RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Structure and Course Details of

B.Tech. (Mechanical Engineering) Degree Programme

Programme Code: 005

Faculty of Engineering and Technology

Batch 2026-2030

Approved during 38th Academic Council Meeting held on 10th June 2026

Head
Department of Mechanical Engineering
Faculty of Engineering and Technology
M.S.Ramaiah University of Applied Sciences
Bengaluru - 560 058.

Associate Dean - Academics
Ramaiah Technology Campus
M. S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Dean
Faculty of Engineering & Technology
M. S. Ramaiah University of Applied Sciences
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University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes

Department of Mechanical Engineering

Vision of the Department

To excel in Mechanical Engineering education and applied research by fostering innovation, professional competence, ethical values and lifelong learning for the benefit of industry and society.

Mission of the Department

Mission of the department will be achieved by,

M1. Empowering students through hands-on learning, applied problem-solving and strong engineering fundamentals for successful careers.

M2. Cultivating a research and innovation mindset by engaging students with emerging technologies and industry collaboration to develop sustainable solutions.

M3. Nurturing students with ethical values and professional skills to become responsible leaders to uphold integrity, embrace global perspectives and contribute to societal and environmental needs

Programme Specifications: B. Tech. (Mechanical Engineering)

Faculty	Engineering and Technology
Department	Mechanical Engineering
Programme Code	005
Programme Name	B.Tech. (Mechanical Engineering)
Dean of the Faculty	Prof. Sarat Kumar Maharana
Head of the Department	Dr. Suresh R

1. **Title of the Award:** B.Tech. (Mechanical Engineering)
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Engineering and Technology, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** June 2026
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 10th June 2026
8. **Next Review Date: May** 2030
9. **Programme Approving Regulating Body and Date of Approval:** All India Council for Technical Education, New Delhi, 30-Jun-2020
10. **Programme Accredited Body and Date of Accreditation:** Not Applicable
11. **Grade Awarded by the Accreditation Body:** Not Applicable
12. **Programme Accreditation Validity:** Not Applicable
13. **Programme Benchmark:** Not Applicable
14. **Rationale for the Programme**

Mechanical engineering is one of the oldest disciplines of engineering. Designing and manufacturing of mechanical machinery and equipment have been there world over for many centuries. Mechanical Engineering is a foundational discipline, critical to the success of many enterprises. It plays a key role in energy, transportation, development of infrastructure and manufacturing of consumer durables.

Presently, mechanical engineers are contributing in research and development pertaining to environmental and bio-medical fields. Mechanical engineers are responsible for selection and processing of eco-friendly materials and processes, design and fabrication of medical devices and prostheses to improve quality of life.

The mechanical engineering programme at Faculty of Engineering and Technology at RUAS has been developed by the members of the faculty based on their teaching experience and long standing interactions with various Universities and industries in India and abroad. The curriculum is outcome based and helps students to develop critical thinking abilities and imbibe relevant practical

skills for a smooth transition from academics to real-life work environment. Opportunities are provided for the students to do their internship in India or abroad depending on their preferences.

The alumni of the faculty hold respected positions in industry and business in India and abroad. The faculty interacts with the industry and business offering engineering and consultancy, product design and development services along with training modules to practicing professionals. The faculty interacts with more than 150 companies in public and private sectors including OEMs spread across India. The above mentioned features of the programme and the faculty members' strong footing in industry and business make the programme unique. The student admitted to the programme in mechanical engineering is given a strong foundation in real-life problem solving which is quite rare with many institutions offering similar programme.

15. Programme Mission

The purpose of the programme is creation of innovative problem solvers in multi-disciplinary settings, entrepreneurs and leaders applying the knowledge, understanding, cognitive abilities, practical skills and transferable skills gained through systematic, flexible and rigorous learning in the chosen academic domain.

16. Programme Outcomes (POs)

B.Tech. graduates will be able to:

PO-1. **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO-2. **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO-3. **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO-4. **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO-5. **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO-6. **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7). Apply knowledge of mathematics, science,

basic engineering fundamentals and engineering specialization concerned for the solution of complex engineering problems

PO-7. **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO-8. **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO-9. **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO-10. **Project Management and Finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO-11. **Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

17. Programme Goal

The programme goal is to produce graduates with critical, analytical and problem solving skills, and ability to think independently, to pursue a career in Mechanical Engineering.

18. Programme Educational Objectives (PEOs)

The objectives of the B.Tech. (Mechanical Engineering) Programme are:

PEO-1. Establish successful careers in mechanical engineering and allied industries by applying knowledge, analytical skills, and modern engineering tools & techniques

PEO-2. Pursue higher education or skill enhancement initiatives for continuous professional growth

PEO-3. Demonstrate effective communication, leadership and teamwork to contribute to technological advancement and societal needs

19. Programme Specific Outcomes (PSOs)

At the end of the B.Tech.(Mechanical Engineering) program, the graduate will be able to:

PSO-1. Apply the principles of energy systems and engineering management to design sustainable and efficient solutions for environmental and industrial needs.

PSO-2. Develop innovative engineering solutions by leveraging the concepts of mechanical design and advanced manufacturing technologies to address environmental and societal needs.

20. Programme Structure:

Semester 1 (Physics Cycle)								
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1	MTF101B	Engineering Mathematics-1	3	1	0	4	120	100
2	PYB101A	Applied Physics for Engineers	2	1	2	4	120	100
3	MED101A	Introduction to Mechanical Engineering	3	0	2	4	120	100
4	MEL105A	Workshop Practice	0	0	2	1	30	50
5	TSM103A	Communicative English	1	0	2	2	60	50
6	BTN101A	Environmental Studies	2	0	0	2	60	50
		Total	11	2	8	17	510	450
Total number of contact hours per week			21					

Semester 1 (Chemistry Cycle)								
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1	MTF101B	Engineering Mathematics-1	3	1	0	4	120	100
2	CYB101A	Chemistry of Materials for Engineering Applications	2	1	2	4	120	100
3	MED101A	Introduction to Mechanical Engineering	3	0	2	4	120	100
4	MEF103B	Engineering Graphics	2	0	2	3	90	100
5	TSM104A	Kannada Kali	1	0	0	1	30	50
6	EEF101A	Design Thinking and Idea Lab	0	0	4	2	60	50-
		Total	11	2	10	18	540	500
Total number of contact hours per week			23					

Semester 2 (Chemistry Cycle)								
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1	MTF111B	Engineering Mathematics - 2	3	1	0	4	120	100
2	CYB101A	Chemistry of Materials for Engineering Applications	2	1	2	4	120	100
3	MED104A	Applied Mechanics	3	1	0	4	120	100
4	CSD106A	Programming in Python	2	0	2	3	90	100
5	MEF103B	Engineering Graphics	2	0	2	3	90	100
6	DIL101A	Design Thinking and Idea Lab	0	0	4	2	60	50
7	TSM104A	Kannada Kali	1	0	0	1	30	50
		Total	13	3	10	21	630	600
		Total number of contact hours per week	**26**					

Semester 2 (Physics Cycle)								
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1	MTF111B	Engineering Mathematics - 2	3	1	0	4	120	100
2	PYB101A	Applied Physics for Engineers	2	1	2	4	120	100
3	MED104A	Applied Mechanics	3	1	0	4	120	100
4	CSD106A	Programming in Python	2	0	2	3	90	100
5	MEL105A	Workshop Practice	0	0	2	1	30	50
6	BTN101A	Environmental Studies	2	0	0	2	60	50
7	TSM103A	Communicative English	1	0	2	2	60	50
		Total	13	3	8	20	600	550
		Total number of contact hours per week	**24**					

Semester 3

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	MED201A	Mathematics- 3 (ME)	2	1	0	3	90	100
2.	MEC202A	Materials Science	3	0	0	3	90	100
3.	MEC203A	Mechanics of Deformable Solids	2	0	2	3	90	100
4.	MEC204A	Mechanical Dissection and Machine Drawing	2	0	2	3	90	100
5.	MEC205A	Manufacturing Processes	2	0	2	3	90	100
6.	MEC206A	Engineering Thermodynamics	3	0	0	3	90	100
7.	MEC207A	Mechanical Measurements and Metrology	2	0	2	3	90	100
8.	LAN201A	Indian Constitution, Human Rights and Professional Ethics	2	0	0	2	60	50
		Total	18	1	8	23	690	750
Total Number of Contact Hours per week			**29**					
1.	MTF210A	Foundation Mathematics -1	1	1	0	0	-	Audit

Semester 4

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	MED211A	Mathematics - 4 (ME)	2	1	0	3	90	100
2.	MEC212A	Machine Dynamics- 1	3	0	2	4	120	100
3.	MEC213A	Fluid Mechanics and Machines	2	0	2	3	90	100
4.	MEC214A	Conventional Machining Processes	2	0	2	3	90	100
5.	MEI201A	Internship – 1	0	0	4	2	60	50
6.	TSN201A	Essence of Indian Knowledge System	1	0	0	1	30	50
7.	BAU201A	Entrepreneurial Mindset and Action	3	0	0	3	90	100
8.	TSU201A	Universal Human Values – 2	2	0	0	2	60	50
		Total	15	1	10	21	630	650
Total Number of Contact Hours per week			**26**					
	MTF220A	Foundation Mathematics -2	1	1	0	0	-	Audit

Semester 5

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	ROC301A	Control Systems and Engineering	2	0	2	3	90	100
2.	MEC302A	Thermal Engineering	2	0	2	3	90	100
3.	MEC303A	Design of Machine Elements- 1	2	1	0	3	90	100
4.	MEC304A	Machine Dynamics-2	2	0	2	3	90	100
5.	MEC305A	Additive Manufacturing	2	0	2	3	90	100
6.	MEC306A	AI for Mechanical Engineers	3	0	0	3	90	100
7.	BNE101A	Yoga for Health and Wellness	0	0	4	2	60	50
	PTU101A	Sports	1	0	2		30	50
8.	PTU301A	Aptitude and Analytical Reasoning	0	0	2	1	30	50
		Total	14	1	16	21	630	700
		Total Number of Contact Hours per week	31					

Semester 6

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	MEC311A	Heat Transfer	2	0	2	3	90	100
2.	MEC312A	Finite Element Analysis	3	0	2	4	120	100
3.	MEC313A	Design of Machine Elements - 2	2	1	0	3	90	100
4.	MEC314A	Automation in Manufacturing and Industry 4.0	2	0	2	3	90	100
5.	MEC315A	Project Management and cost Accounting	3	0	0	3	90	100
6.	MEE31XA	Professional Core Elective – 1	3	0	0	3	90	100
7.	MEI301A	Internship – 2	0	0	4	2	60	50
8.	PTU302A	Logic and Coding	0	0	2	1	30	50
		Total	15	1	12	22	660	700
		Total Number of Contact Hours per week	28					

Semester 7

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	MEE4XXA	Professional Core Elective - 2	3	0	0	3	90	100
2.	MEE4XXA	Professional Core Elective - 3	3	0	0	3	90	100
3	MEE4XXA	Professional Core Elective - 4	3	0	0	3	90	100
4	OETXXX	Open Elective - 1	3	0	0	3	90	100
5	MEP401A	Integrated Design Project	0	0	8	4	120	100
		Total	12	0	8	16	480	500
		Total Number of Contact Hours per week	20					

Semester 8

Sl. No	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Notional Hours	Max. Marks
1.	OETXXX	Open Elective - 2	3	0	0	3	90	100
2.	MEI401A	Internship – 3	0	0	4	2	60	50
3.	MES411A	Technical Seminar	0	0	4	2	60	50
4.	MEP412A	Capstone Project	0	0	24	12	360	300
		Total	3	0	32	19	570	500
		Total Number of Contact Hours per week	35					

PCE-1, Sem. 6	Course Code	MEE311A	MEE312A	MEE313A	MEE314A	MEE315A	MEE316A
	Course Title	Fluid Power Systems	Advanced Manufacturing Technologies	Quality Management and Six Sigma	Mechatronics and Automation	Probability and Statistics	Advanced Mechanics of Materials
PCE-2 Sem. 7	Course Code	MEE401A	MEE402A	MEE403A	MEE404A	ROC305A	MEE405A
	Course Title	Computational Fluid Dynamics	Advanced Materials and Process	Kaizen and Lean Manufacturing	Robot Kinematics and Dynamics	Image Processing and Computer Vision	Composite Materials and Structural Design
PCE-3 Sem.7	Course Code	MEE406A	MEE407A	MEE408A	MEE409A	CSE421A	MEE410A
	Course Title	Sustainable Energy Technologies	Digital Manufacturing	Operations Research	Drone Technology	Data Analytics	Fatigue and Fracture Mechanics
PCE-4 Sem.7	Course Code	MEE411A	MEE412A	MEE413A	ROC312A	MEE414A	MEE415A
	Course Title	Power Plant Engineering	Advanced Control System	Supply Chain Management	Robot Programming and Simulation	Predictive maintenance using AI	Industrial Tribology

21. Open Elective Courses

A number of Open Elective Courses from various Faculties of RUAS are offered as mentioned in the University's website. Students can choose the Open Electives of their choice. The students are permitted to chose online electives from the list approved by the respective HoD and Dean.

21.1. MOOC- Courses in Lieu of Open Elective Courses

Students can take the SWAYAM/NPTEL/MOOC courses approved by the department in Lieu of Open Elective Courses

21.2. Course Delivery: As per the Timetable

21.3. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project Exhibitions
11. Technical Festivals
12. Self Learning

22. Assessment and Grading

22.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of

the semester.

Marks obtained CE and SEE components have a weightage of 60:40 (CE: 60% and SEE: 40%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

22.2. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

22.2.1 Theory Courses

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

22.2.2 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The subcomponents can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

22.2.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments (20 %)	Lab CE (10%)	Written exam	LSEE: SEE
CO-1					
CO-2					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- In case of courses where laboratory is combined with theory, laboratory components to be assessed in both CE and SEE
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

22.2.4 Ability Enhancement courses

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests or Assignments	
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

22.2.5 Course leaders to declare the assessment components before the commencement of the session and get approval from HoD

24 Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

25 Quality Control Measures

1. Review of Question Papers and Assignment Questions
2. Student Feedback
3. Opportunities for students to see their assessed work
4. Staff Student Consultative Committee meetings
5. Student Exit Feedback
6. Subject Assessment Board (SAB)
7. Programme Assessment Board (PAB)

26 Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

27 Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

28 Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

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Course Title	Chemistry of Materials for Engineering Applications
Course Code	CYB101A
Course Type	Core Theory
Department	ASE/AE/ME/RE/CE
Faculty	Engineering and Technology

1. Course Summary

This course introduces the application of chemical principles in electrochemical energy systems, electronic materials, corrosion, lubricants, admixtures, metal finishing, water chemistry, and nanotechnology. Emphasis is on energy materials, and advanced materials. The laboratory component emphasizes synthesis, characterization, data analysis, and mini projects to develop practical skills for industry readiness.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	2:1:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Chemistry
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Apply the concepts of electrochemical storage and conversion devices, combustion chemistry, water chemistry, lubricants, admixture and corrosion mechanisms to analyze material performance and protection methods.

CO-2: Analyze the properties of materials to evaluate their performance in engineering applications.

CO-3: Evaluate the properties of synthesized materials and performance of nanomaterials for engineering applications.

4. Course Contents

Unit 1: Energy Storage Systems and Alternative Fuels

Basics of electrochemistry and batteries: Dry cell, Lithium-ion batteries and solid-state batteries; materials, working principles, and performance parameters; Fuel Cells: Principles and operation of Direct Methanol Fuel Cells (DMFC), Solid Oxide Fuel Cells (SOFC), efficiency and applications.
Supercapacitors: Types and working principles with examples.
Renewable and non-renewable energy: Sources of Fuels, Characteristics of a good fuel, Proximate and ultimate analysis, Petroleum cracking, Mechanism of Knocking and its effect, Anti-knocking

agents, Octane and Cetane numbers, Functioning of Catalytic converter, Introduction to Biofuels and power alcohol, biodiesel and environmental concerns and safety.

Unit 2: Corrosion and Metal Finishing

Types of corrosion. Electrochemical theory of corrosion. Factors affecting corrosion, Corrosion control: Metal coating, cathodic protection, organic coating, and corrosion-inhibitors.
Technological importance of metal finishing, Polarization and factors influencing polarization, Principle of electroplating and electroless plating, Electroplating of Chromium and Gold. Electro-less Plating of Copper and Nickel, sustainable coatings and environmental aspects.

Unit 3: Introduction to nanomaterials

Classifications, Size-dependent properties of nanomaterial-surface area, catalytical, electrical, mechanical and thermal properties. Synthesis of nanoparticles by top-down and bottom-up approaches including ball-milling and sol-gel methods. Graphene - Synthesis, properties and engineering applications. Carbon nanotubes (CNTs) in engineering applications.

Unit 4: Sustainable Materials for Engineering Applications

Introduction to polymers, classification, Tg concept and factors affecting Tg, structure property relationship. Polymeric Materials: Polystyrene, Polyisocyanurate (insulation chemistry). Self-healing polymers, Low-VOC and non-volatile materials
Polymer Composites: Introduction, synthesis, properties of fiber-reinforced polymers (FRPs), Thermal Analysis.
Bio-based Materials: Natural Fibers: Rammed earth, Chemical stabilization techniques. (cellulose, hemicellulose, lignin); Advantages and limitations of bio-based materials
3D Printing materials: Introduction, synthesis, properties and applications.

Unit 5: Lubricants and Admixture

Introduction to lubrication and lubricants. Functional lubricants, basic types of lubricants, rheological aspect and viscosity concept, requirements for lubricating performance, lubrication mechanisms, selection of lubricants, applications.

Admixtures: Fundamentals: Adsorption, Desorption, Dispersion
Admixtures: Plasticizers, Superplasticizers, Accelerators and Retarders, Green admixtures (overview)

Unit 6: Chemistry of Water

Types and Sources of Water: Surface water, groundwater, rainwater, recycled water. Water Quality Parameters: pH, hardness, alkalinity, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Drinking Water Standards: As per Bureau of Indian Standards (IS 10500). Water Treatment Methods: Primary treatment (screening, sedimentation)

Secondary treatment (biological processes), Tertiary treatment (advanced purification, disinfection)

List of Experiments:	
1	Determination of viscosity coefficient of lubricating oil using an Ostwald's viscometer.
2	Estimation of acid mixtures using conductometric techniques.
3	Determination of pKa values of weak acids used in metal etching and cleaning processes using conductometric titration.
4	Estimation of ferrous ammonium sulfate (FAS) using standard potassium dichromate ($K_2Cr_2O_7$) by potentiometric titration.
5	Determination of copper/iron content in rust samples using colorimetric methods.
6	Potentiometric Determination of Water Alkalinity Using Electrochemical Analysis and Assessment as per Bureau of Indian Standards IS 10500 Drinking Water Standards.
7	Conductometric Determination of Water Hardness in Various Sources of Potable Water and Assessment as per Bureau of Indian Standards IS 10500 Drinking Water Standards
8	Determination of sodium/potassium ion concentration in a corrosion medium using flame photometry.
8	Estimation of Fe^{2+} content in iron ore using standard $K_2Cr_2O_7$ solution.
9	Determination of Residual Chloride in Admixture-Treated Cement by Colorimetric method
10	Synthesis of biodiesel from waste vegetable oil.
	Measurement of voltage in a hydrogen-oxygen fuel cell*.
11	Determination of cloud point, pour point, and flash point of liquid fuels and assess fuel quality*.
12	Design and fabricate a printed circuit board (PCB) and analyze material and process considerations*.
13	Evaluation the performance of a lead-acid battery cell*.
14	Determination and evaluate the calorific value of a fuel using a bomb calorimeter*.

Mandatory experiments: 08, *****Demo/Mini project experiments

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												
CO-2		1											
CO-3	2												1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		30

1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	50
4. Brain Storming Sessions	00	
5. Mini Group Project	05	
6. Discussing Possible Innovations	45	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**120**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programmes. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component(CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3, LSC4orLSC5), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation							
Course Outcome		**CE (Weightage: 60 %)**				**SEE**	**Lab**
	(30 %)		**(10 %)**	**(10 %)**	**(10 %)**	**(Weightage: 25 %)**	**(Weightage: 15 %)**
	TSC1 Term test 1	**TSC2 Term test 2**	**TSC3 Assignment**	**TSC4 Quiz**	**LSC5: Lab**	**Written exam**	**LSEE: SEE**
CO-1	×	×	×	×		×	
CO-2	×	×	×	×		×	
CO-3			×		×		×
The details of TSC1, TSC2, TSC4 or LSC5 are presented in the Programme Specifications Document.							

