GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA (JHAJJAR)

An Autonomous Institute

'A' GRADE ACCREDITED BY NAAC

Scheme of Examinations & Syllabus For

Master of Technology (Machine Design) 2nd Year

(Effective from the Session: 2025-26)

APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU, ROHTAK

1. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	2 Practical (Lab) per week	1 Credit
3	2 Seminar per Week	2 Credit
4	4 Project per Week	2 Credit

2. RANGE OF CREDIT

A credits of 86 for a student to be eligible to get Post Graduate degree in Machine Design.

3. STRUCTURE OF MASTER OF TECHNOLOGY (MACHINE DESIGN)

Sr. No.	Category	Breakup of Credits
1	Professional Core Courses	32
2	Professional Elective Courses	8
3	Multidisciplinary Open Elective Courses	6
4	Foundation Elective Courses	3
5	Mandatory Learning Course	3
6	Seminar	6
7	Lab Courses	4
8	Project	2
9	Dissertation	22
	Total Credits	86

4. COURSE CODE AND DEFINITIONS

Sr. No.	Category	Course Code
1	Professional Core Courses	PCC
2	Professional Elective Courses	PEC
3	Multidisciplinary Open Elective Courses	OEC
4	Foundation Elective Courses	FEC
5	Mandatory Learning Course	MLC
6	Seminar	SM
7	Lab Courses	LC
8	Project	PROJ
9	Dissertation	DISS

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examinations

M.Tech (MACHINE DESIGN) – 3rd Semester

w.e.f. 2025-26

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-MTMD-201A	Mechanical Behaviour of Materials	4	0	0	4	4	40	60		100	3
2	Professional Elective Courses	Refer Table -IV	……	4	0	0	4	4	40	60		100	3
3	Mandatory Learning Course	MLC-01A	Research Methodology and IPR	3	0	0	3	3	40	60		100	3
4	Multidisciplinary Open Elective Courses	Refer Table-V	……	3	0	0	3	3	40	60		100	3
5	Project Courses	PROJ-MTMD-213A	Project	0	0	4	4	2	50		50	100	3
6	Seminar	SM-MTMD-215A	Seminar-III	0	0	2	2	2	50			50	
7	Dissertation	DISS-MTMD-217A	Dissertation (Phase-I)	0	0	4	4	2	100			100	
Total Credits								**20**				**650**	

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examinations

M.Tech (MACHINE DESIGN) – 4th Semester

w.e.f. 2025-26

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Dissertation	DISS-MTMD-202A	Dissertation (Phase-II)	-	-	-	-	20	250		500	750	
Total Credits								**20**				**750**	

Table IV (Program Elective Courses)

Course Code	Course Title
PEC-MTMD-203A	Total Quality Management
PEC-MTMD-205A	Tribology
PEC-MTMD-207A	Mechanical Vibrations
PEC-MTME-209A	Industrial Robotics
PEC-MTME-211A	Supply Chain Management

Table V (Multidisciplinary Open Elective-II Courses)

Students of all PG programmes are required to study one open elective course in 3rd Semesters for 2-Years Programmes. They may choose any one of the following courses (excluding the courses offered by the departments of their own subjects, if not stated otherwise).

SN	Courses Code	Course Title	Offered by Department
1	OEC-131A	Fundamental of Income Tax	Management Department
2	OEL-133A	Stress Management	Management Department
3	OEC-135A	Fundamental of Marketing	Management Department
4	OEC-137A	Business Analytics	Management Department
5	OEC-139A	Statistical Tools using SPSS	Applied Sc. & Humanities (Mathematics)
6	OEC-141A	Mathematical Techniques and Applications	Applied Sc. & Humanities (Mathematics)
7	OEC-143A	MATLAB	Electrical Engineering
8	OEC-145A	Source of Energy-II	Electrical Engineering
9	OEC-147A	Natural and Manmade Disaster	Civil Engineering
10	OEC-149A	Optimization Techniques	Computer Sc. & Engineering
11	OEC-151A	Composite Materials	Mechanical Engineering
12	OEC-153A	Cost Management of Engineering Projects	Mechanical Engineering
13	OEC-155A	Voice and Data Network	Electronics & Communication Engineering
14	OEC-157A	IT for Professionals	Computer Sc. & Applications

