculty members specialized in various fields of Mechanical Engineering. The students will present their project work before the committee. Each group will submit the copies of the completed project report signed by the guide to the department. The head of the department will certify the copies and return the reports to the students. Students have to submit the three hard copies, one copy to the respective guide, one copy to the departmental library and another copy to the college library