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following

teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Mini projects
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. CourseResources

a. Essential Reading

1. O.G. Palanna, (2011), Engineering Chemistry, New Delhi, Tata McGraw Hill Education Pvt Ltd
2. Gadag, R.V. and Nityananda Shetty A., (2010), Engineering Chemistry, Second Edition, New Delhi, I.K. International Publishing House
3. S.S. Dara, S.S. Umare, (2008), A Text Book of Engineering Chemistry, Ram Nagar, New Delhi, S. Chand & company PVT LTD.
4. Gurudeep Raj, (2014), Advanced Physical Chemistry, Meerut-Uttar Pradesh, Krishnan Prakashana
5. Pradeep. T, (2012) "A Text Book of Nanoscience and Nanotechnology", New Delhi, Tata McGrawHill Company Ltd.

b. Recommended Reading

1. Shashi Chawala (2017) A text book of Engg chemistry 5th Edition Dhanpat Rai & CO.
2. Pletcher, D. and Walsh, F.C., (1993), Industrial Electrochemistry, Second edition, UK, BlackieAcademic and Professional
3. Kuriacose, J.C. &Rajaram, J., (1998), Chemistry in Engineering & Technology (Vol I & II), Third reprint, New Delhi, Tata McGrahill Company
4. C. N. R. Rao, Achim Muller and A.K. Cheetham, (2004), The Chemistry of Nanomaterials, Vol I & II, Weinheim, Wiley VCH.

c. Magazines and Journals

Journal of chemical Education
Chemistryworld
https://edu.rsc.org/

d. Websites

https://learncheme.com/
https://webbook.nist.gov/chemistry/reac-ser/

e. Other Electronic Resources

1. http://nptel.ac.in/
2. Electronic resources on the subject area are available on MSRUAS library

10. CourseOrganization

Course Code	CYB101A	
Course Title	Chemistry of Materials for Engineering Applications	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cy.ns@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	



Course Specifications: Engineering Mathematics - 1

Course Title	Engineering Mathematics - 1
Course Code	MTF101B
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts of calculus and matrix algebra. Students are taught the concepts of limits, continuity, differentiation, series expansion for the functions of one and two variable, indefinite and definite integrals of single real variable functions. Basic concepts of vectors with necessary properties and operations are taught. The mathematical operations in matrix theory, eigenvalue and eigenvector, inversion and diagonalization of matrix and matrix solution for linear system of equations are discussed in this course.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** State definitions and theorems of calculus and matrix algebra
- **CO-2.** Explain the basic concepts of calculus and matrix algebra
- **CO-3.** Solve simple mathematical problems associated with calculus and matrix algebra
- **CO-4.** Apply the techniques of calculus and matrix algebra to solve real world problems
- **CO-5.** Formulate mathematical models for complex real-world problems associated with calculus and matrix algebra

4. Course Contents

Unit 1 (Calculus):
Review of basic calculus, limits, continuity, differentiability, differentiation, Integration. Applications of Differentiation and Integration.

Unit 2 (Single Variable Calculus):
Rolle's Theorem and Lagrange's mean value theorem and their applications. Fundamental theorem of integral calculus. Improper integrals - classification and convergence, gamma and beta functions. Sequence of real numbers, Series, Tests for convergence of series: ratio test and root test. Power series, Taylor and Maclaurin

series.

Unit 3 (Two Variable Calculus):
Functions of two variables, and partial differentiation. Total differential, tangent plane approximation of a surface. Partial differentiation of composite. Unconstrained and constrained extrema**.**

Unit 4 (Matrix Algebra):
Matrix algebra, elementary row operations, row and reduced row echelon forms. Linear system of equations, existence and uniqueness of solution. Eigenvalues, eigenvectors and diagonalization.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3	3											
CO-2	3	3											
CO-3	3	3											
CO-4	3	3											
CO-5	3	3											
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**60**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Quiz**	**50 Marks**
Maximum Marks ▶	**25**	**25**	**40**	**10**	
CO-1	×	×		×	×
CO-2	×	×		×	×
CO-3	×	×		×	×
CO-4			×		×
CO-5			×		×
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. James Stewart, 2015, Calculus: Early Transcendental, 8th edition, Boston, Cengage Learning
3. Steven Leon, 2014, Linear Algebra with Application, 9th edition, New Jersey, Pearson
4. Jain R K and Iyengar S.R.K, 2017, Advanced Engineering mathematics, 5th edition, Narosa, publishing house

b. Recommended Reading

1. Maurice D. Weir and Joel Hass, 2017, Thomas Calculus, 13th edition, New Jersey, Pearson
2. Gilbert Strang, 2016, Introduction to Linear Algebra, 5th edition, Massachusetts, Cambridge Press
3. Grewal B S, 2021, Higher Engineering Mathematics, 44th edition, Khanna Publication.
4. Erwin Kreyszig, 2014, Advanced Engineering mathematics, U K, Wiley

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm

10. Course Organization

Course Code	MTF101B	
Course Title	Engineering Mathematics - 1	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	080 4906 5555
	E-mail:	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Introduction to Mechanical Engineering

Course Title	Introduction to Mechanical Engineering
Course Code	MED101A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at preparing the students to understand the concepts and underlying principles of mechanical engineering. The students are taught various types of energy sources, power generation, energy conversion methods and types of power plants. Students are taught the working of IC engines and power transmission elements. Students are also exposed to basic operations and applications of machine tools.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe energy sources, energy conversion systems, mechanical power transmission systems, machine tools, modern manufacturing tools and their processes and techniques
CO-2. Solve numerical problems on machining and mechanical power transmission systems
CO-3. Apply principles of energy conversion systems, power transmission systems, machining processes to practical applications
CO-4. Perform operations on Lathe, Drilling machines and joining process as per the given drawing

4. Course Contents

Unit 1 (Introduction and overview of Mechanical Systems):

Role of Mechanical Engineering in Industries and Society- Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, A3utomotive, Aerospace, and Marine sectors and contribute to the GDP.

Unit 2 (Energy Sources and its Conversion Devices):

Energy Sources and Power Plants:

Review of energy sources; Construction and working of Hydel power plant, Thermal power plant,

Nuclear power plant, Solar power plant, Tidal power plant, Wind power plant.

Steam Formation and Application:

Formation of steam and thermodynamic properties of steam (Simple Problems using Steam Tables), Applications of steam in industries namely, Sugar industry, Dairy industry, Paper industry, Food processing industry for Heating/Sterilization, Propulsion/Drive, Motive, Atomization, Cleaning, Moisturization, Humidification**.**

Unit 3 (Fundamentals of IC Engines):

Review of Internal Combustion Engines, 2-Strokes and 4-Strokes engines, Components and working principles, Application of IC Engines in Power Generation, Agriculture, Marine and Aircraft Propulsion, Automobile.

Insight into future mobility technology; Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles, Drives and Transmission. Advantages and disadvantages of EVs and Hybrid vehicles.

Unit 4 (Mechanical Power Transmission and Fundamentals of Robot):

Gear Drives: Types - spur, helical, bevel, worm and rack and pinion, velocity ratio, Gear Trains and their application: simple and compound Gear Trains, Simple numerical problems on Gear trains involving velocity ratios.

Belt Drives: Components of belt drive and concept of velocity ratio; Types of belt drives, FlatBelt Drive, V-Belt Drive and Application of Belt Drives. Simple numerical problems on Belt drives involving velocity ratios,

Concept of Chain, Rope drives and their applications

Introduction to Robotics

Robot anatomy, Joints & links, common Robot configurations. Applications of Robotics in Material Handling, Processing, Assembly, and Inspection

Unit 5 (Fundamentals of Machine Tools and Operations):

Fundamentals of Machining and machine tools, Construction and Working Principle of Lathe, Various Lathe Operations: Turning, Facing, Taper Turning and Knurling. Construction and working of simple Drilling Machines and applications.

Demonstration of 3-D Printing and CNC Machining.

Demonstration of Lathe Tool and Drill Tool Dynamometers.

Laboratory Exercises	
01	Model-I: To perform Facing, Centering and Plain turning and chamfering operations on a lathe machine as per the given drawing and develop a model
02	Model –II: To perform Parting/Step turning and Taper turning operations on a lathe machine as per the given drawing and develop a model
03	Model –III: To perform Knurling and Thread cutting operations on a lathe machine as per the given drawing and develop a model
04	Model-IV: To perform Drilling, Reaming and Tapping operations on a drilling machine as per the given drawing and develop a model

05	Model-V: To perform pipe welding, resistance welding, spot and seam welding as per the given drawing and develop models

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2	3												
CO-3	3											2	
CO-4					2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	30	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)	
Subcomponent ▶	SC1	SC2	SC3	SC4	SEE (Weightage: 25%)	SEE (Weightage: 15%)
Subcomponent Type ▶	Term Test – 1	Term Test – 2	Assignment	Laboratory	Written Exam	Lab Exam
Maximum Marks ▶	15	15	20	10	40	
CO-1	x				x	
CO-2		x	x		x	
CO-3		x	x		x	
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. V. K. Manglik, 2014, Elements of Mechanical Engineering, PHI Learning
3. K. R. Gopalakrishna, 2024, Elements of Mechanical Engineering, Subhash Publishers

b. Recommended Reading

1. G.D. Gokak, J.K. Kittur, 2014, Elements of Mechanical Engineering, Wiley publications
2. G. S. Sawhney, 2003, Fundamental of Mechanical Engineering, Prentice Hall of India Publication
3. S. Trymbaka Murthy, 2010, A Text book of Elements of Mechanical Engineering, 3rd Revised Edition, I .K. International Publishing House Pvt. Ltd.
4. K. P. Roy and S. K. Hajra Chaudhary, 2014, Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd.

c. Magazines and Journals

1. ASME Mechanical Engineering Magazine
2. Machine Tools

d. Websites

1. https://www.asme.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MED101A	
Course Title	Introduction to Mechanical Engineering	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Workshop Practice

Course Title	Workshop Practice
Course Code	MEL105A
Course Type	Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This laboratory deals with various workshop operations, tools and their applications. The students will be equipped with basic knowledge and understanding of various workshop tools, equipment and measuring instruments used for bench work. The student will be exposed to the practical application of fitting, welding, sheet metal and carpentry operations. In addition, the student will be trained to select and use suitable tools and processes required for metal fabrication.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Perform operations and prepare physical models of metal fitting, carpentry wood model, sheet metal, pipe fitting and metal arc welded joint models as per given drawing

CO-2. Draft the fitting, welding, pipe fitting and carpentry models and development drawings for sheet metal models

4. Course Contents

Introduction: Marking tools, workshop tools and their usage, safety precautions.

Fitting Practice: V-joint, semi-circular joint, pipe fitting.

Welding: Practice of welding joints.

Sheet metal fabrication: Sheet metal joints, Development and creation of cylinder and cones.

Carpentry Practice: – Wood Carving, Cutting, Planning and demonstration of wood turning operations.

Plumbing Practice: – Internal and External Threading, Pipe fitting.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												
CO-2	3												
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	30	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent ▶	SC1	SC2	
Subcomponent Type ▶	Laboratory Test	Report / Manual Writing	Lab Exam
Maximum Marks ▶	10	20	20
CO-1	x	x	x
CO-2	x	x	x
The details of SC1 and SC2, are presented in the Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Hajra Choudhary S. K., Bose S. K., Hajra Choudhary A. K. and Roy Nirjha, (2014) Elements of Workshop Technology Volume No. II: Machine Tools, Media Promotors and Publishers Pvt. Limited

b. Recommended Reading

1. W. Chapman (2019) Workshop Technology, Part 2, Butterworth-Heinemann

c. Magazines and Journals

1. Mechanical Engineering Magazine ASME

d. Websites

1. www.toolstop.co.uk/workshop-toolsenglishwilleasy.com/english-through-pictures/things-english-throughpictures/workshop/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEL105A		
Course Title	Workshop Practice		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Communicative English

Course Title	Communicative English
Course Code	TSM103A
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Aim and Summary

The course aims to equip students with foundational and advanced communicative competencies in English, enabling them to listen actively, speak articulately, read strategically, and write professionally. By integrating core linguistic mechanics with practical application, the course prepares students to navigate academic, professional, and contemporary digital landscapes with confidence, clarity, and grammatical precision.

2. Course Size and Credits:

Number of credits	02
Credit Structure (Lecture: Tutorial: Practical)	1:0:2
Total hours of interaction during the semester	45
Number of semester weeks	15
Department responsible	Centre for Professional Development
Total Course marks	50
Pass requirement	As per the Academic Regulations
Attendance requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After undergoing this course students will be able to:

CO-1. Demonstrate active listening, strategic reading, and articulate speaking skills to navigate academic and professional communication contexts (e.g., interviews, meetings, and group presentations)

CO-2. Compose clear, context-appropriate professional documents, persuasive emails, and structured paragraphs for workplace and academic requirements

4. Course Content

Pronunciation: Introduction, Consonant Sounds, Kinds of Consonant Sounds, Vowel Sounds, Short and Long Vowel Sounds, Kinds of Vowel Sounds, Comparison of Sounds and Sentence Identification and Stress, Noun-Verb Pronunciation Difference, Pronunciation Rules.

Listening Skills: News Article, Narratives, Conversation, Advertisement, News Article

Speaking Skills: Hobbies and Interests, Extempore, Prepared Speech, Presentation Skills Language Enhancers; Order of Words, Question Tags, Transformation of Sentence

Reading Skills: Skimming and scanning skills

Writing Skills: Formal Letter, Paragraph and Blog Writing, Informal Letter, Email Writing

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1								2	3				
CO-2									3				
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	00	
3. Engineering Workshop / Course Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Written Examination, Presentations		5
Total Duration in Hours		45

6. **Method of Assessment**

There are two components for assessment in this course:

	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent Type ▶	**(Lab Assessment /Demonstrative Assessment)**	**Semester End Examination**
Maximum Marks ▶	**30**	**20**
CO-1	**X**	**X**
CO-2	**X**	**X**

Component - 1: 60% weight

Continuous Evaluation during lab hours. A demonstration of spoken skills during theory hours in the classroom

Component - 2: 40% weight

Written Semester End Examination

Reassessment

As per Academic Regulations

7. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S.No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory sessions/ Theory sessions
2.	Understanding	Face to face lectures
3.	Analytical Skills	Face to face lectures, activities, , group
4.	Practical Skills	Laboratory sessions ,Face to face lectures, activities, , group discussions, course work
5.	Group Work	Course work, practice, group discussion
6.	Self-Learning	Laboratory sessions
7.	Written Communication Skills	Face to face lectures, Course work, Laboratory sessions practice, assignment, group
8.	Verbal Communication Skills	Face to face lectures, Course work, Laboratory sessions practice, assignment, group
9.	Presentation Skills	Demonstrations by students during theory hours and lab hours
10.	Behavioral Skills	Course work, practice, assignment, Laboratory sessions, group discussion, presentation practice, role plays\
11.	Information Management	Laboratory sessions, Face to face letures, Group Discussions , Brain storming
12.	Personal Management	Laboratory sessions, Face to face letures, Group Discussions , Brain storming
13.	Leadership Skills	Face to face letures, Group Discussions , Brain storming

8. Course Resources

a. Essential Reading

1. Class Notes
2. Raman M and Sharma S (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press
4. Hory Sankar Mukherjee, (2013), Business Communication, Oxford University Press
5. Kroehnert, Gary (2004), Basic Presentation Skills, Tata McGraw Hill

b. Recommended Reading

1. Sathya Swaroop Debashish and Bhagaban Das, (2014), Business Communication, PHI, New Delhi
2. Young, Dona J (2006) Foundations of Business Communications: An Integrated Approach, Tata McGraw Hill
3. Kaul, Asha (2007) Effective Business Communication, Prentice Hall India
4. Bienvenu, Sherron (2008) The Presentation Skills Workshop, Prentice Hall
5. Kavita Tyagi and Padma Misra (2011) Professional Communication, PHI Learning Private Limited, New Delhi

c. Websites

1. www.myenglishpages.com
2. www.britishcouncil.com
3. www.englishmagazine.com
4. www.justenglishmagazine.com

d. Other Electronic Resources

1. Wordsworth Language Laboratory

9. Course organization

Course Code	TSM103A	
Course Title	Communicative English	
Course Leader/s Name	As per Time - table	
Course Leader Contact Details	**Phone:**	080 – 4536 6666
	E-mail:	dean.cpd@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review	June 2030	

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Course Specifications: Environmental Studies

Course Title	Environmental Studies
Course Code	BTN101A
Course Type	Humanities and Social Sciences
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to invoke awareness among students about the burning global environmental issues. The course exposes the students to various problems associated with abuse of natural resources. The concepts of ecosystems, biodiversity and its conservation and environmental pollution will be discussed. The course emphasizes social issues associated with the environment, and the impact of human population on the environment.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Department of Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the significance of natural resources, ecosystems, and biodiversity in supporting human well-being and sustainable societal development.
- **CO-2.** Relate the impact of environmental pollution, disasters, and human activities on society, and identify measures for environmental protection and conservation
- **CO-3.** Interpret environmental ethics, sustainability principles, population concerns, and environmental legislation to promote responsible citizenship and societal welfare.

4. Course Contents

Unit 1: Natural resources:

Forest resources: Use and overexploitation, deforestation**, Water resources:** Use and overutilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems**,** Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies**. Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit 2: Ecosystems:

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries).

Unit 3: Biodiversity and its conservation:

Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5: Environmental Pollution:

Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution. **Disaster management:** floods, earthquake, cyclone and landslides.

Unit 6: Social Issues and the Environment:

From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, rainwater harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

Unit 7: Environmental ethics:

Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation, Consumerism and waste products, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness. Human Population and the Environment: Population growth, variation among nations, Population explosion.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1						2	3						
CO-2						3	3						
CO-3						3	3						
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	03	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests or Assignments**	
CO-1	×	×
CO-2	×	×
CO-3	×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Bharucha, E., 2004, Environmental Studies, New Delhi, University Grants Commission Ahluwalia, V.K., 2013,
3. Environmental Studies: Basic concepts, The Energy and Resources Institute (TERI).

b. Recommended Reading

1. Jadhav, H. and Bhosale, V. M., 1995, Environmental Protection and Laws, New Delhi, Himalaya Publishing House

c. Magazines and Journals

https://www.omicsonline.org/environmental-sciences-journals-impact-factor-ranking.php

d. Websites

https://www.sciencedaily.com/news/earth_climate/environmental_science

e. Other Electronic Resources

http://www.globalissues.org/issue/168/environmental-issues

10. Course Organization

Course Code	BTN101A		
Course Title	Environmental Studies		
Course Leader Name		As per Timetable	
Course Leader Contact Details		**Phone:**	08045366666
		E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Engineering Mathematics - 2

Course Title	Engineering Mathematics – 2
Course Code	MTF111B
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts of vector spaces, vector algebra, vector calculus and numerical methods. The solution procedures for certain standard forms of vector algebra are illustrated. The role, relevance of vector spaces and vector calculus in modelling some of the real-world problems are emphasized. This course also covers the underlying principles and applications of numerical methods in various engineering disciplines.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the principles of vector spaces, vector algebra, vector calculus and numerical methods to solve mathematical problems.
- **CO-2.** Analyze vector spaces, linear transformations, vector fields, and numerical approximation techniques using appropriate mathematical methods.
- **CO-3.** Evaluate and interpret mathematical models involving linear transformations, vector calculus and numerical methods in the investigation of engineering and interdisciplinary problems.

4. Course Contents

Unit 1 (Vector Spaces):
Vector spaces, subspaces, linear independence, basis and dimension. Row, column and null space of a matrix, Rank-Nullity Theorem. Linear transformations**.**

Unit 2: (Vector Algebra)
Review of vector algebra, scalar, vector, addition and subtraction of vectors, angle between

two vectors, scalar triple product of vectors, Multiplication of vectors, projections of two vectors.

Unit 3 (Vector Calculus):
Vector and scalar fields, derivatives of vector valued functions, curves, tangents, arc length. Gradient of a scalar field, directional derivatives, divergence and curl of a vector field. Polar, Cylindrical and Spherical coordinates systems**.**

Unit 4 (Numerical Methods):
Newton-Raphson method and Numerical solution of system of linear equations by Gauss Seidel method. Interpolation - Lagrange interpolation, Newton's divided difference interpolation. Linear and non-linear curve fitting. Numerical Integration – trapezoidal, Simpson's 1/3, Simpson's 3/8 rules and Gaussian quadrature.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3	1											
CO-2	2	3											
CO-3	3	2											
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**60**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Quiz**	**50 Marks**
Maximum Marks ▶	**25**	**25**	**40**	**10**	
CO-1	×	×	×	×	×
CO-2	×	×	×		×
CO-3			×		×
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson
3. Steven J. Leon, 2010, Linear Algebra with Applications, 8th edition, Pearson
4. S.S Sastry, 2012, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited.

b. Recommended Reading

1. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, tenth edition, John Wiley & Sons Inc.
2. Marsden and Tromba, 2012, Vector Calculus, 6th edition, W. H. Freeman and Company.
3. Dennis G.Z, 2017, Advance Engineering Mathematics, 6 th edition, Jones and Bartlett India Pvt.Ltd.
4. Grewal B S, 2021, Higher Engineering Mathematics, 44th edition, Khanna Publication.