Course Code	**PCC-MTMD-201A**				
Category	Professional Core Courses				
Course Title	**Mechanical Behaviour of Materials**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • To enhance the understanding of material behavior under various mechanical conditions. • To cultivate skills in evaluating material properties and predicting their behavior under stress, strain, and environmental factors. • To study how different factors affect the performance and durability of materials in real-world applications.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Define the fundamental concepts of mechanical behaviour of materials
CO2	Explain the impact of various factors on material properties.
CO3	Apply theories and principles to examine the behaviour of materials.
CO4	Analyze the behaviour of materials subject to different loading conditions.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	**Plastic Deformation and Dislocation Theory**; lattice defects, deformation in a perfect lattice, dislocation in crystal and deformation, strain hardening of single crystal, low angle grain boundaries, yield point and strain ageing. Stress field of a dislocation, forces between dislocations, dislocation climb and jog, interaction with vacancy and impurity. Multiplication of dislocation and pile-up.
Unit-II	**Behaviour under Tension**; Engineering and true stress-strain curves, strength coefficient and strain hardening exponent, necking or instability in tension, effect of gauge length on strength and elongation. Effect of strain rate and temperature on tensile properties. Yield point phenomenon. Fracture under tension and torsion.
Unit-III	**Fatigue of Metals**; Stress cycle, fatigue curve, fatigue fracture characteristics. Fatigue testing and testing machines, determination of fatigue strength. Factors affecting fatigue- size, surface, stress concentration, superimposed static stress, corrosion, contact under pressure. Under stressing, coaxing and overstressing. Effect of metallurgical impurities..

Unit-IV	**Creep of Metals**; Creep strain and creep-time curves, low temperature and high temperature creep theories. Fracture at elevated temperature. Stress rupture. Creep parameters and practical applications. Effect of metallurgical variables and materials for high temperature applications. **Brittle failure and Behavior under Impact**; The history of failure of engineering structures and parts, high strain rate, stress concentration and low temperature effects, impact tests and results, transition temperature and factors affecting transition temperature. Flow and fracture under rapid loading. Temper and hydrogen embrittlement.

Suggested Readings

1. Mechanical Behaviour Materials by Marc Andre Meyers, K.K. Chawla, PHI
2. Mechanical Metallurgy by GE Dieter; McGraw-Hill.
3. Fatigue of Metals by PG Forrest; Pergamon Press.
4. Material Science by Abdul Mubeen; Khanna Publishers

Useful Video links

Unit No.	Topic	Link
UNIT-I	Plastic Deformation and Dislocation Theory.	https://nptel.ac.in/courses/11310610
	Multiplication of dislocation.	https://nptel.ac.in/courses/113104085
UNIT-II	Engineering and true stress-strain curves.	https://nptel.ac.in/courses/113104096
	Effect of strain rate and temperature on tensile properties.	https://nptel.ac.in/courses/113104104
UNIT-III	Fatigue curve, fatigue fracture, Fatigue testing.	https://nptel.ac.in/courses/113105106
	Determination of fatigue strength.	https://nptel.ac.in/courses/113105106
UNIT-IV	Creep of Metals.	https://nptel.ac.in/courses/113106088
	Brittle failure and Behavior under Impact.	https://nptel.ac.in/courses/113105106

Course Code	**PEC-MTMD-203A**				
Category	Professional Elective Courses				
Course Title	**Total Quality Management**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • Study the key concepts, principles, and practices of Total Quality Management (TQM). • Learn the tools and techniques used in TQM, including PDSA, Kaizen, Benchmarking, and the Seven Quality Tools, for continuous improvement and problem-solving. • Learn statistical process control (SPC) methods, including Taguchi's design and FMEA, to improve product and process quality • Familiarize about international quality standards such as ISO 9000 and EMS 14001, and conduct quality audits and vendor rating systems for performance measurement.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Define the basic terminologies of Total Quality Management.
CO2	Explain the principles, philosophies, and frameworks of total quality management and their application in organizations.
CO3	Apply advanced techniques and tools to monitor and improve processes.
CO4	Analyse the performance measures to enhance the organizational outcomes.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	**TQM Perspective and TQM Implementation**: Quality, Chain Reaction, Dimensions of Quality, Evolution Of Quality, Quality Control, Quality Assurance, Quality Planning, Quality Improvement, Quality Management, Total Quality Management, Cost Of Quality, Classification of Failure Cost, Reducing Costs, Juran's Model of Optimum Quality Costs, Analysis of COQ For Improvement, Analysis of External and Internal Failure Costs, TQM, Elements of TQM, Leadership For TQM, Deeming 14 Points For Top Management, TQM Tools And Techniques, PDSA, Barriers For TQM Implementation.
Unit-II	**TQM principles and Strategies:** Customer Satisfaction & Employee Involvement. Service Quality, Features of Services, The Kano Model, Employee Motivation, Motivation Theory of Individual Employees, Effective Communications, Training and Mentoring, Recognition and Reward. Continuous Process Improvement and Process Approach. Juran's Tribology, Kaizan,

