

HONOURS

S.No	Course Code	Course Title	Scheme of Instructions Hours per Week				Scheme of Examination Maximum Marks		
			L	T	P	C	I	E	Total
1	23HRMEC1	Automotive Thermal System	3	-	-	3	30	70	100
2	23HRMEC2	Simulation and Modeling of Manufacturing Systems	3	-	-	3	30	70	100
3	23HRMEC3	Supply Chain Management	3	-	-	3	30	70	100
4	23HRMEC4	Advanced Mechanism Design	3	-	-	3	30	70	100
5	23HRMEC5	Biomechanics	3	-	-	3	30	70	100
6	23HRMEC6	Applied Project Work	-	-	-	6	30	70	100

B.Tech (ME)– Honor's in Mechanical Engineering (R23)

23HRMEC1	AUTOMOTIVE THERMAL SYSTEM	L	T	P	C
		3	0	0	3

Unit I**Fundamentals and Systematic Approach to Heat Transfer Concepts**

Energy, Heat & Work, First Law of Thermodynamics, Heat Engines, Refrigerators, and Heat Pumps, Second Law of Thermodynamics, Carnot Cycle, Conduction, Convection-Parallel flow on a 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**

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**

Psychrometric 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- Heat Exchangers**

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

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.

TEXT BOOKS:

1. Yunus A Cengel, Afshin J Ghajar, —Heat and Mass Transferl., Tat McGraw Hill Education Private Limited, New Delhi,2018
2. W. F. Stoecker Design of Thermal Systems Third Edition, McGraw – Hill, New york, 1989
3. HoSung Lee —Thermal Design: Heat Sinks, Thermoelectrics, Heat Pipes, Compact Heat Exchangers, and Solar Cellsl 2011 John Wiley & Sons, Inc

REFERENCES:

1. Jaluria, Yogesh.Design and optimization of thermal systems 2nd Edition CRC Press, Taylor & Francis Group 2018.
2. Quansheng Zhang —Automotive Air Conditioning Optimization, Control and Diagnosisl Springer International Publishing AG 2016
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2012.
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003 8. —Bosch‘ Automotive Handbookl, 8thEdition

Online Learning Resources:

<https://nptel.ac.in/courses/112108317>

<https://nptel.ac.in/courses/112108149>

<https://nptel.ac.in/courses/112103275>

<https://nptel.ac.in/courses/112103276>

B.Tech (ME)– Honor's in Mechanical Engineering (R23)

23HRMEC2	SIMULATION AND MODELLING OF MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

UNIT – I

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

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

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoulli – Binomial – uniform – poisson. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

UNIT – IV

Output data analysis – Types of Simulation w.r.t output data analysis – warmup period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT –V

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

TEXT BOOKS:

1. Law, A.M. & Kelton, —Simulation Modelling and Analysis, McGraw Hill, 2nd Edition, New York, 1991.
2. Narahari and M. Vishwanathan Prentice hall England wood Cliffs, —Performance modelling of automated manufacturing systems. NJ USA 1992.

REFERENCES:

1. Carrie A. / Wiley, NY, —Simulation of Manufacturing Systems, 1990.
2. Ross, S.M., McMillan, NY, —A Course in Simulation, 1990. Simulation Modelling and SIMNET / Taha H.A / PH, Englewood Cliffs, NJ, 1987.
3. Banks J. & Carson J.S., PH, —Discrete Event System Simulation, Englewood Cliffs, NJ, 1984

Online Learning Resources:

<https://nptel.ac.in/courses/112102318>

<https://nptel.ac.in/courses/112104188>

<https://nptel.ac.in/courses/112104189>

<https://nptel.ac.in/courses/112101005>

B.Tech (ME)– Honor's in Mechanical Engineering (R23)

23HRMEC3	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT-1**Introduction to Supply Chain Management**

Supply chain - objectives - importance - decision phases - process view -competitive and supply chain strategies - achieving strategic fit – supply chain drivers - obstacles – framework - facilities - inventory-transportation-information-sourcing-pricing.

UNIT-2**Designing the distribution network**

Role of distribution - factors influencing distribution - design options - e-business and its impact – distribution networks in practice –network design in the supply chain - role of network -factors affecting the network design decisions modeling for supply chain. Role of transportation - modes and their performance – transportation infrastructure and policies - design options and their trade-offs tailored transportation.

UNIT-3**Supply Chain Analysis.**

Sourcing - In-house or Outsource - 3rd and 4th PLs - supplier scoring and assessment, selection - design collaboration - Procurement process - Sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts.