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. tutorial.math.lamar.edu/

10. Course Organization

Course Code	MTF111B	
Course Title	Engineering Mathematics - 2	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Applied Mechanics

Course Title	Applied Mechanics
Course Code	MED104A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is an introduction to concepts and principles of engineering mechanics and its applications to mechanical engineering problems. Students will be trained on application of engineering mechanics to solve practical problems pertaining to various force systems and static and dynamic equilibrium of rigid bodies.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the concepts of force, moment and couple and represent them in engineering problems involving rigid bodies at rest or in motion
- **CO-2.** Apply the principles of resolution and composition of forces, conditions of equilibrium to rigid bodies
- **CO-3.** Analyse and determine the centroid, centre of gravity and moment of inertia for various cross-sections of structural members

4. Course Contents

Unit 1 (Fundamental Concepts and Principles):
Engineering Mechanics, Applications of Engineering Mechanics, Systems of Units; Method of Problem Solution; Numerical Accuracy; Vectors for mechanics; Forces in plane and Space; Resultant of forces; Resolution of forces into components; Equilibrium of particles; Rigid bodies and Equivalent system of forces; External and Internal Forces; Principle of Transmissibility; Equivalent Forces; Moment of a Force about a Point; Varignon's Theorem; Rectangular Components of the Moment of a Force; Moment of a Force about a given Axis; Moment of a Couple; Equivalent Couples; Addition of Couples; Reduction of a System of Forces to one Force and a couple; Equivalent Systems of Forces; Reduction of a System of Forces to a Wrench

Unit 2 (Equilibrium of Rigid Bodies):
Free-Body Diagram; Equilibrium in Two Dimensions; Reactions at Supports and Connections for a Two-Dimensional Structure; Statically Indeterminate Reactions, Partial constraints; Equilibrium in Three Dimensions; Reactions at Supports and Connections for a Three-Dimensional Structure.

Unit 3 (Centroid and Moment of Inertia):
Distributed Forces, Centroids and Centers of Gravity; Center of Gravity of a Two-Dimensional Body; Centroids of Areas and Lines; First Moments of Areas and Lines; Composite Plates and Wires; Determination of Centroids by Integration; Distributed Loads on Beams; Forces on Submerged Surfaces. Volumes; Center 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; 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; Product of Inertia; Principal Axes and Principal Moments of Inertia; Moment of Inertia of a Mass; Moments of Inertia of Thin Plates; Determination of the Moment of Inertia of a Three-Dimensional Body by Integration; Moments of Inertia of Composite Bodies; Moment of Inertia of a Body with Respect to an Arbitrary Axis

Unit 4 (Friction):
Introduction; The Laws of Dry Friction; Coefficients of Friction; Angles of Friction; Problems Involving Dry Friction; Wedges; Square-Threaded Screws; Journal Bearings - Axle Friction; Thrust Bearings - Disk Friction; Wheel Friction – Rolling Resistance; Belt Friction.

Unit 5 (Kinematics of Rigid Bodies):
Introduction, Translation, Rotation about a Fixed Axis, General Plane Motion, Absolute and Relative Velocity in Plane Motion, Instantaneous Center of Rotation in Plane Motion, Absolute and Relative Acceleration in Plane Motion, Rate of Change of a Vector with Respect to a Rotating Frame, Plane Motion of a Particle Relative to a Rotating Frame, Coriolis Acceleration, Three-Dimensional Motion of a Particle Relative to a Rotating Frame, Frame of Reference in General Motion.

Unit 6:
Kinetics of Rigid Bodies: Forces and Accelerations, Equations of Motion for a Rigid Body, Angular Momentum of a Rigid Body in Plane Motion, Plane Motion of a Rigid Body , D'Alembert's Principle, Systems of Rigid Bodies, Constrained Plane Motion.
Introduction to Kinetics of Rigid Bodies in Three Dimensions: Angular Momentum of a Rigid Body in Three Dimensions, Application of the Principle of Impulse and Momentum to the Three-Dimensional Motion of a Rigid Body, Kinetic Energy of a Rigid Body in Three Dimensions, Motion of a Rigid Body in Three Dimensions.
Energy and Momentum Methods: Principle of Work and Energy for a Rigid Body, Work of Forces Acting on a Rigid Body, Kinetic Energy of a Rigid Body in Plane Motion, Systems of Rigid Bodies, Conservation of Energy, Power, Principle of Impulse and Momentum for the Plane Motion of a Rigid Body, Systems of Rigid Bodies, Conservation of Angular Momentum.
Method of Virtual Work: Introduction, Work of a Force, Principle of Virtual Work, Applications of the Principle of Virtual Work, Real Machines, Mechanical Efficiency, Work of a Force during a Finite Displacement, Potential Energy, Potential Energy and Equilibrium, Stability of Equilibrium.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2	3												2
CO-3		2											2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Assignment/Quiz /Tutorials	Written Exam
Maximum Marks ▶	15	15	20	10	40
CO-1	x				x
CO-2	x	x		x	x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Beer, Johnston, Cornwell and Sanghi, (2025), Vector Mechanics for Engineers: Statics and Dynamics, 13th Edition, McGraw-Companies, Inc., New York

b. Recommended Reading

1. S. Timoshenko, D.H. Young, J.V. Rao, Sukumarati (2017), Engineering Mechanics, McGraw Hill Education
2. Meriam J.L and Kraige L.G., Engineering Mechanics, (2021), Volume I - Statics, Volume II - Dynamics, John Wiley & Sons, New York
3. Russell C Hibbeler and Ashok Gupta (2021), Engineering Mechanics: Statics and Dynamics (15th Edition), Pearson Education Inc., Prentice Hall.
4. C. Lakshamanarao, J. Lakshinarashiman, Raju Sethuraman, Srinivasan M. Sivakumar (2013), Engineering Mechanics: Statics and Dynamics, PHI, New Delhi
5. R K Rajput (2016), A Text Book of Applied Mechanics, Laxmi Publications

c. Magazines and Journals

1. Journal of Engineering Mechanics
2. International Journal for Theoretical and Applied Mechanics

d. Websites

1. https://asme.org/
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MED104A	
Course Title	Applied Mechanics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Programming in Python

Course Title	Programming in Python
Course Code	CSD106A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is intended to teach the students the techniques for solving computing problems and programming in Python. Python programming language constructs, standard data structures and structured problem solving via functional decomposition are taught in detail. Python libraries and their use in the implementation of computer programs are covered. Students learn program development, testing, randomized test input generation and exception handling.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply Python concepts, libraries and modules for building programs
- **CO-2.** Analyze key components and syntax of the python programming language
- **CO-3.** Develop Python programs for simple applications
- **CO-4.** Test and validate Python programs

4. Course Contents

Unit 1 (Introduction):

Introduction to computer programming, programming languages, Python programming language, IDEs and Workbooks.

Laboratory Exercises: Basic use of Python IDE

Unit 2 (Elements of Programming in Python):

Basic data types, variables and keywords in Python. Arithmetic, logical operations, operators and expressions. Input/Output operations in Python. Conditional statements chained and nested conditionals. Loop statements and iteration in Python.

Laboratory Exercises on Problem Solving using Python.

Unit 3 (Data Structures in Python):

Standard data structures in Python: Lists, Strings, Tuples, Sets and Dictionaries.

Laboratory Exercises on programming using data structures in Python.

Unit 4 (Structured Programming using Python):
Built-in and user-defined functions in Python, Function calls, Program structure and decomposition using functions, Variable scope: global and local variables. Recursion and recursive functions. Iteration vs recursion.
Laboratory exercises on structured programming in Python.

Unit 5 (Programming using Python Libraries):
Modules and libraries in Python. Introduction to the Python Standard Library. Programming using libraries. Basics of numpy and matplotlib libraries.
Laboratory exercises on programming using Python libraries.

Unit 6 (Program Development using Python):
Elements of good programming style, decomposing problems. Identifying test cases and test data generation. Exception handling in Python.
Demonstrations and laboratory exercises on program development in Python.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3				3								
CO-2		3											
CO-3			3		2								
CO-4	2	2	2		2								
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		25
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	25	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**60**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**25**	**25**	**25**	**25**	**50**	**30**
CO-1	**X**				**X**	
CO-2	**X**				**X**	
CO-3	**X**	**X**	**X**	**X**	**X**	**X**
CO-4		**X**	**X**	**X**		**X**
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Rao, B. N., 2021, Learning Python, CyberPlus Infotech.

b. Recommended Reading

1. Downey, A. B., 2016, Think Python: How to Think like a Computer Scientist, O'Rielly.
2. Dromey, R. G., 1982, How to Solve It by Computer, New Delhi: Pearson Education.
3. Schneider, G. M., and Gersting, J. L. (2019) Invitation to Computer Science, 8th edn., Cengage.

c. Magazines and Journals

d. Websites

1. Association of Computing Machinery (ACM), http://www.acm.org/
2. IEEE Computer Society, http://www.computer.org/
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	CSD106A		
Course Title	Programming in Python		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Engineering Graphics

Course Title	Engineering Graphics
Course Code	MEF103B
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with graphical representation of geometrical entities in various views for visualization and communication. The students will be taught orthographic projection of points, lines, planes and solids. The students will be taught sections and development of solids; and isometric projections of simple and combination of solids. The students will be equipped to visualize and apply principles of orthographic projection to a given application. The students will also be trained to use CAD tool to carry out the above geometric projections.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the principles of engineering drawing to construct and interpret projection of points, lines and planes
- **CO-2.** Develop and analyse projection of solids including sections and surfaces
- **CO-3.** Create isometric views from given orthographic drawings to visualize three-dimensional objects

4. Course Contents

Unit 1 (Introduction to Engineering Drawing and CAD Tool):
Drawing Instruments and their uses, Bureau of Indian Standards (BIS) conventions and specifications, Dimensioning and Significance of Lettering, Graphical User Interface (GUI), Co-ordinate system and reference planes. Definitions of Horizontal Plane (HP), Vertical Plane (VP), Right Profile Plane (RPP) & Left Profile Plane (LPP). Creation of 2D environment. Selection of drawing size and scale. Creation of geometric entities and text. Modification and editing of geometric entities. Dimensioning, line conventions and material conventions.

Unit 2 (Orthographic Projections of Points, Lines and Planes):
Definitions - Planes of projection, reference line and conventions employed.
Projections of points in all the four quadrants

Projections of straight lines (located in First quadrant, first angle of projection), True and apparent lengths.
Definitions–projections of plane Surfaces –triangle, square, rectangle, pentagon, hexagon. Planes in different positions by change of position method only
Computer Aided Drawing:
To develop CAD models for the manual drawings using commands like Polygon, Rectangle, Copy, Move, Rotate, Align and Array

Unit 3 (Orthographic Projections – Solids (First Angle Projection):
Definitions – Projections of solids– cube, prisms, cylinder, pyramids, cones in different positions
Computer Aided Drawing:
To develop CAD models for the manual drawings using commands like Polygon, Rectangle, Copy, Move and Rotate Command, Align, Array

Unit 4 (Orthographic Projections – Section of Solids and Development of Surfaces (First Angle Projection):
Section planes, Sectional views, apparent shapes of sections of right regular prisms, pyramids, cylinders and cones resting in simple positions
Computer Aided Drawing:
To develop CAD models for the manual drawings using commands like Polygon, Rectangle, Copy, Move and Rotate Command, Align, Arc, Hatching, Pattern

Unit 5 (Isometric Projections using Isometric Scale):
Isometric scale, Isometric projection of simple solids and truncated solids – prisms, pyramid, cylinders, cones and simple combinations of solids
Computer Aided Drawing:
To develop CAD models for the manual drawings using commands like Isometric grid, scaling

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												2
CO-2					2								2
CO-3					2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00

1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x		x		x
CO-2		x		x	x
CO-3				x	x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. K. R. Gopalakrishna, 2005, Engineering Graphics, 32nd Edition, Shubhash Publishers

b. Recommended Reading

1. W. J. Luzadder, 2015, Fundamentals of Engineering Drawing, 11th Edition, Pearson Education India
2. N. D. Bhatt and V. M. Panchal, 2026, Engineering Drawing, 56th Edition, Charotar Publishing House
3. CAD Tool Users Manuals

c. Magazines and Journals

d. Websites

1.
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEF103B	
Course Title	Engineering Graphics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Mathematics – 3

Course Title	Mathematics-3 (ME)
Course Code	MED201A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces the concepts of Probability and Statistics, complex variables, Laplace transform, Fourier series and Fourier transform. The course encompasses the essentials of statistics and probability theory. Students are taught the probability theory and statistical distributions needed to quantify uncertainty and accuracy of information. The applications of complex analysis to solve complex engineering problems and that of Fourier series and Fourier transforms in modeling real world problems are highlighted. This course also aims at solving Engineering problems associated with Fourier series, Fourier transform and Laplace transform methods using MATLAB.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of probability, probability distribution, Statistics to solve mathematical problems of Engineering Applications
- **CO-2.** Evaluate and solve the problems associated with complex variables
- **CO-3.** Analyze and solve the problems of Laplace transform, Fourier series and Fourier transform by implementing standard algorithms in MATLAB

4. Course Contents

Unit 1 (Probability and Statistics):
Review of basics of probability and statistics, Correlation and regression, conditional probability and Bayes' theorem. Random variables, probability distribution. Discrete and continuous probability distribution. Binomial, Poisson, exponential and normal distributions. Application of probability distribution on quality control and statistical process control.

Unit 2 (Complex Variables):
Complex valued functions, limits, continuity and differentiability. Analytic functions and Cauchy-

Riemann equations. Construction of analytic functions, Harmonic functions. Complex line integral, Cauchy's integral theorem and integral formula. Taylor and Laurent series. Computation of circulation and work done by fluid forces in fluid mechanics.

Unit 3 (Laplace Transform: MATLAB-1):
Introduction to MATLAB, Basic algebraic and matrix operations, built-in and command line functions, plots scripts and functions, Definition of Laplace transform, properties and theorems, transforms of derivatives, integrals, unit step function, Dirac delta function, time and frequency shifting property, Inverse Laplace transform, solution of initial value problem. System dynamics and vibration analysis.

Unit 4 (Fourier Analysis: MATLAB-2): Periodic functions, Fourier series, Dirchlet's conditions, Fourier series for a periodic function of period T. Half range Fourier series, complex Fourier series, Harmonic Analysis. Fourier Transform - Definition, Fourier transform of elementary functions, properties. Inverse Fourier transform. Application of Fourier transform in solving heat conduction problems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3	3											
CO-2	3	3											
CO-3	2	2			3								
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory		
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Lab**	**50 Marks**
Maximum Marks ▶	**25**	**25**	**30**	**20**	
CO-1	×	×			×
CO-2	×	×			×
CO-3			×	×	×
CO-4			×	×	×
CO-5			×	×	×
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--

9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson
2. Dennis Zill and Warren Wright, 2011, Advanced Engineering Mathematics, 4th edition, Jones and Bartlet
3. Sheldon Ross, 2013, A first course in probability, 9th edition, Pearson education
4. Rudra Pratap, 2010, Getting Started with MATLAB, 1st edition, Oxford University Press

b. Recommended Reading

1. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, tenth edition, John Wiley & Sons Inc
2. Spiegel, M.R., Schiller, J and Srinivasan, R.A., 2000, Probability and Statistics, 2nd Ed., New York: McGraw-Hill.
3. Amos Gilat, 2016, MATLAB An Introduction with Applications, 6th edition, Wiley

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. tutorial.math.lamar.edu/

10. Course Organization

Course Code	MED201A	
Course Title	Mathematics-3 (ME)	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Materials Science

Course Title	Materials Science
Course Code	MEC202A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course deals with introduction to engineering materials, their properties and applications. The students will be able to develop an understanding of the structure of metals, ceramics, polymers and composites. Physical and mechanical properties of engineering materials will be discussed. Students will be exposed to application of phase diagrams, TTT diagrams and heat treatment methods. Concepts of strengthening mechanisms, creep, fracture and fatigue in engineering materials will be taught. Students will be able to apply the mechanism of plastic deformation, principle of strengthening methods, utilize the mechanical behavior of materials and learn about failure analysis. Students will acquire knowledge about properties and applications of advanced engineering materials.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss phase diagrams, heat treatment processes and strengthening mechanisms to correlate the material behaviour under specific processing conditions
- **CO-2.** Identify the causes of failure by using appropriate mechanical testing and characterization techniques
- **CO-3.** Correlate the properties of conventional and advanced engineering materials to select the appropriate material for a given application

4. Course Contents

Unit 1 (Phase Diagram and Heat Treatment):

Crystal structure, Imperfection in solids, Solid solutions – Types, factors governing solubility rules. Phase diagram – cooling curve, phase rule, types and interpretation. Iron–Iron carbide (Fe-Fe_3C) phase diagram, Microstructural aspects and invariant reactions in Fe-Fe_3C diagram. Effect of alloying elements on Fe-Fe_3C diagram. TTT and CCT diagrams. Various heat treatment and surface hardening process.

Unit 2 (Elastic and Plastic Behaviour of Materials):
Stress-Strain relation in elastic and plastic region Mechanism of plastic deformation – slip and twinning, slip systems, critically resolved shear stress, Shear strength of perfect and real crystals. Dislocation – climb, interaction, multiplication and pile ups. Strengthening mechanisms – Solid solution, Grain boundary, Dispersion, Precipitation, Fiber, Martensite strengthening, Strain aging and Strain hardening.

Unit 3 (Characterization of Materials):
Types of fracture in metals, Griffith's theory of brittle fracture, Stress intensity factor, Fracture toughness, Theory of Ductile to brittle transition. Creep – Creep curve, mechanism of creep deformation. Fatigue - S-N curve, low and high cycle fatigue, stages of fatigue. Sources of failure, Procedure of failure analysis. Hardness: Rockwell, Brinell, Vickers hardness, Nano-Indentation Technique. Introduction to characterization of materials - XRD, SEM and TEM. Demonstration – various material characterization.

Unit 4 (Properties of Advanced Materials):
Properties of plain carbon steel, Tool steel, Stainless steel, Cast iron. Need of microalloying, HSLA steel - Dual phase steel, TRIP steel. Aluminum alloys – classifications, properties, applications, Titanium alloys. Polymers – Types, Properties and applications. Ceramics – Types, Properties and applications. Composites – classification, Reinforcement and matrix material, Rule of Mixture. Properties and applications of MMC, CMC and PMC. Demonstration – Various characterizations of materials.