	PDCA, Seven Quality Tools, BPR, Seven Deadly Wastes, ETX Model, Lean Manufacturing, Kanban System, Cellular Manufacturing, Single Piece Flow, Zero Defects.
Unit-III	**Statistical Process Control & TQM Tools:** The Seven Quality Control Tools, Standard Normal Distribution, AQL, Seven Management Tools, Benchmarking, QFD, Taguchi's Design, TPM, FMEA.
Unit-IV	**Quality Systems:** ISO9000 standard, EMS14001, Quality Awards Supplier Partnership and Performance Measures-Importance of Suppliers, Selection And Standards, Quality Audit, Product Audit, Vendor Rating System, PDCA For Measurements, Performance Measure Design, BSC.

Suggested Readings

1. Total Quality Management by Oakland (Butterworth- Heinemann Ltd.)
2. Managing for total quality from Deming to Taguchi and SPC by Logo Thetis N.(PHI)
3. Total Quality Control by Feigenbaum A.V. (MGH)
4. Total Quality Management by Bester field Dale H (Pearson Education)

Useful Video links

Unit No.	Topic	Link
UNIT-I	Quality and its dimensions	https://youtu.be/5pMWmU_8lfI?si=hI0dsNsI2yUMLrz1
	Quality Control	https://youtu.be/xQQ2AWs0hT4?si=EKjvfZUQxU53kai2
	Total quality management	https://www.youtube.com/watch?v=yWlAOFs04go
	Deeming 14 Points	https://archive.nptel.ac.in/courses/110/105/110105088/
UNIT-II	Seven Quality Tools	https://www.youtube.com/watch?v=HQiiRh5GoIc
	Lean manufacturing	https://archive.nptel.ac.in/courses/110/107/110107130/
	Kanban	https://archive.nptel.ac.in/courses/110/107/110107130/
UNIT-III	The Seven Quality Control Tools	https://www.youtube.com/watch?v=6-JVHv5djIc
	TPM	https://www.youtube.com/watch?v=UOuTBCrW2kY
	FMEA	https://www.youtube.com/watch?v=UOuTBCrW2kY
UNIT-IV	ISO 9000	https://archive.nptel.ac.in/courses/110/104/110104080/
	PDCA	https://www.youtube.com/watch?v=4XYS7_NSvLA

Course Code	**PEC-MTMD-205A**				
Category	Professional Elective Courses				
Course Title	**Tribology**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • To introduce the fundamental principles of tribology including friction, wear, and lubrication. • To provide knowledge on various lubrication mechanisms and types of lubricants used in different applications. • To familiarize students with tribological testing methods, standards, and diagnostics in real-world systems and extreme environments.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Define the concepts of friction, wear, lubrication, and tribological components.
CO2	Explain tribological principles and their influence on machine elements and performance.
CO3	Apply tribological concepts for specific engineering applications.
CO4	Analyze tribological behavior and system performance under varying conditions.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	**Introduction:** Introduction of Tribology – General tribological considerations in the design of bearings, gears, cams, reciprocating components, etc. **Engine tribology basics** - tribology / aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.
Unit-II	**Friction**: Natural of metal surfaces - Surface properties - Surface parameters and measurements. Friction – Sliding friction - Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction - Losses and engine design parameters. **Wear**: Economic role of wear – type of wear- wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis. **Bearings and Lubrication**: Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination..

Unit-III	**Hydrodynamic Lubrication**: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings. **Externally (Externally - pressurized) lubrication**: Hydrostatic bearing, basic concepts, bearing pads, coefficients, restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.
Unit-IV	**Elasto-hydrodynamic lubrication**: Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics. **Rheodynamics (Static) lubrication**: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribology-testing and standards.

Suggested Readings

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974.
2. Friction & Wear of Material, Ernest Rabinowitz.
3. Tribology – Handbook, Neal M.J., Butterworth, 1973
4. Theory of Hydro-dynamic Lubrication, Pinkus O, & Sternlicht B., McGraw Hill, 1961.