UNIT-4**Dimensions of Logistics**

A macro and micro dimension - logistics interfaces with other areas - approach to analyzing logistics systems - logistics and systems analysis - techniques of logistics system analysis - factors affecting the cost and importance of logistics. Demand Management and Customer Service Outbound to customer logistics systems - Demand Management –Traditional Forecasting - CPFRP - customer service - expected cost of stock outs - channels of distribution.

UNIT-5

Recent Trends in Supply Chain Management-Introduction, New Developments in Supply Chain Management, Outsourcing Supply Chain Operations, Co-Maker ship, The Role of E-Commerce in Supply Chain Management, Green Supply Chain Management, Distribution Resource Planning, World Class Supply Chain Management

TEXT BOOKS:

1. Sunil Chopra and Peter Meindl, Supply Chain Management – —Strategy, Planning and Operation, 3rd Edition, Pearson/PHI, 2007.
2. Supply Chain Management by Janat Shah Pearson Publication 2008.

REFERENCE BOOKS:

1. A Logistic approach to Supply Chain Management – Coyle, Bardi, Longley, Cengage Learning, 1/e
2. Donald J Bowersox, Dand J Closs, M Bixby Coluper, —Supply Chain Logistics Management, 2nd edition, TMH, 2008.
3. Wisner, Keong Leong and Keah-Choon Tan, —Principles of Supply Chain Management A Balanced Approach, Cengage Learning, 1/e
4. David Simchi-Levi et al, —Designing and Managing the Supply Chain – Concepts.

Online Learning Resources:

<https://nptel.ac.in/courses/112103774>

<https://nptel.ac.in/courses/112107219>

<https://nptel.ac.in/courses/112101005>

B.Tech (ME)– Honor's in Mechanical Engineering (R23)

23HRMEC4	ADVANCED MECHANISM DESIGN	L	T	P	C
		3	0	0	3

UNIT– I

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 - 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: 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 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

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

TEXT BOOK:

1. Amitabh Ghosh and Ashok Kumar Mallik, —Theory of Mechanisms and Machines, 3e, EWP, 1999
2. Arthur G. Erdman and G.N. Sandor, —Advanced Mechanism Design: Analysis and Synthesis, Vol. II, PHI, 1984.

REFERENCES:

1. Shigley Joseph Edwards and Uicker John Joseph, —Theory of Machines and Mechanisms, 2e, McGraw Hill, 1985.
2. Arthur G. Erdman and G.N. Sandor, —Advanced Mechanism Design: Analysis and Synthesis, Vol. I, PHI, 1984.

Online Learning Resources:

<https://nptel.ac.in/courses/112101005>
<https://nptel.ac.in/courses/112104230>
<https://nptel.ac.in/courses/112107258>

B.Tech (ME)– Honor's in Mechanical Engineering (R23)

23HRMEC5	BIOMECHANICS	L	T	P	C
		3	0	0	3

Unit I

Introductory Mechanics – Statics and Dynamics – Basic Principles. The human body as a biomechanical system – basic terminologies.

Unit II

Kinematics of muscles and joints - free-body diagrams and equilibrium, forces and stresses in joints
Biomechanical analysis of joints of upper limb - Shoulder, Elbow, wrist, hand and fingers.

Unit III

Upper limb as a mechanical system – analysis of reaching as movement of a multi-link serial chain – forward kinematics, analysis of fingertip forces as a parallel manipulator

Unit IV

Biomechanical analysis of joints – Spine, Hip, Knee, Ankle. Introduction to Postural stability and Gait analysis. Gait analysis in health and disease - basics. Mechanics of Hard Tissues - Definition of Stress and Strain, Deformation Mechanics, structure and mechanical properties of bone - cortical and cancellous bones, Wolff's law of bone remodeling.

Unit V

Soft Tissues - Structure, functions, material properties – tendon function, elasticity in a tendon, models of non-linear elasticity in a tendon – physiological and non-physiological regimes, Davis' law of soft tissue remodeling. Visco-elastic properties of soft tissues, Models of visco-elasticity: Maxwell & Voight models. Basic Biofluid mechanics - Flow properties of blood in the intact human cardiovascular system.

TEXT BOOKS

1. David A. Winter, Biomechanics and Motor Control of Human Movement .
2. Margareta Nordin and Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System.

REFERENCE BOOKS

1. Francisco Valero-Cuevas, Fundamentals of Neuromechanics.
2. Susan Hall, Basic Biomechanics.
3. Irving Hermann, Physics of Human Body.

Online Learning Resources:

<https://nptel.ac.in/courses/112105305>

<https://nptel.ac.in/courses/112104029>