Unit 5 (Futuristic Materials and Computational Materials Design):
Smart materials – Types, Shape memory alloys. Nanomaterials: Carbon nanotubes, Graphene – properties and applications. Metallic foams, Metallic glasses, Super alloys, High entropy alloys, biomaterials. Multiscale materials modelling, Integrated Computational Materials Engineering with application to Industry 4.0. Materials Informatics, Machine learning for design of materials.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												
CO-2	3												2
CO-3	3												3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	**X**				**X**
CO-2	**X**	**X**	**X**	**X**	**X**
CO-3			**X**		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. W. D. Callister Jr. and D. G. Rethwisch, 2020, Materials Science and Engineering: An Introduction, 10th Edition, Wiley Publications

b. Recommended Reading

1. H. Van Vlack, 2002, Elements of Materials Science and Engineering, 6th Edition, Addison-Wesley.
2. V. Raghavan, 2015, Materials Science and Engineering: A First Course, 6th Edition, PHI.
3. Donald R. Askeland, 2016, The Science and Engineering of Materials, 8th Edition, Chapman and Hall.
4. Z. L. Wang and Z. C. Kang, 2012, Functional Materials: Structural Evolution and Structure Analysis, Plenum, New York.
5. Flake. C Campbell, Elements of Metallurgy and Engineering Alloys, ASM International, 2008
6. Dieter G.E, Mechanical Metallurgy, McGraw Hill, 2019
7. Budinski.K.G, Budinski.M.K, Engineering Materials Properties and Selection, Pearson Publication, 2010
8. ASM Handbook, Failure analysis and Prevention, Vol: 11, 2021
9. Chaudhary Mustansar Hussain, Smart Materials and New Technologies, Springer, 2022
10. Shubhabrata Datta and J. Paulo Davim, Machine Learning in Industry, Springer, 2021
11. Shubhabrata Datta and J. Paulo Davim, Materials Design Using Computational Intelligence Techniques, CRC Press, 2016

c. Magazines and Journals

1. Materials Science and Engineering: A
2. Materials Science and Engineering: B
3. Materials Science and Engineering: C
4. Materials Science and Engineering: R: Reports
5. Materials Research Bulletin
6. Journal of Materials Science
7. Materials Today Magazine

d. Websites

1. http://www.mrs.org
2. http://www.mrsi.org.in
3. http://www.asminternational.org
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC202A	
Course Title	Materials Science	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Mechanics of Deformable Solids

Course Title	Mechanics of Deformable Solids
Course Code	MEC203A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the concepts and principles of strength of materials. Students are taught various types of forces and their reactions on the structures. The concepts of stress, strain, deformation and their applications in solving general engineering problems will be explained. Students are trained to analyse the response of the simple structural components to applied forces and boundary conditions. Students will be able to apply principles of strength of materials to solve problems of practical importance.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss various types of forces, stresses, strains, elastic constants and the stress-strain behaviour of engineering materials and structural elements
- **CO-2.** Solve problems on stress, strain and deflection analysis for structural elements including bars, beams, shafts, cylinders and columns
- **CO-3.** Determine mechanical properties of engineering materials through experiments and apply principles of strength of materials to problems of practical importance

4. Course Contents

Unit 1 (Introduction):

Importance of strength of materials, basic assumptions, fundamental laws of mechanics, types of loading, Concept of stress; normal stress; shear stress; bearing stress; different states of stress – uniaxial, biaxial, triaxial, plane stress; Equivalent stress, principal stresses and maximum shear stress, Mohr's circle applied to biaxial state of stress, Concept of strain; normal strain; shear strain; different states of strain – uniaxial, biaxial, triaxial, plane strain, principal strain, volumetric strain.

Unit 2 (Mechanical Behavior of Material):

Stress-strain diagram; properties of engineering materials; Hooke's law; Poisson's ratio; elastic

modulus, bulk modulus; modulus of rigidity; relationship between different elastic constants, strain energy in axially loaded members, Thermal Effects, Coefficient of thermal expansion, thermal strain, thermal stress, examples of thermal stresses.

Unit 3 (Thin and Thick Cylinders):
Thick and thin cylinders; Thin cylindrical pressure vessels subjected to internal pressure; Stresses in thin cylinders; Thick cylindrical pressure vessels subjected to internal pressure; Stresses in thick cylinders.

Unit 4 (Beams and Stresses due to Bending):
Types of loads; types of supports; reactions. Shear Force and Bending Moment, sign conventions, diagrams for simply supported, cantilever and overhang beams with point load, couple, uniformly distributed load, uniformly varying load, point of contra flexure, Beams with uniform cross section; pure bending of beams, assumptions, moment of inertia, neutral axis, bending stress; normal and shear stresses in beams, Deflection and slopes in beams, Deflection and slopes in simply supported and cantilever beams, strain energy in beams.

Unit 5 (Torsion in Shafts and Columns and Struts):
Pure torsion; Assumptions, polar moment of inertia, angle of twist, stresses due to torsion; solid and hollow circular shafts; Torsional strain energy, combined torsion and axial loading. Elastic stability of columns; critical load of a slender column; eccentrically loaded columns; Euler's and Rankine Gordon theory of columns.

Laboratory Exercise

1	Conduct tensile test on Mild steel and Aluminum to determine tensile strength as per ASTM E9 (M)
2	Conduct compression test on ductile (Mild steel and Aluminum) and brittle (Cast iron) materials to determine compressive strength as per ASTM E9 (M)
3	Conduct single and double shear test to determine shear strength of given material
4	Conduct Izod and Charpy impact test to determine the energy absorbed by the test specimen as per ASTM E23(M)
5	Conduct Rockwell hardness test on ferrous and non-ferrous materials to determine Brinell hardness number for the test material as per ASTM standard E18-19
6	Conduct Brinell hardness test on ferrous and non-ferrous materials to determine Brinell hardness number for the test material as per ASTM standard E10-18

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2		2											3
CO-3	3												3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)	
Subcomponent ▶	SC1	SC2	SC3	SC4	SEE (Weightage: 25%)	SEE (Weightage: 15%)
Subcomponent Type ▶	Term Test – 1	Term Test – 2	Assignment	Laboratory	Written Exam	Lab Exam
Maximum Marks ▶	15	15	20	10	40	
CO-1	x	x			x	
CO-2	x	x	x		x	
CO-3				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. R. C. Hibbeler, 2024, Mechanics of Materials, 11th Edition, Pearson Education India.
3. S. N. Ramamrutham, 2022, Strength of Materials, 20th Edition, Dhanpat Rai Publishing Company.

b. Recommended Reading

1. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, 2015, Strength of Materials, 10th Edition, Laxmi Publications.
2. Stephen H. Crandall, Norman C. Dahl, Thomas Lardner and M. S. Sivakumar, 2012, An Introduction to Mechanics of Solids, 3rd Edition, Tata McGraw-Hill.
3. S. Timoshenko, 1986, Strength of Materials, Part 1 and 2, 3rd Edition, CBS.
4. Robert L. Mott, Joseph A. Untener, 2017, Applied Strength of Materials, CRC Press.
5. Sadhu Singh, 2022, Strength of Materials, 11th Edition, Khanna Publishers.

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC203A		
Course Title	Mechanics of Deformable Solids		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Mechanical Dissection and Machine Drawing

Course Title	Mechanical Dissection and Machine Drawing
Course Code	MEC204A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course aims at preparing the students to use engineering drawing concepts to visualize machine components/elements, prepare parts, assembly, detailed drawings and BOM of mechanical systems. This will be achieved through teaching the principles of drawings, dimensioning, tolerances and fits used in machine drawing. Students will be trained to produce part, assembly as well as production drawings of various machine elements /components as per the standards using CAD software tool. The students are trained to dis-assemble simple machines and products, identify and document components, their functionality, form, features and material.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss ISO notations and standards used in machine drawings
- **CO-2.** Dissect a given machine or product by examining its components for form, features, and functionality and develop 2D/3D sketches of the components
- **CO-3.** Develop 3D assembly models with 2D detailed drawings, sectional views and Bill of Materials (BOM) for standard assemblies

4. Course Contents

Unit 1:

General Considerations and Procedure for Design of Machinery, Classification of design, Machine component design, geometric modeling, various methods, recent trends in modeling, assembly modeling and their applications.

Unit 2 (Overview of Machine Drawing):

Importance and areas of applications – Conventions, abbreviations and symbols, Principles of Drawing-Scales, types of lines, title block and BOM, Part drawing, assembly and detail drawing, production drawing.

Unit 3 (Dimensions, Fits and Tolerances):
Dimensioning, Principles of dimensioning methods, use of symbols and abbreviations in machine drawing, allowances, tolerance and surface finish, standards and accepted practices.

Unit 4 (3-D Modelling):
Creation of 3-D models, assemblies and detailed drawings of Power transmission elements like Knuckle Joint, Oldham's coupling, Protected type flanged coupling, Screw Jack; Plummer Block, Machine Vice, Non-return valve and Tailstock of lathe.

Unit 5 (Thread Forms):
Thread terminology, Types of nuts and bolts. (Hexagonal bolt and nut with washer (assembly), square bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut.
Keys: Types and their applications Riveted Joints and their applications. Representation of standard Mechanical Components in Assemblies.

Unit 6 (Dissection of Machine/Product):
Flanged coupling, machine vice, single cylinder four stroke IC engine, brake assembly and hand drilling machine.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2		3											3
CO-3					3								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x				x	
CO-2	x	x		x		x
CO-3			x	x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment

5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. N. D. Bhatt and V. M. Panchal, 2026, Engineering Drawing, Charotar Publishing House
3. K. R. Gopalakrishna, 2012, Machine Drawing, Subhas Publications

b. Recommended Reading

1. W. J. Luzadder, 2006, Fundamentals of Engineering Drawing, Prentice Hall India
2. M. Siddeshwara, P. Kamaiah, V.S. Sastry, 2007, Machine Drawing, Tata McGraw-Hill
3. K. L. Narayana, P. Kanaiah, K. Venkatat Reddy, 2006, Machine Drawing, New Age International Publication
4. M. B. Shah, B. C. Rana, 2007, Engineering Drawing, Dorling Kindersly (India) Pvt. Ltd.

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC204A		
Course Title	Mechanical Dissection and Machine Drawing		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Manufacturing Processes

Course Title	Manufacturing Processes
Course Code	MEC205A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with primary manufacturing processes like metal casting, metal forging, metal joining and sheet metal forming. Students are introduced to working principles, operations and application of various metal casting, metal forging. Metal joining and sheet metal forming processes. Students will be able to select suitable metal casting, metal forging, metal joining and sheet metal forming processes based on component features and application. Students will be able to identify the casting, welding and forging defects formed during manufacturing process and suggest suitable remedies.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the working principles, equipment, process parameters and defects of metal casting, forging, joining and sheet metal forming processes along with their remedial actions
- **CO-2.** Determine the load and power requirements for forging and sheet metal forming processes
- **CO-3.** Select the appropriate manufacturing process for a given component based on its features and application requirements
- **CO-4.** Construct sand moulds using different patterns after testing sand properties, and fabricate components through forging operations as per given engineering drawings

4. Course Contents

Unit 1 (Introduction to Manufacturing Processes):

Overview of Manufacturing Processes, Classification, Primary and secondary processes, Characteristics, Classification based on type of energy used and Influence of manufacturing processes on mechanical properties.

Unit 2 (Metal Casting Processes):
Introduction to casting processes, Classification, Advantages, Limitations and Applications of Casting Processes Sand Casting and Moulding Practices: Moulding sand characteristics, Core sand properties, Green sand, Baked sand, No bake sand and CO2 processes, Patterns - materials, types, pattern allowances, Shell mould casting, Investment casting, Gravity die casting, Pressure die casting, Centrifugal casting, Squeeze casting, Thixocasting, Rheocasting processes.

Unit 3 (Furnaces and Melting Practices):
Furnaces – Oil / gas fired, Electric arc, Resistance and Induction furnaces Degassing, Grain refining, Casting cleaning and Foundry defects.
Gating System: Elements of gating system, Function of sprue, Runner, Gates and Risers.

Unit 4 (Metal Forming Processes):
Introduction to metal forming processes, Classification, Advantages, Limitations and Applications of forming processes, Hot working and cold working, Plastic deformation of metallic materials.
Forging: Working Principle, Types, Characteristics of forged products, Forging load, Forging dies and presses, Forging defects, Numerical problems on calculation of forming load in forging process.
Rolling: Working Principle, Types, Characteristics of rolled products, Rolling load, Effect of friction, Rolling of structural shapes and sheets.
Extrusion and Drawing: Working Principle, Types, Extrusion equipment, Wire, rod and tube drawing, Extrusion defects.

Unit 5 (Metal Joining Techniques):
Overview of joining processes, classification, Heat Affected Zone (HAZ). Welding techniques – resistance, arc, friction, laser welding processes and mechanical sheet metal joining processes, welding defects, Applications.

Unit 6 (Sheet Metal Operations): Formability and Forming Limit Diagram, Press tool operations, Tooling for press work, Dies and presses, Drawing, Stretch forming, Embossing and coining, Defects in sheet formed components, Numerical problems on calculation of forming load.

Laboratory Exercise

1	Determination of compression and shear strength tests on green sand specimen and discuss the results.
2	Determination of the percentage of clay content for green sand specimen.
3	Determination of the percentage of moisture content for green sand specimen.
4	Determination of the permeability number on green sand specimen and discuss the results.
5	Conduction of the mouldability and friability test on green sand specimen and discuss the results.
6	Determination of the grain fineness number for foundry sand.
7	Preparation of green sand moulding using cope and drag for split piece pattern and core mould.
8	Demonstration of melting of Aluminum alloys and pouring of castings and NDT techniques.
9	Conduct of hot forging operations and draw conclusions.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												
CO-2		2											2
CO-3	3												3
CO-4		2											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)	
Subcomponent ▶	SC1	SC2	SC3	SC4	SEE (Weightage: 25%)	SEE (Weightage: 15%)
Subcomponent Type ▶	Term Test – 1	Term Test – 2	Assignment	Laboratory	Written Exam	Lab Exam
Maximum Marks ▶	15	15	20	10	40	
CO-1	x	x			x	
CO-2		x			x	
CO-3			x		x	
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. P. N. Rao, 2018, Manufacturing Technology, Foundry, Forming and Welding,

Tata McGraw-Hill
3. Serope Kalpakjian and Steven R. Schmid, 2024, Manufacturing Engineering and Technology, Pearson Education

b. Recommended Reading

1. Paul Degarmo E. and Black Jt., 2004, Materials and Processes In Manufacturing, JWS
2. Peter Beeley, 2001, Foundry Technology, Butterworth-Heinemann
3. Heine, Loper and Rosenthal, 2008, Principles of Metal Casting, McGraw-Hill
4. John G Lenard, 2002, Metal Forming Science and Practice, Elsevier

c. Magazines and Journals

1. Journal of Materials Processing Technology
2. Journal of Manufacturing Processes, Society of Manufacturing Engineers
3. International Journal of Material Forming
4. International Journal of Forming Processes, Computational and Physical Methods, Esaform
5. Indian Foundry Journal, Institute of Indian Foundrymen
6. International Welding Journal, American Welding Society
7. Indian Welding Journal, Indian Institute of Welding

d. Websites

1. http://www.efoundry.iitb.ac.in
2. http://www.asm.org
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC205A	
Course Title	Manufacturing Processes	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Engineering Thermodynamics

Course Title	Engineering Thermodynamics
Course Code	MEC206A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course intends to impart the knowledge of principles of classical thermodynamics. In this course, students are different approaches to thermodynamic systems and the concept of thermodynamic equilibrium. Zeroth, First, Second and Third Law of Thermodynamics and their application for energy conversion will be discussed. Students will be able to identify different thermodynamic processes and relate their properties to estimate the work and heat interaction.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the fundamental knowledge of thermodynamics laws to interpret simple thermodynamic systems with appropriate engineering applications
- **CO-2.** Analyse thermodynamic processes and cycles using thermodynamic equations and P-V, T-s, h-s diagrams
- **CO-3.** Solve numerical problems involving various thermodynamic relations using thermodynamic principles

4. Course Contents

Unit 1 (Fundamental Concept and Definitions):
Role of Thermodynamics in Engineering applications, Basic Definitions, Types of thermodynamic Systems, Characteristics of system boundary and control-volume, Thermodynamic properties. Thermodynamic state and processes, Thermodynamic equilibrium; thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature concepts, scales, fixed points and measurements.

Unit 2 (Work and Heat):
Definition of heat and work and its limitations, units and sign convention; Displacement work and Quasistatic process, functions, Different types of Work-Shaft work; Electrical work, Stirring

work, Flow work, etc. Comparison between heat and work; Joule's experiments.

Unit 3 (First Law of Thermodynamics):
First law of thermodynamics for open and closed system undergoing -cyclic processes and a non-cyclic process/change of state, Energy as a property of a system, Different forms of energy, PMMI -Perpetual Motion Machine I, Extension of the first law to open system/control volume, Mass and energy balance in steady flow process, Steady flow energy equation and its applications.

Unit 4 (Second Law of Thermodynamics):
Definitions of heat engines and reversible heat engines, Energy reservoirs, Kelvin Planck and Clausius statements of II Law, Heat engine performance parameters -Refrigerator and Heat pump, Corollaries of II law and PMM II, Reversibility and irreversibility as applied to cyclic and non-cyclic process. Carnot Cycle and Reversible heat engine, Carnot's Theorem, Efficiency of reversible heat engines, Thermodynamic scale of temperature.

Unit 5 (Entropy):
Clausius theorem, Clausius Inequality, Entropy - A Property of a System, Entropy Change in Reversible Process, Thermodynamic Property Relation, calculation of Change in Entropy, Principle of Increase of Entropy.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3											2	
CO-2		2										2	
CO-3		2										2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x			x	x
CO-2	x	x		x	X
CO-3	x	x	x	x	x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination

6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. P. K. Nag, 2025, Basic and Applied Thermodynamics, 7th Edition, Tata McGraw Hill.
3. Y. A. Cengel and M. A. Boles, 2023, Thermodynamics An Engineering Approach, Tata McGraw Hill

b. Recommended Reading

1. G. J. Van Wylen and R. E. Sonntag, 2001, Fundamental of Classical Thermodynamics, 3rd Edition, Wiley Eastern
2. David Burghardt, 1986, Engineering Thermodynamics with Applications, Harper Row International Edition
3. T. D. Eastop and A. McConkey, 2006, Applied Thermodynamics for Engineering Technologies, Pearson
4. K. Mark, 1995, Advanced Thermodynamics for Engineers, Tata McGraw Hill

c. Magazines and Journals

1. Journal of Energy Engineering (IJEE)
2. American Journal of Energy Engineering (AJEE)
3. Journal of Power and Energy Engineering (IJPEE)

d. Websites

1. www.learnthermo.com
2. http://termodinamik.webs.com
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC206A		
Course Title	Engineering Thermodynamics		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Mechanical Measurements and Metrology

Course Title	Mechanical Measurements and Metrology
Course Code	MEC207A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course introduces the principles of measurement, metrology, and geometric dimensioning used in mechanical and manufacturing engineering. It covers measurement systems, errors, calibration, sensors, transducers, signal conditioning, limits, fits, gauges, GD&T, and surface roughness measurement. Students gain practical knowledge in selecting, calibrating, and using direct and indirect measuring instruments for accurate measurement and inspection of engineering components.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the principles and characteristics of measurement systems, sensors, transducers, errors, calibration methods, and signal conditioning techniques used in metrology applications
- **CO-2.** Examine limits, fits, gauges, GD&T specifications, and surface characteristics for inspection and quality assessment of engineering components using metrology practices
- **CO-3.** Apply appropriate measuring instruments and techniques for evaluating dimensional, geometrical, mechanical, and thermal parameters of engineering components

4. Course Contents

Unit 1 (Introduction and Mechanical Measurements):

Need and Significance of Mechanical Measurements, Standards of Measurement, Generalized Measurement system, First order-Second Order systems.

Linear and angular measurements:

Length standard, line and end standard, Contact and non-contact type measuring techniques, linear measuring instruments-Vernier caliper, Micrometer, Vernier Height Gauge; Measurement of angles and tapers-Bevel protractor, Sine bar, Sine Centre, Slip gauges, Dial indicator; CMM and its

applications.
Measurement of component geometry using appropriate instruments.

Unit 2 (Sensors and Transducers):
Classification of transducers, Linear Variable Differential Transformer (LVDT), Elastic Transducers, Piezoelectric sensors, Piezo resistive s ensors, Thermoelectric sensors, Photodetectors, Strain measurement, Strain gauge, load cell, Force and torque measurement, Pressure measurement, Temperature measurement, Resistance Temperature Detectors (RTD), Thermocouple, Thermistors.
Calibration of Linear Variable Differential Transformer (LVDT)
Calibration of strain gauge, load cell and thermocouple.

Unit 3 (Limits, Fits and Gauges):
Engineering tolerance-Unilateral, Bilateral and Compound tolerance; System of limits and fits and their types; hole and shaft basis systems; interchangeability and selective assembly; Numerical.**:** Classification of gauges, Taylors principle, Maximum and Minimum Material conditions, Design of Go and No Go gauges, Numerical; Usage of gauges-Plug gauge, Ring gauge, Bore gauge, Thread plug gauge, Thread ring gauge, Feeler gauge, Screw pitch gauge, Snap gauge and Air gauge.

Unit 4 (GD & T):
GD & T symbols and their interpretations, feature control frames, datum systems, and various tolerances (form, orientation, location, and runout). It includes advanced topics like positional and composite tolerances, their applications in design, Applications of GD & T techniques for dimension control and case studies.