Useful Video links

Unit No.	Topic	Link
UNIT-I	General tribological considerations in the design of components	https://www.youtube.com/watch?v=hNfgnX2lA18
	Tribology	https://www.youtube.com/watch?v=7XBeRGmpLrE&t=230s
UNIT-II	Engine friction	https://www.youtube.com/watch?v=VulB-5MvdOs
	SOAP	https://www.youtube.com/watch?v=UFA7UqPND4U
UNIT-III	Hydrodynamic Lubrication	https://www.youtube.com/watch?v=45CcdjPrxoM
	Hydrostatic bearing	https://youtu.be/YBxAa2fOWqk?si=53PMHWLnCiKa7Z6F
	Bearing characteristics number and performance coefficients	https://www.youtube.com/watch?v=TCyMujHvDBM
UNIT-IV	Selection and life estimation	https://www.youtube.com/watch?v=vGl7nQUbWGM
	Thixotropic materials	https://www.youtube.com/watch?v=XzgbYwquPjk&t=1288s

Course Code	**PEC-MTMD-207A**				
Category	Professional Elective Courses				
Course Title	**Mechanical Vibrations**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • To introduce the fundamental principles and types of mechanical vibrations in engineering systems. • To create awareness how to model vibrating systems and derive their governing equations. • To provide analytical and numerical techniques for determining system response under various conditions.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated
CO1	Define the fundamental concepts of mechanical vibration.
CO2	Explain the vibration behavior of mechanical systems using theoretical, mathematical, and experimental approaches.
CO3	Apply analytical and numerical methods to solve vibration problems.
CO4	Analyze the vibration characteristics of engineering systems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Fundamentals**; review of single degree freedom system, response to arbitrary periodic excitation, Duhamel's integral impulse response function, Lagrange's equation, single degree freedom forced vibration with elastically coupled viscous dampers, system identification from frequency response, Laplace formulation.
Unit-II	**Two Degree of Freedom System**; free vibration of spring-mass coupled system, bending vibration of two degree of freedom system, forced vibration, vibration absorption and isolation.
Unit-III	**Multi Degree of Freedom System**; normal mode of vibration, flexibility matrix and stiffness matrix, eigen values and vectors, orthogonal properties-modal matrix analysis, matrix inversion method, modal damping in forced vibration, numerical methods.
Unit-IV	**Vibration of Continuous Systems**; systems governed by wave equations, vibration of strings and rods, Euler equation for beams, effect of rotary inertia and shear deformation, vibration of plates. **Experimental Methods**; vibration exciters and measuring devices, vibration tests and analysis, tests on free and forced vibration with examples, vibration monitoring and diagnosis, case studies.

Suggested Readings

1. Theory and Practice of Mechanical Vibration by JS Rao and K Gupta; New Age Publications.
2. Mechanical Vibrations by Den Hartog; Dover Publications.
3. Theory of Vibration with Applications by W. T. Thomson; CBC Publishers.
4. Theory of Machines by T Bevan; Longmans and Green.

Useful Video links

Unit No.	Topic	Link
UNIT-I	Review of single degree freedom system	https://www.youtube.com/watch?v=Wrfjs-ix8M0
	Duhamel's integral impulse response function	https://www.youtube.com/watch?v=N2uJ-OKRip8
	Lagrange's equation	https://www.youtube.com/watch?v=5KLdiwaJFMg
	Laplace formulation.	http://digimat.in/nptel/courses/video/111106139/L21.html
UNIT-II	Free vibration of spring-mass coupled system	https://www.youtube.com/watch?v=3i2gu74ghKg
	Bending vibration of two degree of freedom system	https://www.youtube.com/watch?v=3i2gu74ghKg
	Vibration absorption and isolation	https://www.youtube.com/watch?v=HiReWrkvQIA
UNIT-III	Normal mode of vibration	https://www.youtube.com/watch?v=YakssZ7obRI
	Orthogonal properties-modal matrix analysis	https://www.youtube.com/watch?v=leQmYZsHWao
	Eigen values	https://www.youtube.com/watch?v=h5urBuE4Xhg
UNIT-IV	Euler equation for beams	https://www.youtube.com/watch?v=5aDa30ym8RI
	Tests on free and forced vibration with examples	https://www.youtube.com/watch?v=tJNaPt5aPmg