Unit 5 (Optical and Surface Roughness Measuring Instruments):
Tool maker's microscope, Profile projector, Autocollimator, Interferometry- optical flats, NPL interferometer Surface roughness measurement.
Roughness, Waviness, Numerical assessment of surface finish-CLA, R.M.S, Rz values, Methods of measurement of surface finish, ISI symbols, Measurement through comparators- Mechanical comparators
Measurement of component geometry using Tool maker's microscope and Profile projector
Assessment of surface roughness parameters using Surface Roughness Tester.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2	3				2								3
CO-3					2								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)	
Subcomponent ▶	SC1	SC2	SC3	SC4	SEE (Weightage: 25%)	SEE (Weightage: 15%)
Subcomponent Type ▶	Term Test – 1	Term Test – 2	Assignment	Laboratory	Written Exam	Lab Exam
Maximum Marks ▶	15	15	20	10	40	
CO-1	x	x			x	
CO-2			x		x	x
CO-3				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Thomas G. Beckwith, Roy and John H. Lienhard, (2020), Mechanical Measurements, Pearson Education, India
3. Jain R.K, (2024) Engineering Metrology, Khanna Publishers, India

b. Recommended Reading

1. Vinay A Kulkarni, Anand K Bewoor (2009) Metrology and Measurement, Tata

McGraw Hill Education India
2. N V Raghavendra, L Krishnamurthy (2013) Engineering Metrology and Measurements, Oxford University Press
3. Alan S. Morris (1997) The Essence of Measurement, Prentice Hall- Gale
4. Ernest Doebelin's (2007), Doebelin's Measurement Systems, Tata McGraw Hill Education.

c. Magazines and Journals

1. International Journal of Metrology and Quality Engineering, Published online by Cambridge University Press
2. Journal of Metrology and Measurement Systems, Published online by Polish academy of sciences, Division IV - Technical Sciences

d. Websites

1. http://www.tolcap.com/
2. http://www.callabmag.com
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC207A	
Course Title	Mechanical Measurements and Metrology	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Constitution, Human Rights and Professional Ethics

Course Title	Indian Constitution, Human Rights and Professional Ethics
Course Code	LAN201A
Course Type	Humanities and Social Sciences
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic types of laws. It gives a broad overview of the Constitution of India as the epitome of human rights protection. The rights and duties enshrined in our Constitution and constitutional remedies will be introduced. Students will also be introduced to environment protection law and intellectual property rights.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1: Demonstrate ethical reasoning in professional issues
CO2: Relate constitution and human rights to societal context
CO3: Examine environmental laws and justify sustainability
CO4: Classify IPR and interpret its role in innovation

4. Course Contents

Unit 1

Professional Ethics: meaning and importance of ethics; values, morals and ethical behaviour; professional responsibility and accountability; integrity, honesty and transparency; code of professional conduct; conflict of interest and confidentiality; workplace ethics and professional relationships; ethical decision-making; social and environmental responsibilities of professionals.

Unit 2

Constitution and Human rights – Preamble, Right to equality, Right to Freedom, Right against exploitation, Freedom of Religion, Cultural and Educational Rights, Right to Constitutional remedies, broad principles of Universal Declaration of Human Rights (UDHR) and its application in the Indian Constitution, fundamental duties.

Unit - 3

Environmental Law - salient features of Environment Protection Act, 1986, need for sustainable development and environmental impact

Unit 4

Intellectual Property Rights – Broad overview of IPR and the need for its protection - Patent, Copyright, Trademark, Designs, Semi-conductor and integrated chip and Geographic indications.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO-1**	**PSO-2**
CO1						2		3					
CO2						3		3					
CO3						3	3	2					
CO4						2		2			2		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**30**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CEor SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
Component 1: CE (100% Weightage)		
Subcomponent ▶	**SC1 (50%)**	**SC2 (50%)**
Subcomponent Type ▶	**Term Test**	**Assignment**
Maximum Marks ▶	**25**	**25**
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shallprovide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the followingteaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--

8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

- Constitution of India Bare Act
- P M Bakshi, Constitution of India, 19th Edition, 2023, Lexis Nexis
- Y. V. Rao Laymans Guide to Law Know Your Rights, 2018, Civil Law Books, Asia Law House,
- Avtar Singh Intellectual Property Law1st Edition, 2013, EBC

b. Recommended Reading

- Vijay Kumar SinghLearn the Law 1st Edition, 2022 Eastern Book Company
- Indu Bhan Legal Eagles: Stories of the Top Seven Indian Lawyers, 2015, Random House India
- M. Rama Jois Legal And Constitutional History Of India: Ancient Legal, Judicial And Constitutional System (reprint), 2022, Universal Lexis Nexis

c.Magazines and Journals

- The Journal of Legal Studies
- The Indian Journal of Law and Technology
- The National Law School of India Review
- Socio-Legal Review

d. Websites

- Manupatra
- SCC Online
- Law & Justice-National Portal of India

10. Course Organization

Course Code	LAN201B	
Course Title	Constitution, Human Rights and Professional Ethics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Mathematics-4 (ME)

Course Title	Mathematics-4 (ME)
Course Code	MED211A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces the concepts of ordinary differential equations, partial differential equations, line integral, double and triple integral, Greens theorem, Gauss divergence and Stokes theorem. The course encompasses the essentials of numerical solution of ordinary differential equations and partial differential equations. The applications of ordinary differential equations, partial differential equations to solve complex engineering problems and that of line integral, double and triple integral, Greens theorem, Gauss divergence and Stokes theorem in modeling real world problems are highlighted. The students will be able to implement numerical technique to solve a diverse range of applied mathematical problems using MATLAB.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of ordinary differential equations and partial differential equations to solve mathematical problems.
- **CO-2.** Evaluate and solve the mathematical problems of engineering applications associated with integrals, Green's theorem, Stokes' theorem and Gauss divergence theorem
- **CO-3.** Analyze and implement numerical methods to solve problems on ordinary and partial differential equations using standard algorithms in MATLAB.

4. Course Contents

Unit 1 (First Order Differential Equation):
Introductions to differential equations, linear and exact differential equations. Integrating factors. Applications of first order ordinary differential equations: Orthogonal trajectories, Falling body, Frictional forces.

Unit 2 **(Higher Order Differential Equation):**
Introduction, initial and boundary value problems. Linear homogenous/nonhomogeneous differential equations with constant coefficients, method of undetermined coefficients and variation of parameters. Application of second order linear differential equations with constant coefficients-mass-spring-dashpot system.

Unit 3 (Integral Calculus):
Line integral, Applications of line integrals, double integral and triple integral, Green's theorem, Stokes' theorem, Gauss divergence theorem. Computation of moment of inertia of objects by using double integrals and density of wire by using line integrals.

Unit 4 (Partial Differential Equations):
Introduction to partial differential equations, classification of first order partial differential equations. Solutions by Lagrange's method. Problems on structural mechanics.

Unit 5 (Numerical Methods for Ordinary Differential Equations: MATLAB-1): Types of errors, numerical solution of ordinary differential equations by single-step methods – Euler's method, modified Euler's method and Runge-Kutta 4^{th} order method. Milne's predictor corrector method. Solution of boundary value problem: Shooting method. Solution by MATLAB built-in function ode45. Solving vibrations and dynamics of mechanical system and heat transfer problems by using numerical methods**.**

Unit 6 (Numerical methods for partial differential equations: MATLAB-2): Finite differences, explicit methods for one dimensional heat and wave equations, stability conditions. Implicit method for one dimensional heat equation. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain. Solving heat transfer and heat transfer and transient heat conduction problems by using finite difference methods.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3	3											
CO-2	2	2											

CO-3	3	3			3								
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		10
1. Course Laboratory	00	
2. Computer Laboratory	10	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**60**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Lab	50 Marks
Maximum Marks ▶	25	25	30	20	
CO-1	×	×	×	×	×
CO-2		×	×	×	×
CO-3					×
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Dennis Zill and Warren Wright, 2011, Advanced Engineering Mathematics, 4th edition, Jones and Bartlet.
2. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition, Massachusetts, Brooks/Cole.
3. Grewal B S, 2021, Higher Engineering Mathematics, 44th edition, Khanna Publication.

b. Recommended Reading

1. Rao V. Dukkipati, 2011, Applied Numerical Methods using MATLAB, 1st edition, New Delhi, New Age.
2. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons Inc.

c. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

10. Course Organization

Course Code	MED211A	
Course Title	Mathematics-4 (ME)	
Course Leader/s Name	As per timetable	
Course Leader Contact Details	Phone:	080 4906 5555
	E-mail	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date:	June 2030	

Course Specifications: Machine Dynamics-1

Course Title	Machine Dynamics-1
Course Code	MEC212A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to prepare the students to perform kinematic analysis of planar mechanisms and use such mechanisms during design of different types of machinery. Students are taught kinematic analysis of mechanisms to accomplish desired motions of the machinery and their rigid body dynamic behavior during design. Students will be able to perform design/selection of different motion/power transmission mechanisms such as gears and cams. Students are exposed to software tools to solve kinematic analysis of mechanisms.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the basic concepts, principles of kinematics, kinematic construction and working of commonly used planar mechanisms
- **CO-2.** Solve problems on kinematic analysis of planar mechanisms, cam profile construction and gear drives
- **CO-3.** Develop simulation models of planar mechanisms and analyse position, velocity and acceleration using appropriate software tools

4. Course Contents

Unit 1 (Introduction):
Introduction to kinematics of motion, Types of Motion; Displacement; Velocity, Acceleration; Relation between Linear and Angular Motion, Mechanisms and Machines; Links, Kinematic pairs and Kinematic chains; Planar and Spatial Mechanisms; Degree of Freedom in Planar and Spatial Mechanisms; Kinematic Diagrams, Kutzbach and Gruibler's criterion; Grashof's criterion

Unit 2 (Mechanisms):
Four- bar chain and its inversions; Slider crank chain and its inversions; Double slider crank chain and its inversions; Quick return motion mechanisms; Straight line motion mechanisms;

Intermittent Motion mechanisms; Toggle mechanism; Ackerman steering gear mechanism

Unit 3 (Kinematic Analysis of Planar Mechanisms):
Position Analysis of Linkages -Graphical and Analytical Methods; Transmission Angles; Velocity analysis of mechanisms using graphical and analytical methods; Acceleration analysis of mechanisms using graphical and analytical methods; Coriolis component of Acceleration

Unit 4 (Cams):
Overview of Cams; Classification of followers; Classification of Cams; Cam nomenclature; Motion of the Follower; Displacement, Velocity and acceleration diagrams when the follower moves with Simple Harmonic Motion, Uniform acceleration and retardation, uniform velocity, cycloidal motion; construction of CAM profiles

Unit 5 (Gears and Gear Trains):
Law of gearing; Gear tooth nomenclature; Gear types; Simple gear trains; Compound gear trains; Epicyclic gear trains, reverted gear train; numericals

Unit 6 (Kinematic analysis using software):

Laboratory exercises to be performed as part of the course

- Modelling of four bar mechanism and six bar mechanism
- Position analysis of four bar mechanism
- Position analysis of slider crank mechanism
- Velocity analysis of four bar mechanism
- Velocity analysis of slider crank mechanism
- Velocity analysis of toggle mechanism
- Acceleration analysis of four bar mechanism
- Acceleration analysis of slider crank mechanism

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2		2											2
CO-3	3				3								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	

2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2		x	x		x	
CO-3			x	x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. S. S. Rattan, 2019, Theory of Machines, Tata McGraw-Hill Education

b. Recommended Reading

1. R. L. Norton, 2004, Design of Machinery, McGraw-Hill
2. Thomas Bevan, 1984, Theory of Machines, CBS Publishers and Distributors
3. Charles E. Wilson, J. Peter Sadler, 2003, Kinematics and Dynamics of Machinery, 3rd Edition, Prentice Hall
4. A. K. Mallik, A. Ghosh and G. Dittrich, 1994, Kinematic Analysis and Synthesis of Mechanisms, CRC press
5. A. G. Erdman and G. N. Sandor, 1988, Mechanisms Design, Analysis and Synthesis, Affiliated East West Press

c. Magazines and Journals

1. Journal of Mechanisms
2. Mechanism and Machine Theory
3. JSME International Journal - Series C: Mechanical Systems Machine Elements and Manufacturing

d. Websites

1. http://www.machinedesignonline.com
2. http://www.asminternational.org
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library
2. RUAS Laboratory Videos

10. Course Organization

Course Code	MEC212A		
Course Title	Machine Dynamics-1		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Fluid Mechanics and Machines

Course Title	Fluid Mechanics and Machines
Course Code	MEC213A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the principles of fluid mechanics and machines with their application which facilitates students to understand fluid properties and classify fluid flows. Basics of hydrostatics, kinematics and dynamics of fluid flow will be taught. Students are trained to use the principles of dimensional analysis to infer the non- dimensional parameters involved in a flow problem. Students will be able to solve practical fluid flow problems and apply laws of thermodynamics to evaluate fluid machine performance and select the right type of fluid machine for a given application.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the fundamental principles of fluid properties, fluid static and pressure measurement to interpret fluid dynamic conditions
- **CO-2.** Solve engineering flow problems and analyse fluid kinematics and dynamics using continuity equations, Euler's equations, Bernoulli's equations and dimensional analysis
- **CO-3.** Apply the principles of major and minor losses, friction factors and model testing to examine pipe flow systems through experimental and analytical approach
- **CO-4.** Conduct performance tests on hydraulic machines to analyse operating characteristic curves using velocity triangles, model testing concepts and Euler's turbine equation

4. Course Contents

Unit 1 (Different types of fluid Properties and Pressure Measurement):
Units and dimensions, Properties of fluids, Viscosity, No-slip condition, Newtonian and non-Newtonian fluids, Classification of fluids and flows: internal and external, steady and unsteady, uniform and non-uniform, incompressible and compressible, ideal and real, rotational and irrotational flow, laminar and turbulent flow, numerical problems.

Definition of pressure and pressure gradient, Pressure at a point, Pascal's law, hydrostatic pressure, absolute and gauge pressures, Measurement of pressure, simple and differential manometers, numerical problems.

Unit 2 (Hydrostatics and Kinematics of Fluid Flow):
Archimedes principle, buoyancy and stability, Concept of scalar and vector fields, Lagrangian and Eulerian descriptions of fluid flow, Definition of path line, streamline, streak line, stream tube, derivation of continuity equation, acceleration of field of fluid flow, definition of velocity potential, stream function, streamline, equipotential line, relation between velocity potential and stream function, Laplace equation; numerical problems.

Unit 3 (Dynamics of Fluid Flow and Dimensional Analysis):
Derivation of Euler's equation and Bernoulli's equation, assumptions and limitations, Application of Bernoulli's equation - Pitot tube, Venturimeter. Major and Minor losses in pipe derivation of Darcy-Weisbach equation, Chezy's equation, friction factor, Moody chart, numerical problems. Principle of dimensional homogeneity, Buckhingam's π - theorem, Non-dimensional parameters and their importance, Concept of model testing.

Unit 4 (Energy Transfer in Fluid Machines):
Comparison between fluid machines and positive displacement machines; Static and stagnation states; Application of first and second law of thermodynamics to fluid machines. Euler turbine equation; components of energy transfer, Velocity triangles; Principles of impulse and reaction machines; Degree of reaction; Utilization factor for different types of turbines; Relation between Degree of Reaction and Utilization factor; Conditions for maximum utilization factor.

Unit 5 (Hydraulic Machines):

Classification; Pelton, Francis, Propeller and Kaplan turbines; Hydraulic turbine power utilization; Velocity triangles and work done; Hydraulic, and volumetric efficiencies; Performance characteristics; Runaway speed; Penstock, tailstock, draft tubes; Water hammer and surge tank; Cavitation in hydraulic turbines.
Centrifugal pumps – Classification; Working principle; Advantages over positive displacement pumps; Definition of suction head, delivery head, manometric head, gross head, and static head; NPSH; Priming; Theoretical Head-Capacity relationship; Velocity triangles and work done; Power input and various efficiencies; Operating characteristics; Cavitation in hydraulic pumps; Submersible pumps.

Laboratory Experiments

SL No.	Name of Experiment
01	Determination of coefficient of discharge of orifice plate of various diameters
02	Determination of coefficient of discharge of Venturimeter
03	Determination of major losses in fluid flow through pipes
04	Determination of minor losses in fluid flow through pipe fittings and valves
05	Determination of coefficient of impact of jets on different shaped vanes
06	Determination of the performance of a Multi stage Centrifugal pump and plotting operating characteristic curves
07	Determination of the performance of Pelton wheel and plotting main and operating characteristic curves

08	Determination of the performance of Francis turbine and plotting main and operating characteristic curves
09	Determination of the performance of Kaplan turbine and plotting main and operating characteristic curves

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2												2
CO-2		3											3
CO-3	2				2								2
CO-4					2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2	x	x	x		x	
CO-3		x		x	x	x
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. R. K. Bansal, 2023, A Textbook of Fluid Mechanics and Hydraulic Machines, Lakshmi Publications
3. Y. A. Cengel and J. M. Cimbala, 2025, Fluid Mechanics: Fundamentals and Applications, McGraw Hill Education
4. S.M Yahya, 2010, Turbines, Compressors and Fans, 4th Edition, Tata McGraw Hill
5. Vedanth Kadambi and Manohar Prasad, 2011, An Introduction to Energy Conversion Volume III Turbomachinery, Second Edition, New Age International Publishers

b. Recommended Reading

1. F. M. White, 2008, Fluid Mechanics, 6th Edition, Tata McGraw-Hill
2. R. W. Fox, A. T. McDonald and P. J. Pritchard, 2013, Fluid Mechanics, 8th Edition, Wiley Publications
3. P. N. Modi and S. M. Seth, 2015, Hydraulics and Fluid Mechanics including Hydraulics Machines, Standard Book House
4. D. G. Shepherd, 1956, Principles of Turbomachinery, New York, MacMillan Company
5. S. L. Dixon, 1998, Fluid Mechanics and Thermodynamics of Turbo machinery,Reed Educational and Professional Publishing Ltd
6. G. Gopalkrishna and D. Privithiraj, 2002, A Treatise on Turbo machines, Scitech
7. H. I. H. Saravanamuttoo, H. Cohen and G. F. C. Rogers, 1996, Gas Turbine Theory, Longman Publications

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC213A	
Course Title	Fluid Mechanics and Machines	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Conventional Machining Processes

Course Title	Conventional Machining Processes
Course Code	MEC214A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with conventional machining processes. The student will be taught mechanics of metal cutting, cutting tools, cutting fluids and tool life. The students will be taught working principle, construction and operations of different types of machines, namely, turning, milling, shaping, grinding and drilling machines. Work holding devices, cutting tools and cutting fluids useful in performing machining operations will be explained. Student will be trained to select machining operations for achieving a given part feature.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the working principles, construction details, cutting tools, accessories and applications of conventional machining processes and machine tools
- **CO-2.** Determine the material removal rate, cutting forces, tool wear and tool life for machining processes
- **CO-3.** Select appropriate machine tools, cutting tools, cutting fluids and process parameters to achieve the required dimensions and surface finish based on part features
- **CO-4.** Demonstrate turning, milling and drilling operations using machine tools and associated software tools

4. Course Contents

Unit 1 (Overview and Principles of Metal Cutting):
Overview of material removal operations and machine tools. Chip formation, Cutting tool geometry, Metal cutting mechanics, Thermal aspects of metal cutting, Cutting force calculation, Tool dynamometer, Cutting tool materials, Cutting tool life and wear, Cutting fluids, Metal cutting economics

Unit 2 Machine Tools and Turning Machines):
Classification of machine tools, Methods of generating surfaces, Basic elements of machine tools Specifications of lathes, Lathe operations, Machining time and power estimation, Capstan and Turret lathe, Automatic lathes, Numerical problems on material removal rate, cutting forces, tool wear and tool life

Unit 3 (Reciprocating Machine and Milling Machines): Types of milling machines, Milling operations, Milling cutters, Dividing head, Milling fixtures, Machining time estimation, Numerical problems on indexing and gear ratio calculations, material removal rate, cutting forces, tool wear and tool life

Unit 4:
Grinding wheel, Grinding operations, Types of grinding machines, Honing, Lapping and super finishing

Unit 5:
CNC machine tools: Introduction to numerical control, computer numerical control, direct/distributed numerical control, classification of CNC machines, merits and demerits, features of CNC machine tools, manual part programming methods, and computer aided part programming.

Laboratory Exercise

1	Conduction of facing, plain turning, chamfering and step turning operations on component using lathe
2	Conduction of grooving, taper turning and thread cutting operations on component using lathe
3	Conduction of Knurling, Parting, Drilling, Boring, Tapping operations on component using lathe.
4	Conduction of Face milling, End/side milling and Step milling operations on component using vertical milling machine
5	Demonstration of CAPS Mill and Turn software, basic geometries & Simulation
6	Simulation and generation of NC part program for drilling operation
7	Simulation and generation of NC part program for milling operation
8	Simulation and generation of NC part program for plane turning operation
9	Simulation and generation of NC part program for step turning and operation

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2		2											2
CO-3				3									3
CO-4					2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2		x			x	
CO-3			x		x	

CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. P. N. Rao, 2026, Manufacturing Technology, Machine Tools and Machining Operations, Tata McGraw-Hill
3. Serope Kalpakjian and Steven R. Schmid, 2020, Manufacturing Engineering and Technology, Pearson Education

b. Recommended Reading

1. Amitabha Ghosh and Asok Kumar Mallik, 1994, Manufacturing Science, New Delhi, EWP.
2. Production Technology, 1997, HMT, TMH
3. E. Paul DeGarmo, 2005, Materials and Processes in Manufacturing
4. McMillan Publication, Eastern Economy Edition
5. E. M. Trent and P. K. Wright, 2000, Metal Cutting, Butterworth-Heinemann
6. M. C. Shaw, 2005, Metal Cutting- Principles and Practices, Cambridge University Press

c. Magazines and Journals

1. A Efficient Manufacturing, Industrial trade Magazine
2. EDM Today, America's EDM forum Magazine

3. American Machinist Magazine

d. Websites

1. http://americanmachinist.com
2. http://www.edmtodaymagazine.com/
3. http://www.sme.org/
4. http://www.aws.org/
5. https://www.coursera.org/
6. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC214A	
Course Title	Conventional Machining Processes	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Internship-1

Course Title	Internship-1
Course Code	MEI201A
Course Type	Skill Enhancement Course
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

Students are required to undergo an internship of 60 hours during the vacation following the completion of the 2nd Semester. The internship is carried out using the facilities available within the University and/or outside the University, under the guidance of a faculty mentor. It aims to reinforce classroom learning while fostering creativity, problem solving, teamwork and entrepreneurial thinking, thereby bridging the gap between academic knowledge and real-world applications.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	60
Number of Weeks in a Semester	15*
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

* For credit computation only; the 60 internship hours are completed during the vacation period

3. Addressed POs and Assessment

- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out through Technical Report Preparation and Documentation and Presentation and Communication Skills. Students are evaluated based on their ability to prepare professional technical reports, effectively present their internship work, communicate engineering concepts clearly, and participate in technical discussions and viva voce examinations.
- **Program Outcome 11 (Lifelong Learning)**
  The assessment of this Program Outcome is carried out through Initiative towards Learning New Concepts/Skills and Reflection on Learning and Professional Development. Students are evaluated based on their ability to undertake self-directed learning, acquire new technical competencies, reflect on their professional growth, and demonstrate commitment towards continuous learning and professional development.
- **Other Program Outcomes**
  In addition to the direct assessment of PO9 and PO11, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes addressed through the individual internship activities undertaken by each student. The mapping is carried out based on the nature of work performed, engineering tasks executed, tools employed, and learning experiences gained during the internship. This mapping is used solely for documenting Program Outcome attainment and is not considered for evaluation or allocation of marks in the internship course.

4. Evaluation Methodology

The internship carries a maximum of 50 marks and is assessed through the internship technical report, presentation and viva voce conducted by a panel of examiners at the beginning of the 3rd Semester. The evaluation criteria, marks distribution, performance-level descriptors and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section INTERNSHIP. The said document shall be read in conjunction with these Course Specifications and is available with the Department of Mechanical Engineering, ensuring outcome-based and transparent assessment of student performance.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: INTERNSHIP).

6. Course Organization

Course Code	MEI201A	
Course Title	Internship-1	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Essence of Indian Knowledge Systems

Course Title	Essence of Indian Knowledge Systems
Course Code	TSN201A
Course Type	Humanities and Social Sciences
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	1:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	DTSLD
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

CO1: To build in the learners' Ancient Indian culture, civilization, architecture, and assess their understanding and to identify the contributions of ancient Indian Mathematics, Metallurgy, and Astronomy.
CO2: Analyze key concepts and contributions of Indian Knowledge System and communicate their relevance through a presentation.

4. Course Contents

Introduction to IKS [Duration: 8 Lectures]

(Any eight of total sessions assigned for Literary activity)
Introductory lecture on the any eight topics below:
1. Indian Knowledge System
2. Indian Culture & Civilization
3. Ancient Indian Chemistry
4. Ancient Indian Metallurgy
5. Ancient Indian Mathematics
6. Ancient Indian Astronomy
7. Indian Astronomical Instruments
8. Indian Knowledge System (Upveda: Ayurveda)
9. Indian Knowledge System (Upveda: Gandharveda)
10. Indian Knowledge System (Vedangas: Shiksha, Kalpa, Vyakrana)
11. Indian Knowledge System (Vedangas: Jyotisha, Nirukta, Chandas)
12. Indian Architecture I: Sthapatya-Veda
13. Indian Architecture II: Temples
14. Indian Architecture III: Town & Planning

15. Indian Philosophical System

Module 2: Introduction to Creative Practices [Duration: 8 Lectures]

(Eight Lectures with at least Four different topics of total session under Creative activity)
Introductory lecture on the topics below:
1. Dhatuvada: art of metallurgy
2. Akarajnana: art of mineralogy
3. Vastuvidya: art of engineering
4. Yantramatrika: art of mechanics
5. Takshana: art of carpentry
6. Chalitakayoga: art of practicing as a builder of shrines
7. Raupyaratnapariksha: art of testing silver and jewels
8. Maniragajnana: art of tinging jewels
9. Sucivayakarma: art of needleworks and weaving
10. Vadyavidya: art of playing on musical instruments
11. Geetvidya : art of singing
12. Nrityavidya: art of dancing
13. Natyavidya: art of theatricals
14. Alekhyavidya: art of painting
15. Viseshakacchedyavidya: art of painting the face and body with color
16. Udakavadya: art of playing on music in water
17. Manasikavyakriya: art of composing verse
18. Bhushanayojana: art of applying or setting ornaments
19. Citrasakapupabhakshyavikarakriya: art of preparing varieties of delicious food
20. Dasanavasanangaraga: art of applying preparations for cleansing the teeth, cloths and painting the body
21. Utsadana: art of healing or cleaning a person with perfumes
22. Vastragopana: art of concealment of cloths
23. Balakakridanaka: art of using children's toys
24. Tandulakusumabalivikara: art of preparing offerings from rice and flowers
25. Pushpastarana: art of making a covering of flowers for a bed

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1									1				
CO-2									1				
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		12

Demonstrations		03
1.Demonstration usingVideos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		5
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**30**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type	**Terms Tests**	**Assignments**	
CO-1	**x**	**X**	**X**
CO-2	**x**	**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

A. Proposed CE evaluation: Weightage (60 %)

Two components

1. Term test (Weightage 30%): Frequency – 1. Marks – 25. Test can be conducted during term test 2 period. Types of question – MCQ 25 no's
2. Innovation assignment (Weightage 30%): Could be in form Descriptive and / or Quiz

B. Proposed SEE evaluation: Weightage (40 %)

1. SEE: Marks: 50, Types of questions – MCQ 50 nos.

Note: MCQ exams shall be conducted via ERP

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	--
4.	Analytical Skills	--
5.	Problem Solving Skills	--
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. **Essential Reading:**
   a. Class notes
2. **References:**

1. Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru

2. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of

Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust,

Bombay, 1995.

3. The Cultural Heritage of India. Vol.I. Kolkata:Ramakrishna Mission Publication, 1972.

4. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.

5. Dr. R. C. Majumdar, H. C. Raychaudhuri and KalikinkarDatta: An Advanced History of

India (Second Edition) published by Macmillan & Co., Limited, London, 1953.

6. Rao, N. 1970. The Four Values in Indian Philosophy and Culture. Mysore: University of Mysore.

7. Avari, B. 2016. India: The Ancient Past: A History of the Indian Subcontinent from c. 7000

3. **Magazines and Journals: https://thejournals.in/**
4. **Websites:** Indian Knowledge Syste... | College Hive
   Indian Knowledge Systems Short Notes: IKS Corpus Overview and Key Concepts - Studocu

10. Course Organization

Course Code	TSN201A	
Course Title	Essence of Indian Knowledge Systems	
Course Leader Name	As per Timetable	
Course Leader Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.ce.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

◀◆▶

Course Specifications: Entrepreneurship Mindset and Action

Course Title	Entrepreneurship Mindset and Action
Course Code	BAU201A
Course Type	Ability Enhancement Compulsory Courses
Department	Mechanical Engineering
Faculty	Faculty of Engineering Technology

1. Course Summary

The aim of course is to impart comprehensive knowledge of an innovative and entrepreneurial ecosystem. The students are encouraged to develop entrepreneurial spirit by imparting skills to start-up, grow and sustain an enterprise. This course emphasizes on igniting the innovation thought process, thereby leading to new business ventures. Students will be trained to prepare and pitch a business plan to investors using lean canvas model.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the concepts and process of entrepreneurship
CO-2. Distinguish laws and regulations pertaining to entrepreneurial venture
CO-3. Examine innovative ideas for the creation and management of entrepreneurship
CO-4. Analyze financial ecosystem for the start-ups
CO-5. Formulate a viable business plan to the investors appraisal

4. Course Contents

Unit 1 (Entrepreneur & Entrepreneurship): Meaning of Entrepreneur, Evolution of the concept, Functions of an Entrepreneur, Entrepreneurial process, Types of Entrepreneurships - Social entrepreneurship, Rural entrepreneurship, Key Elements in an Entrepreneur's Background, Key Entrepreneurial Feelings and Motivations - Role Models and Support Systems - MSME Policies. Make-In India, Start-Up India, Stand-Up India,

Unit 2 Laws and Regulations: Intellectual Property Rights of a New Venture, Process for Filing Patent, Trademark, Copyrights, Protection of Venture's Trade Secrets Through Licensing, Geographical Indicators, Design Act, internal Auditing Processes - Contracts, Insurance, and Product Safety and Liability

Unit 3 Innovation and Creativity: Types of Innovations. Identify Various Sources of Ideas for New Ventures - Methods Available for Generating New Venture Ideas - Creativity, Design Thinking and the Techniques for Creative Problem Solving. Aspects of the Product Planning and Development Process.

Unit 4 Creating and Managing New Venture: Creating Opportunities, Resources, Role of New Ventures and Small Businesses in the Economy, Types of Entry Strategies, Feasibility Analysis and Launching a New Venture. Generic Strategies, Strategies for Expansion, Joint Ventures, Acquisitions, Mergers, Franchising,

Unit 5 Raising Capital and financial ecosystem for the Start-up Ventures: Financial Need, New Venture Financials and Business Valuation, Sources of Funds for Enterprises, Financial Aspect of Business Plan - Preparation for Generating Funds. Bootstrapping, Banks, Angel finance, Venture Capitalist, Private Equity, Crowd Funding, Online platforms and Informal Risk Capital.

Unit 6 The Business plan: Business Plan, Scope and Value of the Business Plan to Investors, Lenders, Employees, Suppliers, and Customers, Critical Section of the Business Plan, Step-By-Step Explanation of the Business Plan, Monitor the Business Plan, Monitor the Business Plan, Marketing Plan, Organizational Plan, Financial Plan. Preparation of lean canvas Model, Project Report Preparation, Preparation and Pitching Business plan to investors.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2													
CO-3										2			
CO-4										3			
CO-5										2			
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		

1. Course Laboratory	00	00
2. Computer Laboratory	00	
3. Entrepreneurial Workshops	00	
Others		10
1. Case Study Presentation	00	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	03	
5. Group Discussions	02	
6. Discussing Possible Innovations	03	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to M.B.A Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1 and SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: Individual Assignment (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	
Subcomponent Type ▶	**Group Assignment**	**Presentation**	**50 Marks**
Maximum Marks ▶	**25**	**25**	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4		X	X
CO-5		X	X
The details of SC1 and SC2 are presented in the Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment as per the above template at the beginning of the Semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How Imparted During the Course
1.	Knowledge	Class room lectures, Brainstorming Sessions
2.	Understanding	Class room lectures

3.	Critical Skills	Assignment, Brainstorming Sessions
4.	Analytical Skills	Class room, assignment, examination
5.	Problem Solving Skills	Assignment, examination
6.	Practical Skills	Assignment
7.	Group Work	Case study Presentation
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Case study and group discussions
11.	Presentation Skills	Case study and group discussions
12.	Behavioral Skills	Group discussions
13.	Information Management	Assignment
14.	Personal Management	Assignment and Group Discussion
15.	Leadership Skills	Group discussions and Case study

9. Course Resources

k. Essential Reading

1. Course Notes
2. Hisrich, R., Peters, M. and Shepherd, D., 2020. *Entrepreneurship*. 11th ed. McGraw Hill**.**
3. Innovation textbooks and Venture Capital reference material

l. Recommended Reading

1. Charantimath, P., 2018. *Entrepreneurship development and small business enterprises*. 3rd ed. Belgaum, India: Pearson Education.
2. Roy, R., 2020. *Entrepreneurship*. 3rd ed. Noida: Oxford University Press.
3. Innovation textbooks and venture capital

m. Magazines and Journals

1. Business World: ABP Group - Fortnightly business magazine
2. Business Today
3. Business World
4. Journal of Small Business Management, Blackwell publishing- yearly
5. Business Strategy: PwC Strategy & Inc. - Quarterly issue
6. International Journal of Entrepreneurship – Sage Publications
7. The International Journal of Entrepreneurship and Innovation - Sage Publications
8. International Journal of Entrepreneurship and Small Business - Inderscience Enterprises Ltd.

n. Websites

1. India, S., 2022. *Homepage*. [online] Start-up India. Available at: <https://www.startupindia.gov.in/> [Accessed 10 July 2022].
2. Allsharktank, Products., 2022. *Homepage*. [online] All Shark Tank Products. Available at: <https://www.allsharktankproducts.com/> [Accessed 10 July 2022].
3. India, M., 2022. *Make In India*. [online] Makeinindia.com. Available at: <https://www.makeinindia.com/> [Accessed 10 July 2022].
4. Funds seeking and crowd sourcing websites

o. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

10. Course Organization

Course Code	BAU201A	
Course Title	Entrepreneurship Mindset and action	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	080 4906 5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Universal Human Values- 2

Course Title	Universal Human Values- 2
Course Code	TSU201A
Course Type	Humanity and Social Sciences
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, workplace and society, the comprehensive human goal in the society, the mutual fulfillment in the nature and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Evaluate the significance of value inputs in formal education and start applying them in their life and profession
- **CO-2.** Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
- **CO-3.** Analyze the value of harmonious relationship based on trust and respect in their life and profession
- **CO-4.** Understand the role of a human being in ensuring harmony in society and nature.
- **CO-5.** Identify ethical conduct to formulate the strategy for ethical life and profession

4. Course Contents

Unit 1 (Introduction-Basic Human Aspiration, its fulfillment through All- encompassing Resolution):

The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.

Unit 2 (Right Understanding (Knowing) - Knower, Known & the Process):
The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence 3 its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

Unit 3 (Understanding Human Being):
Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self.

Unit 4 (Understanding Nature and Existence):
A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self- awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

Unit 5 (Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living):
Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence.

5. Course Map (CO-PO-PSO)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1											2		
CO-2							2						
CO-3							2						
CO-4						2							
CO-5							2						
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00

1. Solving Numerical Problems	00	
Practical Work		05
1. Course Laboratory	05	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	03	
2. Guest Lecture	03	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	03	
5. Group Discussions	04	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**45**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	
Subcomponent ▶	**SC1**	**SC2**
Subcomponent Type ▶	**Practical / In Class Assessment**	**Presentation**
Maximum Marks ▶	**25**	**25**
CO-1	**×**	**×**
CO-2	**X**	**X**
CO-3	**X**	**X**
CO-4	**X**	**X**
CO-5	**X**	**X**
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi

b. Recommended Reading

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth 3 Club of Rome9s report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008

c. Magazines and Journals

d. Websites

1. https://uhv.org/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	TSU201A		
Course Title	Universal Human Values - II		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Control Systems and Engineering

Course Title	Control Systems and Engineering
Course Code	ROC301A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the modeling and analysis of linear control systems. This course aims to impart concepts of mathematical modelling, time response analysis, frequency response analysis and stability theory. Students will be able to model, apply control system techniques for any given application and analyze the response for suitability of design using standard software.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Apply the fundamental concepts, terminologies, and mathematical modelling techniques of control systems to develop transfer functions for mechanical and other engineering systems

CO-2. Analyse the time response, frequency response, and stability characteristics of control systems to evaluate their dynamic behaviour and performance against design specifications

CO-3. Design linear controllers for a given system, simulate and analyse the closed-loop response using standard software tools to assess the suitability of the design

4. Course Contents

Unit 1 (Concepts of Control Systems):

Introduction to control systems, Open loop and closed loop systems, Examples, Effects of feedback, Classification, Applications.

Unit 2 (Mathematical Model of Physical Systems):

Linear differential equations, Order and degree of a system, Overview of Laplace transforms, Transfer functions of various physical systems, Analogous systems, Block diagram and signal flow graph analysis. Simulation of mathematical models using transfer function, block diagram reduction.

Unit 3 (Time Response Analysis):
Standard input signals: Step, ramp, parabolic and impulse, analysis of first order system, second order systems and time domain specifications. Simulation of first order and second order systems and perform time response analysis.

Unit 4 (Controller Design):
Proportional, Integral, Derivative, Proportional integral, Proportional integral derivative controllers, Transfer function, Applications. Simulation of conventional control techniques.

Unit 5 (Stability Analysis):
Characteristic equation, Necessary and sufficient conditions, Routh – Hurwitz criteria of stability. Root locus plots.

Unit 6 (Frequency Response Analysis):
Introduction to Bode plots, sketching individual Bode components, Bode plots of complex transfer functions, Gain margin, Phase margin, Stability analysis.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		3											3
CO-2			2										2
CO-3					3								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2		x	x		x	
CO-3			x	x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory

7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Norman Nise, (2024) Control System Engineering, John Wiley & Sons.

b. Recommended Reading

1. C. Dorf Richard and R. H. Bishop (2008), Modern Control Systems, Pearson Education
2. Katsuhiko Ogata (2010), Modern Control Engineering, Prentice Hall

c. Magazines and Journals

1. IEEE Control Systems Magazine
2. IEEE Transactions on Automatic Control
3. IEEE Transactions on Control Systems Technology
4. IEEE Control Systems

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	ROC301A		
Course Title	Control Systems and Engineering		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Thermal Engineering

Course Title	Thermal Engineering
Course Code	MEC302A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with gas and vapor power cycles, air compressors, refrigeration, and air conditioning systems. Students are taught the application of gas power cycles (Otto, Diesel, and Brayton), vapor power cycle (Rankine cycle). Students will be able to estimate the performance parameters like power, efficiency for reciprocating compressors, steam power plants, refrigeration, and air conditioning system. Different types of fuels, air- fuel ratio, rich and lean combustion, flame temperature, heats of formation and reaction for various fuels will be discussed. Students will be able to perform numerical calculations to obtain engineering parameters and the overall performance of vapor power cycles, refrigeration, and air- conditioning systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Interpret the properties of fuels, combustion processes and the working principles of air standard cycles, vapor power cycles and reciprocating compressors to classify them based on their thermodynamic characteristics
- **CO-2.** Solve numerical problems on fuels, combustion and thermodynamic cycles by analyzing thermodynamic properties, heat and work interactions and performance parameters of steam turbines, IC engines and reciprocating compressors
- **CO-3.** Evaluate the performance of thermodynamic systems by comparing actual cycles with ideal air standard and vapor power cycles
- **CO-4.** Select and justify appropriate thermodynamic cycles and systems for practical engineering applications based on performance criteria

4. Course Contents

Unit 1 (Gas power cycles):
Review of thermodynamic relations, properties and Ideal gas mixtures; Air standard cycle parameters; Air standard cycles: Carnot, Otto, Diesel, Dual Combustion, Stirling and Brayton cycles;

Comparison of Otto, Diesel and Dual cycles; Fuel- air cycles; p-v and T-s diagrams, efficiencies and mean effective pressures, Chemical equilibrium loss; Comparison between air standard and fuel-air cycles; Thermal efficiency and fuel consumption; Comparison between air standard, fuel-air and real cycles for SI and CI engines; Difference between fuel-air and real cycles.

Experiential Learning:

1. Determination of performance of Multi cylinder Petrol IC engine using Morse test
2. Determination of performance of 4 stroke diesel engine
3. Construction of valve timing diagram of a 4 stroke petrol engine

Unit 2 (Fuels and combustion):
Fuels for IC engines; Fuel properties; Air fuel ratio; Excess Air; Volumetric and Gravimetric analysis of exhaust gases; Measurement of exhaust gas composition; Laminar and Turbulent flames, flame speed, Adiabatic flame temperature.

Experiential Learning:

1. Determination of flash and fire point of liquid fuel using Abel's and Cleveland's apparatus
2. Determination of viscosity of lubricating oils using Redwood and Saybolt viscometers
3. Determination of calorific value of gaseous fuel using Boy's gas calorimeter

Unit 3 (Air Compressors):
Operation of a single stage reciprocating compressor, work input through p-v diagram; Effect of clearance and volumetric efficiency; Adiabatic, isothermal and mechanical efficiencies; Need of multistage compressor; Constructional details of multistage compressors, saving in work, optimum intermediate pressure, inter- and after cooling, minimum work for compression; Theoretical and actual indicator diagram for multistage compressors, Capacity control of compressors.