Course Code	**PEC-MTME-209A**				
Category	Professional Elective Courses				
Course Title	**Industrial Robotics**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • To introduce to the concept of robotics. • To gain the knowledge of kinematics, dynamics, and control of robot manipulators. • To familiarize students with robotic actuators, sensors, and end-effectors for various industrial applications.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated
CO1	Recall the fundamental concepts of mechanical vibration.
CO2	Explain the vibration behavior of mechanical systems using theoretical, mathematical, and experimental approaches.
CO3	Apply analytical and numerical methods to solve vibration problems.
CO4	Analyze the vibration characteristics of engineering systems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Introduction to Robotics**: Evolution of Robots and Robotics, Laws of Robotics, Progressive advancement in Robots. Robot anatomy, Human Arm Characteristics, Design and Control issue, Manipulation and Control, Programming Robots. **Coordinate Frames, Mapping and Transforms**: Coordinate Frames, Description of objects in space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation matrices.
Unit-II	**Direct Kinematic Model**: Mechanical structure and notations, Kinematic modeling of the manipulator, Denavit Hartenberg Notation, Manipulator Transformation Matrix. **The Inverse Kinematics:** Manipulator workspace, solvability of Inverse kinematics model, solution techniques, closed form solution.
Unit-III	**Manipulator Differential Motion and Statics**: Linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, manipulator Jacobian, Jacobian Inverse, Jacobian Singularities, Static Analysis. **Dynamic Modeling**: Largrangian Mechanics, Two Degree of Freedom manipulator dynamic Model, Lagrange-Euler formulation Newton-Euler formulation, Inverse Dynamics.

Unit-IV	**Control of Manipulators:** Open and Close loop control, linear control schemes, linear second order SISO model of a manipulator joint. Joint Actuators, Computed Torque Control, force control of Robotics, Manipulators, Hybrid position/force control, Impedance Force/Torque Control. **Robotic Sensors:** Sensors in Robotics, classification of Robotic sensors, kinds of sensors used in robotics-Acoustic sensors optic, Pneumatic, force/Torque sensors.

Suggested Readings

1. Fundamental of Robotics by Robert J. Schilling Prentice Hall of India.
2. Introduction to Robotics by Saeed B. Niku Pearson Education Asia.
3. Robot Modeling and kinematics by Rashid Mansour, Laxmi Publications.

Useful Video links

Unit No.	Topic	Link
UNIT-I	Robot anatomy	https://youtu.be/rYWJdZ5qg6M?si=2SAVtIH2CeXvQJlq
	Design and Control issue	https://www.youtube.com/watch?v=aa3KDFCSmJ0
	Manipulation and Control	https://youtu.be/74d4vauVcWQ?si=uXyVULGAe8AlnaT1
	Programming Robots	https://www.youtube.com/watch?v=rYWJdZ5qg6M
UNIT-II	Denavit Hartenberg Notation	https://www.youtube.com/watch?v=FMWFDBhL6FQ
	Manipulator Transformation Matrix	https://youtu.be/74d4vauVcWQ?si=paGQubB75ATQ092E
	Solvability of Inverse kinematics model	https://www.youtube.com/watch?v=unwUt3kkgvE
UNIT-III	Linear and angular velocity of a rigid body	https://www.youtube.com/watch?v=oG6-zmspAvc
	relationship between transformation matrix and angular velocity	https://www.youtube.com/watch?v=iFOTm4lwPGA
	Jacobian Singularities	https://www.youtube.com/watch?v=UrKWTE5YSDI
UNIT-IV	linear second order SISO model of a manipulator joint	https://www.youtube.com/watch?v=A5JRXKWQpbs
	Acoustic sensors optic	https://www.youtube.com/watch?v=tD3q5a8LPUc