Experiential Learning:

1. Determination of performance of a two stage reciprocating compressor

Unit 4 (Vapor Power Cycles):
Carnot cycle; Rankine cycle and its performance; T- s diagram; Comparison of Carnot and Rankine cycles; Effects of pressure and temperature on Rankine cycle performance; Actual vapour power cycles; Ideal and practical regenerative Rankine cycle; Open and closed feed water heaters; Reheat Rankine cycle and Multistage regenerative cycles; Organic Rankine cycles.

Types of steam turbines; Compounding of steam turbines; Power efficiency and other related calculations for impulse and reaction turbines using velocity triangles; Reaction turbines and Degree of reactions; Parson's turbines; Internal losses in steam turbines; Reheat Factor; Governing of Steam Turbines and graphical method of solution for numerical problems on steam turbines.

Experiential Learning:

1. Determination of Boiler Efficiency of packaged boiler using indirect method
2. Determination of Dryness Fraction of Steam using separating and throttling calorimeter
3. Determination of Steam turbine efficiency of a two stage steam turbine

Unit 5 (Refrigeration): Analysis of vapour compression and absorption refrigeration system; Refrigerating effect, capacity and power required; Units of refrigeration; COP; Actual vapour compression cycle; Second law analysis of vapour Compression Cycle; Refrigerants and their desirable properties; Selection of refrigerants; Requirements of refrigerants; Effects of lubricants in refrigerants; Air cycle refrigeration; Reversed Carnot cycle; reversed Brayton cycle; steam jet

refrigeration

Vapour compression refrigeration system: Analysis of vapour compression and absorption refrigeration system; Refrigerating effect, capacity and power required; Units of refrigeration; COP; Actual vapour compression cycle; Second law analysis of vapour Compression Cycle; Refrigerants and their desirable properties; Selection of refrigerants; Requirements of refrigerants; Effects of lubricants in refrigerants; Air cycle refrigeration; Reversed Carnot cycle; reversed Brayton cycle; steam jet refrigeration.

Unit 6 (Psychrometry and Air conditioning):
Atmospheric air and psychometric properties; Dry bulb temperature; Wet bulb temperature; Dew point temperature; Partial pressures, specific and relative humidities and the relation between the two enthalpy and adiabatic saturation temperature; Construction and use of psychometric chart; Analysis of various processes- heating, cooling, dehumidifying and humidifying; Adiabatic mixing of moist air; Summer and winter air-conditioning; Load calculation; Layout and design principles of air conditioning system.

Experiential Learning:
1. Determination of heating capacity in Sensible heating mode in an air conditioning system
2. Determination of cooling capacity in Sensible cooling mode in an air conditioning system

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	2											2	
CO-2		3										3	
CO-3					2							3	
CO-4		3			2							3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2	x	x			x	
CO-3			x		x	
CO-4			x	x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. V. Ganesan (2012), I.C. Engines, 4th Edition, McGraw Hill
3. Mahesh M Rathore, (2021), Thermal Engineering, Tata McGraw Hill

b. Recommended Reading

1. Y.A. Cengel and Boles, 2011, Thermodynamics An Engineering Approach (SI Units), Tata McGraw-Hill Education Pvt. Ltd
2. H. N. Shapiro and Moran, 2010, Fundamentals of Engineering Thermodynamics, Wiley Publication
3. M. L. Mathur and Sharma, 1996, Internal Combustion Engine, Dhanpat Rai Publication

c. Magazines and Journals

1. SAE International Journal of Fuels and Lubricants
2. SAE International Journal of Engines
3. Combustion and Flame
4. The Journal of Chemical Thermodynamics
5. Journal of Thermodynamics, Hindawi Publishing Corporation

d. Websites

1. www.learnengineering.org
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC302A		
Course Title	Thermal Engineering		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Design of Machine Elements - 1

Course Title	Design of Machine Elements - 1
Course Code	MEC303A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at preparing the students to carry out design of common machine elements used in different machinery. Students will acquire the knowledge on stress analysis of different machine components subjected to different types of loadings to predict state of stress at critical locations. Students will be taught to design machine components based on predicted stress state and appropriate failure theories. Students will be able to analyse and design machine components like shafts, power screws, couplings and mechanical joints like fastener joints, riveted and welded joints.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the basic concepts, principles of machine component design and identify loading conditions to predict the state of stress at critical locations

CO-2. Determine design stress based on appropriate failure theories, select suitable materials and design machine elements such as shafts, keys, couplings, power screws, riveted and welded joints

CO-3. Evaluate the design of machine elements by comparing induced stress values against design stress limits through iterative calculations

4. Course Contents

Unit 1 (Introduction and Load Analysis):

General considerations, factors affecting machine design, procedure of machine design; Material properties and selection.

Types of loads - static-axial, bending, torsion, dynamic, Impact Loading and cyclic loadings

Unit 2 (Stress, Strain, Deflection and Stress Concentration):

Stress analysis, Simple stress, combined stresses, Principal stress, Maximum shear stress, uniaxial, biaxial and triaxial states of stress; Examples involving different types of machinery components; Stress concentration under static loading, determination of stress concentration

factors, designing to avoid stress concentrations; Examples involving different types of machinery components.

Unit 3 (Static Failure Theories and Design of Curved Beams):
Need of failure theories, Maximum shear stress theory, Distortion energy theory, Maximum principal stress theory, Mohr's theory, design of simple machine elements using failure theories Analysis of Curved Beams, Stresses in curved beams of standard cross sections used in crane hook, punching presses and clamps.

Unit 4 (Design of Shafts, Keys and Coupling): Types of shafts, shaft design on strength and torsional rigidity basis, ASME Code, design of hollow shafts; types of keys, design of flat and square key, design of splines; types of couplings, design procedure for couplings, design of rigid flange coupling and flexible coupling.

Unit 5 (Design of Power Screws and Threaded Fasteners): Types of screws, Terminology of power screws, self-locking screw, torque requirement-lifting load and lowering load, design of screw and nut, threaded joints, types of screw fastening, terminology of screw threads, ISO Metric screw threads, torque requirement of bolt tightening, design of turnbuckle, elastic analysis of bolted joints.

Unit 6 (Design of Welded and Riveted Joints): Design of welded joints- welding processes, butt joints, fillet joints, strength of butt welds, parallel fillet welds, transvers fillet welds, welded joints, welded joint subjected to bending moment and torsional moment.
Strength of riveted joints, failure mechanisms in riveted joints, efficiency of riveted joints and design of riveted joints, longitudinal butt joint for boiler shell, circumferential lap joint for boiler shells.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2		3											3
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		

1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x				x
CO-2	x	x		x	x
CO-3			x	x	x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Bhandari, V. B. (2020) Design of Machine Elements, 5th ed, McGraw-Hill
3. Budynas, R. G., Nisbett, J. K., Tangchaichit, K. (2026) Shigley's Mechanical Engineering Design, 12th Edition, McGraw-Hill
4. Mahadevan, K., Balaveera Reddy, K. (2025) Design Data Handbook for Mechanical Engineers, 4th Edition, CBS Publishers & Distributors

b. Recommended Reading

1. Lingaiah, K. (2017) Machine Design Handbook, 2nd ed, McGraw-Hill
2. Juvinall, R. C., Marshek, K. M. (2016) Machine Component Design, 5th ed, John Wiley & Sons Inc (Sea) Pte Ltd
3. Norton, R. L. (2018) Machine Design, 5th ed, Pearson Education
4. Mott, R. L. (2020) Machine Elements in Mechanical Design, 4th ed, Pearson Education
5. Klebanov, B. M., Barlam, D. M., Nystrom, F. E. (2007) Machine Elements: Life and Design, Boca Raton, CRC Press

c. Magazines and Journals

1. Journal of Advanced Mechanical Design, Systems, and Manufacturing
2. Journal of Machine Design

d. Websites

1. http://www.machinedesignonline.com
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC303A		
Course Title	Design of Machine Elements-1		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Machine Dynamics-2

Course Title	Machine Dynamics-2
Course Code	MEC304A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to prepare the students to understand and apply concepts of machine dynamics and dynamic effects and provide practical knowledge to the students for the design of machines based on dynamic analysis. Students are taught force analysis of mechanisms, effect of unbalanced masses in rotating and reciprocating machinery and methods of balancing. Vibration theory, applications, and benefits of vibration analysis in machinery design will be explained. Students will be able to calculate inertia forces at various joints, balancing force, gyroscopic forces and vibration parameters using graphical and analytical methods. Experiments related to dynamic study using balancing apparatus, cam apparatus and universal vibration apparatus will be carried out. In addition, simulation of mechanisms and evaluation of forces and torque at joints will be taught using appropriate software.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the basic concepts and principles of dynamics of machines and mechanical vibrations for simple mechanical systems
CO-2. Determine static and dynamic forces in planar mechanisms for mechanical systems
CO-3. Solve problems on inertia forces, balancing forces, gyroscopic forces and vibration parameters of mechanical systems
CO-4. Develop simulation models of spring-mass systems and planar mechanisms using appropriate tools and analyse the damping effects and inertia forces through experiments on vibration, gyroscope and balancing of rotating masses

4. Course Contents

Unit 1 (Introduction to Dynamics of Machinery):
Review of fundamentals of dynamics, basic principles of force analysis, D'Alembert's principle and inertia forces.

Unit 2 (Force Analysis of Machinery):
Static forces in machines, force acting on links, Static force analysis of planar mechanisms, graphical force analysis, friction in mechanisms, Inertia forces in machines, dynamic force analysis of mechanisms, Flywheels.

Unit 3 (Balancing of Rotating Masses):
Dynamics of Rotating Bodies; Effects of unbalance, balancing of inertia forces for masses revolving in single and multiple planes; Introduction to Balancing Machines.

Unit 4 (Gyroscope):
Concept of gyroscopic action, gyroscopic effect in ships, airplanes, two-wheeler and four wheeler vehicles, gyroscopic stabilization.

Unit 5 (Vibrations in Mechanical Systems):
Basic concepts and principles of mechanical vibration, Basic components of a vibratory systems, Analysis of Single degree of freedom system under free vibration, damped vibration and Forced vibration condition, modeling of mechanical systems as equivalent vibratory systems; Critical speeds of shafts; vibration control techniques.

Unit 6 (Experiment and Dynamic Analysis using Software)

Experiment:
Conduct test to determine spring stiffness and natural frequency for different springs-mass systems and discuss results
Conduct experiment to study torsional vibration of a single rotor system
Conduct experiment to study damped vibration in a single degree freedom system
Conduct experiment to achieve static balancing of rotating masses
Conduct experiment to determine reactive gyroscopic couple for a given rotating disc

Simulation:
Perform dynamic analysis on slider crank mechanism to determine inertia forces of links
Perform dynamic analysis on four bar mechanism to determine inertia forces of links
Perform dynamic analysis on quick return mechanism to determine inertia forces of links
Perform dynamic analysis on single degree spring mass system to determine damping response and natural frequency of the system

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2		3											3
CO-3		3											2
CO-4					3								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2	x	x			x	

CO-3			x		x	
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. SS Rathan, (2019), Theory of Machines, McGraw-Hill Education
3. Singiresu S. Rao, (2021), Mechanical Vibrations, Pearson

b. Recommended Reading

1. J. J. Uicker, G. R. Pennock and J. E. Shigley, 2003, Theory of Mechanisms and Machines, Oxford University Press
2. Charles E. Wilson J. Peter Sadler, 2003, Kinematics and Dynamics of Machinery, Prentice Hall
3. S Graham Kelley, (2012), Mechanical Vibrations: Theory and Application SI, Global Engineering
4. J. S. Rao and K. Gupta, 1999, Introductory Course on Theory and Practice of Mechanical Vibrations, New Age International

c. Magazines and Journals

1. Mechanism and Machine Theory
2. Journal of Vibration and Control, Sage Publications
3. Machine Vibration

d. Websites

1. http://www.machinedesignonline.com
1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC304A	
Course Title	Machine Dynamics-2	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Additive Manufacturing

Course Title	Additive Manufacturing
Course Code	MEC305A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course introduces the fundamental concepts and technologies of Additive Manufacturing (AM) used in modern engineering design and manufacturing. It covers the principles, classifications, materials, and process chains involved in additive manufacturing. The course provides an understanding of major AM technologies including liquid-based, solid-based, and powder-based systems such as stereolithography, fused deposition modeling, and powder bed fusion processes. Emphasis is given to Design for Additive Manufacturing (DfAM), process selection, and optimization of part design for improved performance and manufacturability. The course also explores industrial applications of additive manufacturing in aerospace, automotive, biomedical, and consumer product sectors. Laboratory sessions provide practical experience in 3D CAD modeling, STL generation, slicing, 3D printing, post-processing, and reverse engineering using 3D scanning techniques. Overall, the course equips students with the knowledge and skills required to apply additive manufacturing technologies in modern product development and advanced manufacturing environments.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss various additive manufacturing processes, materials and process parameters to interpret their impact on product quality and performance
CO-2. Evaluate and select appropriate additive manufacturing techniques for specific engineering applications based on design requirements, cost and functional constraints
CO-3. Develop DfAM principles for the reverse engineered components to enhance manufacturability, efficiency, sustainability and fabricate using 3D printing systems

4. Course Contents

Unit 1 (Introduction to Additive Manufacturing):
Additive manufacturing overview, importance in modern product development, historical

development of AM technologies, comparison between additive manufacturing and CNC machining. Classification of additive manufacturing processes, advantages and limitations. Materials and energy sources used in AM. Additive manufacturing process chain including CAD modeling, STL file generation, part orientation, support generation, slicing, and tool path generation. Guidelines for AM process selection and production planning.

Unit 2 (Liquid Based Additive Manufacturing Systems):
Stereolithography Apparatus (SLA): working principle, process parameters, photopolymer materials, photo-polymerization mechanism, layering technology, laser scanning, surface finish and process capabilities. Digital Light Processing (DLP) and PolyJet printing: process principles, advantages, limitations, and applications. Introduction to microfabrication in additive manufacturing.

Unit 3 (Solid Based Additive Manufacturing Systems):
Solid Ground Curing (SGC): working principle, materials, process parameters, advantages and limitations. Fused Deposition Modeling (FDM): working principle, process parameters, materials, applications. Laminated Object Manufacturing (LOM): process mechanism and materials. Multi-Jet Modeling (MJM): process characteristics and industrial uses. Introduction to metal deposition processes including Direct Metal Deposition (DMD), Electron Beam Based Deposition, and Directed Energy Deposition (DED).

Unit 4 (Powder Based Additive Manufacturing Systems):
Three Dimensional Printing (3DP): working principle, process characteristics, materials and applications. Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM): process mechanisms, advantages and limitations. Challenges in additive manufacturing including errors in prototyping, support removal methods, curing procedures, accuracy improvement, surface finishing techniques, machining strategies, and property enhancement techniques.

Unit 5 (Design for Additive Manufacturing):
Concept of Design for Additive Manufacturing (DfAM), design freedom in AM technologies, DFMA concepts, design tools for AM. Part orientation, support structure design, hollow structures, manufacturing constraints, interlocking features, and reduction of part count in assemblies. Identification markings and component integration strategies. Industrial applications in aerospace, automotive, biomedical implants, prosthetics, and consumer products.

Unit 6 (Laboratory and Reverse Engineering (Case Studies)):
Creation of 3D CAD models using CAD software. Generation of STL files and model preparation for printing. Simulation of FDM process parameters using slicing software. Fabrication of parts using 3D printing systems and post-processing techniques. Reverse engineering using 3D scanning and point cloud data processing with Scan software. Conversion of scanned data to CAD models and STL files followed by additive manufacturing. Case studies from automotive, aerospace, energy, medical, dental, and consumer product industries.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2			3										3
CO-3				3	2								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				Component 2: SEE (40% Weightage)	
Subcomponent ▶	SC1	SC2	SC3	SC4	SEE (Weightage: 25%)	SEE (Weightage: 15%)
Subcomponent Type ▶	Term Test – 1	Term Test – 2	Assignment	Laboratory	Written Exam	Lab Exam
Maximum Marks ▶	15	15	20	10	40	
CO-1	x				x	
CO-2	x	x	x		x	
CO-3			x	x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes
2. Additive Manufacturing Technologies – Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, 3rd Edition, Springer, 2021

3. Additive Manufacturing Technologies – S. Shiva and Anuj K. Shukla, Wiley India, 2024.

b. Recommended Reading

1. Additive Manufacturing Fundamentals and Advancements – Manu Srivastava, Sandeep Rathee, Sachin Maheshwari, T.K. Kundra, CRC Press, 2020.
2. Additive Manufacturing Advanced Materials and Design Techniques – Pulak Mohan Pandey, Nishant Kumar Singh, Yashvir Singh, CRC Press, 2023
3. Additive Manufacturing for Advance Applications: Technologies, Challenges and Case Studies – Pawan Sharma and Vishvesh Badheka, CRC Press, 2024.
4. 3D Printing Technologies: Digital Manufacturing, Artificial Intelligence, Industry 4.0 – Ajay Kumar, Parveen Kumar, Naveen Sharma, De Gruyter, 2024.

c. Magazines and Journals

1. Additive Manufacturing
2. Progress in Additive Manufacturing
3. 3D Printing and Additive Manufacturing
4. Rapid Prototyping Journal

d. Websites

1. https://www.sciencedirect.com/journal/additive-manufacturing
2. https://link.springer.com/journal/40964
3. https://www.liebertpub.com/loi/3dp
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. 3D Printing Industry Magazine
2. Additive Manufacturing Media
3. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC305A	
Course Title	Additive Manufacturing	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: AI for Mechanical Engineers

Course Title	AI for Mechanical Engineers
Course Code	MEC306A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course aims to provide principles of artificial intelligence, intelligent agents in mechanical engineering applications. It covers the concepts of sensing, machine learning, decision making, planning of artificial intelligence in robot operations. Applications of artificial intelligence in searching, goal seeking, computer perception for industrial automation are taught. Case studies covers real life applications of artificial intelligence in various domains including defense and space exploration.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the principles of intelligent agents, knowledge representation, reasoning, planning and uncertain knowledge and apply search techniques including problem solving, adversarial search and constraint satisfaction problems

CO-2. Analyse learning techniques from examples, probabilistic models and reinforcement learning and illustrate the principles of robotics including communication, perception and action

CO-3. Evaluate the principles of localisation, tracking and control by interpreting their applications in robotics, self-driving cars and aviation

4. Course Contents

Unit 1 (Introduction to Artificial Intelligence):

Overview of the role of Artificial Intelligence in mechanical engineering, Self-driving cars and Aviation; Intelligent agents, Agents and environments and the structure of agents.

Unit 2 (Problem Solving):

Solving problems by searching, local search algorithms and optimization problems, searching with partial observations, Adversarial search, Constraint Satisfaction Problems.

Unit 3 (Knowledge, Reasoning and Planning):
Logical agents, Classical planning, Algorithms for planning as state-space search, Planning graphs, Planning and acting in the real-world, Knowledge representation, Uncertain knowledge and reasoning, Quantifying uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over time, Making simple decisions and Making complex decisions.

Unit 4 (Machine Learning):
Learning from examples: Forms of learning, Supervised learning, Decision trees, Artificial Neural Networks, Support Vector Machines, Ensemble learning; Knowledge in learning: Explanation-Based learning; Learning probabilistic models, elements of Reinforcement learning.

Unit 5 (Communication, Perceiving and Acting):
Perception; Industrial Robotics: Robot actuation, Robot Perception, Planning Movements, Robotic Software Architecture.

Unit 6 (Case Studies):
Localization, tracking and control with a focus on examples from Industrial robots, Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2												
CO-2		2											3
CO-3			2										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	15	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	**X**				**X**
CO-2		**X**	**X**	**X**	**X**
CO-3			**X**	**X**	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Arkapravo Bhaumik, (2018), From AI to Robotics, CRC press, Taylor and Francis
3. Francis X. Grovers, (2018), Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques, Packt Publishing

b. Recommended Reading

1. Huimin Lu, Artificial Intelligence and Robotics, Springer

c. Magazines and Journals

1. https://spectrum.ieee.org/topic/robotics/
2. https://aimagazine.com/
3. https://www.servomagazine.com/magazine

d. Websites

1. https://www.intel.com/content/www/us/en/robotics/artificial-intelligence-robotics.html
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC306A	
Course Title	AI for Mechanical Engineers	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Yoga for Health and Wellness

Course Title	Yoga for Health and Wellness
Course Code	BNE101A
Course Type	Health and Wellness
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This elective course on yoga is designed to encourage students to incorporate yoga in their daily routine to manage stress and lead a healthy life.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Contents

Unit 1:
Introduction to yoga, History of yoga, Concept of yoga, Benefits of yoga, Need of yoga practice in modern times, Discussion, Sookshma Vyayama.