Course Code	**PEC-MTME-211A**				
Category	Professional Elective Courses				
Course Title	**Supply Chain Management**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	4	0	0	**4**	
Course Objectives	The objectives of this course are • To develop an in-depth understanding of supply chains. • To explain the concept of strategic fit. • To explore the key drivers of supply chain performance. • To learn the role and design of supply chain networks. • To know the design of distribution networks.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Define the fundamental concepts of supply chain management.
CO2	Explain the concepts of strategic fit and the scope of strategic decisions in aligning supply chain performance with business goals.
CO3	Apply forecasting and aggregate planning techniques to match supply and demand effectively in a supply chain.
CO4	Analyze the design of distribution networks and their application.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	**Introduction to Supply Chain Management:** Understanding the Supply Chain. Supply Chain Performance: Competitive and Supply Chain Strategies, achieving Strategic Fit and Scope of Strategic Fit.
Unit-II	**Supply Chain Drivers and Metrics:** Drivers of Supply Chain Performance, Framework for structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing and Pricing, Case Study: Seven Eleven Japan Company.
Unit-III	**Planning Demand and Supply in a Supply Chain:** Demand Forecasting in a Supply Chain, Aggregate Planning in a Supply Chain. Designing Distribution Networks and Application to E Business- Role of distribution, factors influencing distribution network design, design options for a distribution network, E-Business and the distribution network.
Unit-IV	**Network Design in the Supply Chain:** Role of network design in the supply chain, factors influencing network design decisions, Role of Information Technology in supply chain, coordination in a supply chain, Bullwhip Effect, Effect on performance due to lack of coordination, obstacles to coordination in a supply chain.

Suggested Readings

1. Supply Chain Management: Strategy, Planning & Operation, Sunil Chopra & Peter Meindle, Pearson.
2. Logistical Management: The integrated Supply Chain Process, Donald J. Bowersox & David J. Closs, TMH Publication

Useful Video links

Unit No.	Topic	Link
UNIT-I	Introduction to Supply Chain Management	https://www.youtube.com/watch?v=raqi4gjMLm8
	Supply Chain Strategies	https://www.youtube.com/watch?v=l9mebE3CGBQ&t=1s
UNIT-II	Drivers of Supply Chain Performance	https://www.youtube.com/watch?v=ZiUCB6HDc-8
	Inventory	https://www.youtube.com/watch?v=b6ElgF9TymU&t=2s
UNIT-III	Demand Forecasting in a Supply Chain	https://www.youtube.com/watch?v=tCnFx6VfPUA
	Designing Distribution Networks	https://www.youtube.com/watch?v=-5m3vPMlV70
UNIT-IV	Role of network design in the supply chain	https://www.youtube.com/watch?v=iSr5SrQ5kZM&t=2s
	Role of Information Technology in supply chain, coordination in a supply chain	https://www.youtube.com/watch?v=mW2vJq-KYfw

Course Code	**MLC-01A**				
Category	Mandatory Learning Course				
Course Title	**Research Methodology and IPR**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are: • To enable students to identify and define research problems, formulate objectives and apply appropriate investigative approaches in research methodology. • To impart knowledge of data sources, data collection methods, data processing and the application of statistical tools for research analysis. • To develop awareness of research ethics, plagiarism issues and effective practices in technical writing, report preparation, and research documentation. • To provide a comprehensive understanding of intellectual property rights, patent procedures, technology transfer and international frameworks for innovation protection.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Identify research problems, objectives, and data sources based on fundamental research methodology principles.
CO2	Explain intellectual property rights, patent procedures, and international frameworks for technology transfer and innovation protection.
CO3	Apply research ethics to prepare plagiarism-free technical reports, research papers, and proposals using effective writing and presentation techniques.
CO4	Analyze research data through classification and tabulation to extract meaningful patterns and conclusions using statistical tools and methods.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	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
Unit-II	Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write the report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III	Sampling Methods, Need, Meaning & Type of Sample, Sources of Data, Primary and Secondary, Classification and Tabulation of Data Processing, Analysis and Interpretation of Data, Chi Square Test, significance of statistics in Socio-legal Research, Use of Computer in the Research field work and report writing.
Unit-IV	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, and 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.

Suggested Readings:

- Research Methodology: Methods and Techniques (4th ed.) by Kothari, C. R., & Garg, G, New Age International Publishers.
- Research Methodology: A Step-by-Step Guide for Beginners (4th ed.). by Kumar, R, SAGE Publications India. ISBN: 978-9351501337
- Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets (6th ed.) by Bouchoux, D. E, Cengage Learning.
- Intellectual Property Rights Under WTO by T. Ramappa, S. Chand.

Unit No	**Topics**	**Links**
Unit-I	Defining/formulating research problem Research types, descriptive, analytical, action, empirical, research methodology	https://www.youtube.com/watch?v=oTc4_zjmev0 https://www.youtube.com/watch?v=tjDBPRoyDJA
Unit-II	Types of Plagiarism Research Ethics	https://www.youtube.com/watch?v=5--ssYqyWoE https://www.youtube.com/watch?v=4tRCov8pVgQ
Unit-III	Primary data and Secondary Data. Sampling techniques	https://www.youtube.com/watch?v=caUiRsg5M6k https://www.youtube.com/watch?v=sKtoW5cXt14
Unit-IV	Patent Trademarks and Copyrights. What is Patent? Patent Filing Procedure in India.	https://www.youtube.com/watch?v=XQ8tRdcr0xQ https://www.youtube.com/watch?v=azMNhrkRzww

Course Code	**SM-MTMD-215A**				
Category	Seminar				
Course Title	**Seminar-III**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	2	
Course Objectives	The objectives of this course are to • Develop students' ability to effectively present research topics and findings by effective communication. • Improve problem-solving and critical thinking skills of thestudents. • Expose students to the latest trends and advancements byreviewing and discussing contemporary research.				
Assessment	50 Marks				
End Semester Examination	-				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated.**
CO1	Identify the trends and advancements in the related field.
CO2	Analyze and synthesize research literature with in-depth reviews of key studies andmethodologies.
CO3	Undertake problem identification, formulation, proposing solution and analyze the impact on society, economy and environment.
CO4	Prepare a well-organized report employing elements of effective communication and critical thinking.
CO5	Demonstrate a sound technical knowledge of their research field.

Overview:

This course helps M. Tech students improve their research presentation skills. It focuses on choosing a topic or research paper related to their field, reviewing it thoroughly and presenting the findings clearly and effectively.

General Guidelines:

Topic Selection	Each student is required to choose the research topic based on published review paper(s) or literature related to their relevant field. The same topic cannot be selected by multiple students.
Approval Process	The selectedpaper or topic must be approved by the faculty members/ committee appointed by the Head of Department.
Presentation Guidelines	Each student will have 30-40 minutes for their presentation, followed by 5minutes for Q&A.
Evaluation	The presentation will be evaluated by a committee constituted by the Head ofDepartment. The evaluation will be based on:

Parameters for the Evaluation of Seminar

Sr. No.	Parameters	Marks Allotted	Relevant COs
1	Clarity of the topic	10	**CO1**
2	Literature Survey	10	**CO2**
3	Content Relevancy	10	**CO3**
4	Presentation Skills	10	**CO4**
5	Q&A Response	10	**CO5**

Course Code	**PROJ-MTMD-215A**				
Category	Project Course				
Course Title	**Project**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	4	2	
Course Objectives	The objectives of this course are to • Identify suitable research topics in relevant field for independent investigation. • Understand research methodologies, documentation, and referencing aligned with existing literature. • Develop technical writing skills using appropriate tools, formats, and referencing techniques. • Analyze, interpret, and synthesize research findings within a defined research scope or topic.				
Assessment	50 Marks				
End Semester Examination	50 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated
CO1	Identify complex engineering problems relevant to project work based on domain knowledge and real-world challenges.
CO2	Describe the workflow, technical background, and tools required for planning and executing engineering projects.
CO3	Apply appropriate methods, tools, and techniques to carry out project development and prepare technical documentation.
CO4	Analyze the key stages of project development to ensure systematic execution and identify performance issues.
CO5	Evaluate alternative approaches and select suitable methodologies to achieve optimal and feasible project outcomes.
CO6	Design innovative and practical engineering solutions to address societal and industrial needs.

Each student is required to carry out a hardware-based project and submit the project report. The project title and objectives should be chosen by the student in consultation with their allocated Project Guide.

Evaluation Criteria (Total: 50 marks)

Sr. No.	Evaluation Parameter	Marks
1	**Problem Definition and Relevancy** - clarity of problem, significance and alignment with discipline	5
2	**Proposed Solution and Implementation** - functionality, originality, technical depth.	5
3	**Project Benefit and Impact** - benefits to society, industry, and environment.	10
4	**Cost-Effectiveness and Practical Viability** - consideration of cost, resources, and practicality.	10
5	**Presentation and Communication Skills (Viva-voce)** - ability to explain, answer questions, confidence, and depth of knowledge.	10
6	**Project Report Quality** - clarity, completeness, format, and technical content.	10

Course Code	**DISS-MTMD-217A**				
Category	Dissertation				
Course Title	**Dissertation (Phase-1)**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	4	2	
Course Objectives	The objectives of this course are to • Introduce students to identifying research topics relevant to field. • Explain the research process, including literature review, documentation, and structured writing. • Develop proficiency in using research tools, reference management, and academic writing techniques. • Enhance ability to analyze, synthesize, and present research findings in a chosen domain.				
Assessment	100 Marks				
End Semester Examination					
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Identify the research topic/area relevant to the field to carry out independent research.
CO2	Understand the research process, literature review, result formulation and writing conclusions with reference to existing literature.
CO3	Apply appropriate tools, references and writing skills for effective report writing related to research work.
CO4	Analyze and synthesize research findings to the agreed area of research carried out.
CO5	Evaluate the research methods and available knowledge to propose appropriate solutions to the specific research problem.
CO6	Design engineering solutions by developing improved results, properly documenting them in a thesis or report, and publishing them in journals or conferences.

Each student will undertake their dissertation under the supervision of one or more supervisors. The dissertation topic must be approved by a committee constituted by the Head of the concerned Department.

Students are required to deliver two seminar presentations: the first, at the beginning of Dissertation Phase-I, to outline the scope of the work and finalize the topic; the second, towards the end of the semester, to present the progress and work completed during the semester.

The committee will evaluate both presentations and award sessional marks out of 100. Students who fail to secure the minimum passing marks must improve their grade before proceeding to the 4th semester. Failure to do so will require the student to repeat Dissertation Phase-I in the next regular 3rd semester.

<table>
<tr><td>Course Code</td><td colspan="5">DISS-MTMD-202A</td></tr>
<tr><td>Category</td><td colspan="5">Dissertation</td></tr>
<tr><td>Course Title</td><td colspan="5">Dissertation (Phase-II)</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-IV</td></tr>
<tr><td>0</td><td>0</td><td>20</td><td>20</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The objectives of this course are to
Introduce research fundamentals and help identify topics in relevant field.
Understand structured research methodology, literature review, and documentation of results and conclusions.
Develop skills in using research tools, technical writing, referencing, and report formatting.
Analyze, evaluate, and present research findings through effective report or thesis preparation.</td></tr>
<tr><td>Assessment</td><td colspan="5">250 Marks</td></tr>
<tr><td>End Semester Examination</td><td colspan="5">500 Marks</td></tr>
<tr><td>Total</td><td colspan="5">750 Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
</table>

Course Outcomes: After successful completion of this course, the students will be able to:

COs	Skills Demonstrated
CO1	Identify the research topic/area relevant to the field to carry out independent research.
CO2	Understand the research process, literature review, result formulation and writing conclusions with reference to existing literature.
CO3	Apply appropriate tools, references and writing skills for effective report writing related to research work.
CO4	Analyze and synthesize research findings to the agreed area of research carried out.
CO5	Evaluate the research methods and available knowledge to propose appropriate solutions to the specific research problem.
CO6	Design engineering solutions by developing improved results, properly documenting them in a thesis or report, and publishing them in journals or conferences.

Dissertation Stage-I will continue as the final dissertation in the 4th semester. Sessional marks, out of 250, will be awarded by an internal committee constituted by the Head of the Department. The assessment will be based on presentations, reports, and related materials submitted to the committee. Failure to appear before the committee will result in disqualification from submitting the dissertation.

If a student scores less than 40% in the sessional assessment, they must revise and resubmit the dissertation after incorporating all required corrections and improvements. The revised dissertation will be evaluated in the next academic session.

At the end of the semester, each student is required to submit three soft-bound copies of their Master's dissertation to the office of the Head of the Department. One copy will be retained for departmental records, one

will be provided to the supervisor, and one will be sent by mail to the external examiner, following their appointment and notification from the university.

The dissertation will be evaluated by a committee consisting of the Head of the Department, the dissertation supervisor(s), and one external examiner. The external examiner will be appointed by the Chairman of the Board of Studies. If the appointed examiner is unable to attend, the Director of the Institute, upon the recommendation with the Head of the Department, is authorized to appoint a substitute examiner from another institution or the parent institute.

Students must defend their dissertation through a presentation before the evaluation committee, which will assign marks accordingly.

Note:

- The scheme for awarding grades will be provided by the department to the examiner(s).
- The plagiarism of the dissertation report must be below 10%; otherwise, the report will not be accepted.
- Students have to publish a research paper in a journal / conference of the research work done before the final submission of Dissertation.
- The student must follow the guidelines for the Dissertation report.