Unit 2:
Discussion, Practice sessions, Ananda balasana, Balasana, Sukhasana, Badhhakonasana, Yoga nidra (Guided Relaxation), Vibhagiya Pranayama, Bhramari Pranayama, Sheethali/Shitkari Pranayama.

Unit 3:
Discussion, Practice sessions, Surya Namaskara, Dhanurasana, Bhujangasana, Paschimottanasana, Setubandhasana, Guided relaxation techniques like DRT & QRT

Unit 4:
Discussion, Practice sessions, Suryanamaskara, Sarvanganasana, Trikonasana, Marjarasana, Savasana, Virabhadrasana, Kapalabhati, Nadi Shodhana Pranayama, Yoga Nidra, Samavrritti Pranayama.

Unit 5:
Discussion, Practice sessions, Padahastana, Tadasana, Vrukshasana, Padmasana, Vakrasana, Ardhamatsyendrasana, Sarvangasana, Nadi Shodhana Pranayama, Bramhari Pranayama.

4. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		60
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

5. Course Assessment and Reassessment

SL No	TIME (Hrs.)		Learning Objectives	Content	Teaching/ Learning Activities	Assessment method
	T	P				
I	2	1	Students will be motivated to practice basic yoga postures	Introduction to yoga • History of yoga • Concept of yoga • Benefits of yoga • Need of yoga practice in modern times	•Discussion • Sookshma Vyayama	MCQ
II	2	3	Students will be able to better manage stress and anxiety through the practice of specific yoga techniques.	Yoga techniques: Asana Relaxation Technique Pranayama	Discussion Practice sessions Ananda balasana Balasana Sukhasana Badhhakonasana Yoga nidra (Guided Relaxation) Vibhagiya Pranayama Bhramari Pranayama	MCQ Class Assessment

					Sheethali/Shitkari Pranayama	
III	2	4	Students will be equipped to improve general health and immunity.	Yoga techniques: Asana Relaxation Technique Pranayama	Discussion Practice sessions Surya Namaskara Dhanurasana Bhujangasana Paschimottanasana Setubandhasana Guided relaxation techniques like DRT & QRT	MCQ Class Assessment
IV	2	6	Students will be able to create a balance between strength, flexibility and body weight.	Yoga techniques: Asana Relaxation Technique Pranayama	Discussion Practice sessions Suryanamaskara Sarvanganasana Trikonasana Marjarasana Savasana Virabhadrasana Kapalabhati Nadi Shodhana Pranayama Yoga Nidra Samavrritti Pranayama	MCQ Class Assessment
V	2	6	Students will have an enhanced ability to improve their memory and concentration.	Yoga techniques: Asana Relaxation Technique Pranayama	Discussion Practice sessions Padahastana Tadasana Vrukshasana Padmasana Vakrasana Ardhamatsyendrasana Sarvangasana Nadi Shodhana Pranayama Bramhari Pranayama	MCQ Class Assessment

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

6. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures
3.	Critical Skills	--
4.	Analytical Skills	--
5.	Problem Solving Skills	--
6.	Practical Skills	Classroom lectures
7.	Group Work	--
8.	Self-Learning	Classroom lectures
9.	Written Communication Skills	--

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Examination
14.	Personal Management	--
15.	Leadership Skills	--

7. Course Resources

a. Essential Reading

1. Course notes
2. Karmananda S. Yogic management of common diseases. Bihar: Yoga publications trust; 2021.
3. Patanjali. Yoga Sutras. New Delhi: Srishti publishers and distributors; 2021.

b. Recommended Reading

1. Purameri S. Psychology of yoga an introduction to ancient Indian psychology. India: Sarovaram books; 2021.

c. Websites

1.
2. https://www.coursera.org/
3. http://nptel.ac.in/

d. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

8. Course Organization

Course Code	**BNE101A**		
Course Title	**Yoga for Health and Wellness**		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Sports

Course Title	Sports
Course Code	PTU101A
Course Type	Health and Wellness
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course aims to familiarize students with fundamental concepts of sports and Health and Wellness through healthy lifestyle. In addition, it provides training and develops essential skills to enhance the performance capacity in different sports activities. The course emphasizes on physical fitness, management of sports injuries, rules of common sports, ethical practices and practice activities.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	1:0:2
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the benefits of sports & fitness and ethical responsibilities of athletes, coaches, officials, and sports organizations.
- **CO-2.** Identify common sports injuries, their causes and types, and demonstrate basic knowledge of prevention, management techniques, and first aid
- **CO-3.** Apply principles of personal hygiene, balanced nutrition, and daily fitness regimes to maintain a healthy lifestyle and improve physical performance
- **CO-4.** Organize sports events to promote physical fitness, teamwork, ethical practices and a competitive spirit

4. Course Contents

Unit 1 (Introduction to Sports):

Aim, Objectives and Importance of Sports in Educational Institutions, Ethics in Sports.

Unit 2 (Fitness):

Meaning and Definition, Components of Physical Fitness - Endurance, Speed, Flexibility, Strength and Agility, Skill Related Fitness, Health Related Fitness, Importance and Benefits, Daily Regime for Sportspersons, Personal Hygiene, Balanced Nutrition, Warm Up Exercises, Fitness Exercises, Cool Down or Limbering Down Exercises.

Unit 3 (Sports Injuries and Management):
Definition, Causes and Types of sports injuries, Prevention, Management Techniques and First Aid.

Unit 4 (Common Games any one):
Basketball/ Volleyball / Throw Ball/ TT/ Handball/ Kabaddi/ Kho-Kho- Rules and Regulations, Skills Development Drills, game practices, Intra-Murals competitions, Ethical Practices.

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		05
Demonstrations		03
1. Demonstration using Videos	03	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory/ Playground	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		02
1. Case Study Presentation	00	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**45**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Continuous Evaluation				
Course Outcomes	**Sessional Work 1 Theory Assignment**	**Sessional Work 2 Practical Assignment**	**Sessional Work 3 Group activity (Intramural activity-organizing-participation)**	**Attendance**
Maximum Marks	**10**	**20**	**20**	**10**
CO-1	X			
CO-2	X			
CO-3	X			
CO-4		X	X	

- **Group Activity – 20 Marks:**

  Group activity will be assessed based on

  Skills in planning and organizing the tournament – 5 Marks.
  Team Work – 5 Marks.
  Ethics displayed – 5 Marks.
  Performance in the tournament – 5 Marks.

- **Attendance Marks-10 Marks:**

  75% - 80% - 2 Marks.
  80% - 85% - 4 Marks.
  85% - 90% - 6 Marks.
  90% - 95% - 8 Marks.
  95% - 100% -10 Marks.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures
3.	Critical Skills	--
4.	Analytical Skills	--
5.	Problem Solving Skills	--
6.	Practical Skills	Classroom lectures
7.	Group Work	--
8.	Self-Learning	Classroom lectures
9.	Written Communication Skills	--
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Examination
14.	Personal Management	--

15.	Leadership Skills	--

8. Course Resources

a. Essential Reading

1. Course notes
2. Singh Ajmer, Rachhpal Bains Jagdish, Brar Singh, Gill Singh Jatar,(2016), Essentials of Physical Education, 5th Ed, India, Kalyani Publishers

b. Recommended Reading

1. Srivastava A.K., (2010), Book of Rules of Games and Sports, 1st Ed, India, Sports Publication
2. Peterson Lars,Renstrom A.F.H. Per,(2017), Sports Injuries- Prevention, Treatment and Rehabilitation, 4th Ed, Oxfordshire, Routlede
3. William J. Morgan, (2018), Ethics in Sport, 3rd Ed,United Kingdom, Human Kinetic
4. Bean Anitha, (2017), the Complete Guide to Sports Nutrition, 8th Ed, London, Bloomsbury

c. Magazines and Journals

1. Sportstar, The Hindu, India
2. ESPN the Magazine, SPN Sports Network, Connecticut

d. Websites

1. https://www.fiba.basketball/documents
2. https://www.throwballfederationofindia.in/throwball-rules.htm
3. https://www.fivb.com/en/volleyball/thegame_glossary/officialrulesofthegames
4. https://www.ihf.info/sites/default/files/2022-03/09A%20-%20Rules%20of%20the%20Game_Indoor%20Handball_E.pdf
5. https://documents.ittf.sport/sites/default/files/public/2021-04/2021ITTFHandbook.pdf
6. http://khokho.co.in/kho-kho-game-rules
7. https://www.indiankabaddi.org/rules-of-kabaddi.html

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library
2. DELNET
3. EBSCO

9. Course Organization

Course Code	PTU101A	
Course Title	Sports	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	manager1.sports@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

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Course Specifications: Aptitude and Analytical Reasoning

Course Title	Aptitude and Analytical Reasoning
Course Code	PTU301A
Course Type	Ability Enhancement
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is designed to enhance the employability of students by learning critical thinking problem-solving skills, logical thinking, and quantitative abilities. It covers key concepts in numerical aptitude, logical reasoning, and data interpretation, which are essential for competitive exams, job assessments, and decision-making in professional settings

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recall fundamental concepts of quantitative aptitude, logical reasoning, and verbal ability.
- **CO-2.** Explain problem-solving approaches in numerical, logical, and verbal domains.
- **CO-3.** Apply quantitative and logical reasoning techniques to solve aptitude problems.
- **CO-4.** Analyze problems and select appropriate strategies to arrive at efficient solutions.

4. Course Contents

Unit 1 (Quantitative Aptitude):

Number Systems

Concept explanation of Classification of Numbers, Divisibility Tests, Power Cycles & reminders, factors and multiples – Multiples, Highest Common factor (HCF), Least common multiple (LCM), finding HCF & LCM with prime factorization and Applications of HCF & LCM. Solving problems related to the topics.

Ratio, Proportion, Variation, Linear Equations and Problems on Ages

Introduction to ratio & proportions, formulas on ratios and proportions & difference between ratio & proportion. Explanation of Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratios in investment or partnership. Explanation of variation & linear equations. Solving problems using these concepts.

Percentages, Simple interest and Compound interest `

Concept Explanation - Quick Calculation of Percentages, Conversion of Fraction to Percentage Table, Percentage Change, Percentage Point Change, Increased Value & Increase in Value, Percentage Changes in Numerator & Denominator, Successive Percentage,
Simple Interest, Compound Interest, basic formulas, Difference between simple interest & interest, Successive percentages in SI & CI. Relation between Simple and Compound Interests Shortcut methods and Solving problems on these concepts

Profit & Loss, Partnerships, Averages, Mixtures and Allegations

Basic terminology in Profit and loss, Concept Explanation - Profit, Loss, Cost Price, Selling Price, & Marked Price. Solving problems to review the concepts. Averages - Concept Explanation, Average Formula to calculate the Mean, to determine the Median, to determine the Mode & the concept of Weighted Average. Mixtures and alligation & Rule of alligation. Alligation cross, Alligation line, Successive replacement, practicing problems to review the concepts.

Unit 2:

Time Speed and Distance

Basic formulas, Basic relationships, Concept of average speed, Average speed when Distance is constant, Average speed when Time is constant, Average speed when Speed is constant, Acceleration & deceleration, Concept of relative speed & Concept of resultant speed.
Application of relative speed in train problems, boats & streams problems, basic formulas, shortcut methods, 4 rules of boats & streams, the escalator problems, circular motion tips, concept of races, Problems solved on Easy, Medium and Difficult Questions.

Time and Work

Concept explanation of Working with Different Efficiencies, Pipes and Cisterns, work equivalence (man days) & Division of Wages. Solving problems related to these concepts.

Set theory and functions

Concept of Set Formulas, Power Set, Subset, Domain & Range. Solving problems related to these topics.

Permutation, Combination and Probability

Fundamental Counting Principle, Permutation and Combination, Computation of Permutation, Circular Permutation, Computation of Combination & basic concept of Probability. Solving problems to review the concepts.

Logarithms, Progressions, Geometry and Quadratic equations

Concept explanation of Logarithms, Arithmetic Progression (A.P), Geometric Progression (G.P), Geometry, Mensuration & Quadratic Equations. Solving problems relevant to these topics

Unit 3 (Logical Reasoning):

Logical connectives, Syllogisms and Venn diagram

Concept explanation of Logical connectives, Syllogisms, Venn diagrams – Interpretation & Venn diagrams. Solving problems to review the concept.

Number Series

Explanation of patterns of number series –Explanation on Alphanumeric series & solving problems

Analogies in Reasoning & Judgement Reasoning

Explanation of Numerical analogy, Letter/Word analogy & Image based analogy. Solving questions on these concepts. Judgement Reasoning – Decisions based on passages, Eligibility based judgements,

Attention to details

Concept explanation of String Matching, Text and Image- based Questions. Practice of problems related to the topic

Data Arrangements and Blood Relations

Concept explanation of data arrangements - Linear Arrangement, Circular Arrangement, distribution and blood relations. Solving problems related to these topics.

Coding and decoding, series, analogy, odd man out and visual reasoning
Concept explanation of Coding and Decoding, Number and Alphabet Series, Analogy, Odd Man Out and visual reasoning. Practicing problems to familiarize the concepts.

Unit 4:
Critical Reasoning
Concept explanation of Arguments, Explaining Statements & Course of actions, Statement & Conclusion concepts, Types of statements & Conclusion concepts – Action based & Keywords based, Cause – Effect – Immediate cause, principal cause, independent cause. Tips to solve these problems. Concept of Statement & Argument & various types of statements & arguments. Solving problems related to these concepts.
Image Interpretation
Concept explanation of Rebus Puzzles & Forming Words Based on Images. Practice exercise to familiarize the concepts.
Data Interpretation and Data Sufficiency
Concept of Data Interpretation – Tables, pie charts, Bar graphs & Data sufficiency.
Clocks, Calendars & Direction Sense
Conceptual review of Clocks, Calendars, Direction Sense and Cubes & practicing related problems**.**

Unit 5 (Verbal Ability):
Reading Comprehension
Speed Reading Strategies, reading comprehension types and tackling strategies – different types of approaches – Scholar approach, hunter approach, balanced approach. Look for signpost words, go around speakers & itemize. Solving problems related to these concepts.
Sentence correction
Review of basics on Subject – Verb agreement, Modifiers, Parallelism, Pronoun – Antecedent Agreement, Verb-Time Sequence, Comparisons, Prepositions & Determiners. Practicing problems to familiarize the concepts.
Vocabulary
Vocabulary Demystified, Synonyms and Antonyms, Word Analogy, Patterns of questions on word analogy, Idioms, Phrasal Verbs & commonly confused words.
Sentence completion and Para- jumbles
Formats of the question, Type 1 – Single blank & Type 2 – Double blank, basic steps for solving questions on sentence completion, Strategies to solve sentence completion problems, proactive solving, Identify clues – Signposts, Root-words, Prefixes and Suffixes, Sentence structure clues, Cause & Effect, Definition & re statement and parts of speech.
Para Jumbles – Types of paragraph structure – Moving jumbles, Anchor jumbles, strategies for solving jumbled paragraphs – Find the opening sentence, identify logical pairs to eliminate options, taking cues from signpost words, match the right pronoun and antecedent, idea elaboration,
Voices & Speech
Review of basics on Active vs Passive Voice, Direct vs Indirect Speech. Practice problems related to the topics for familiarizing the concept.
Articles, Prepositions and Interrogatives
Definite and Indefinite Articles, Omission of Articles, Prepositions, Prepositions of Place, Time, & direction. Compound Prepositions and Prepositional Phrases, Interrogatives. Practicing problems to review the concepts.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2													
CO-3													
CO-4		2											
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		10
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**50**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type	Terms Tests	Quizzes	
CO-1	x	X	X
CO-2	x	X	X
CO-3	X	X	X
CO-4	X	X	X
The details of the number of tests and Quizzes to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Quiz
2.	Understanding	Classroom lectures cum practice sessions, Quiz, Self-study
3.	Critical Skills	Classroom lectures cum practice sessions, Quiz, self-study, examination
4.	Analytical Skills	Classroom lectures cum practice sessions, Quiz, Examination
5.	Problem Solving Skills	Practice in the computer lab, Quiz, Examination
6.	Practical Skills	Classroom lectures, Quiz, Examination
7.	Group Work	Lab Exercises, Mini-Projects
8.	Self-Learning	Quiz, Self-study
9.	Written Communication Skills	Classroom lectures, practice sessions, Quiz, Examination
10.	Verbal Communication Skills	Quiz, Self-study
11.	Presentation Skills	Project Presentations, Lab Demonstrations
12.	Behavioral Skills	Lab Conduct, Teamwork during Assignments
13.	Information Management	Quiz, Examination
14.	Personal Management	Course work
15.	Leadership Skills	Leading Lab Projects, Peer Mentoring in Practice Sessions

9. Course Resources

a. Essential Reading

1. Course notes

2. "Quantitative Aptitude for Competitive Examinations" – R.S. Aggarwal
3. "A Modern Approach to Logical Reasoning" – R.S. Aggarwal
4. "How to Prepare for Data Interpretation" – Arun Sharma
5. "Objective General English" – SP Bakshi (Arihant Publications)
6. IndiaBix – Free questions for Quant, LR, DI, Verbal, and Puzzles.
7. HackerRank – Logical reasoning & puzzles.
8. Merriam-Webster Vocabulary Quizzes – Word games to improve vocabulary.

b. Recommended Reading

1. "Quantitative Aptitude Quantum CAT" – Sarvesh Kumar Verma
2. "How to Prepare for Logical Reasoning for CAT" – Arun Sharma
3. "Data Interpretation & Data Sufficiency" – RS Aggarwal
4. "How to Prepare for Verbal Ability and Reading Comprehension" – Arun Sharma & Meenakshi Upadhyay
5. PrepInsta – Placement papers & company-specific mock tests.
6. LeetCode – IT aptitude & coding practice.
7. Grammarly Blog – Grammar & sentence structure lessons.

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	PTU301A	
Course Title	Aptitude & Analytical Reasoning	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Heat Transfer

Course Title	Heat Transfer
Course Code	MEC311A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course intends to impart knowledge about principles of heat and mass transfer applicable to design of thermal systems. Students are taught the modes of heat transfer and their governing laws, thermal properties of materials, principles of boiling and condensation and various types of heat exchangers. Students will be able to apply the principles of heat and mass transfer for a given application

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the fundamental laws of heat transfer in conduction, convection, and radiation to analyze steady-state and transient problems
- **CO-2.** Determine forced and free convection in internal and external flows and assess heat transfer phenomena including boiling and condensation
- **CO-3.** Design and analyze heat exchangers using LMTD and ε-NTU methods, to solve given heat transfer application problems
- **CO-4.** Conduct heat transfer experiments, measure thermal parameters accurately, and interpret experimental data

4. Course Contents

Unit 1 (Introduction):
Heat Transfer: Modes of heat transfer; Fourier's law; Conductivity. Newton's law of convection and Stefan Boltzmann law of radiation.
Heat Conduction: General heat conduction equation; Boundary and initial conditions; Heat generation; Thermal conductivity; Steady heat conduction: Conduction in plane wall, cylinder, sphere and composite walls; Resistance network analysis; Heat losses and insulation; Critical radius of insulation; Heat transfer from fins; Numerical problems.

Unit 2 (Transient Heat Transfer):
Transient Heat Conduction: Lumped system analysis; Transient heat conduction in large plane walls, long cylinders and spheres with spatial effect; Heisler and Grober charts; Numerical methods of heat conduction; Numerical problems.

Unit 3 (Convection Heat Transfer):
Principles of convection heat transfer; Velocity and thermal boundary layer; laminar and turbulent flows; Conservation equations for mass, momentum and energy; Solution of boundary layer equations; Analogy between heat and momentum transfer; Non-dimensional numbers.
External Convection Heat Transfer: Laminar boundary layers; Similarity and integral solutions; Drag and heat transfer, Flow over flat plates, cylinders and spheres
Internal Convection Heat Transfer: Mean velocity and mean temperature; Entrance region; Constant heat flux and temperature condition in pipe flow; Hagen–Poiseuille flow; Heat transfer in laminar developed and developing duct flows; Heat transfer in turbulent boundary layers and turbulent duct flows
Natural/Free Convection: Grashoff number; Natural convection over surfaces and inside enclosures; Laminar and turbulent free convection; Numerical problems

Unit 4 (Boiling and Condensation and Heat Exchangers):
Boiling and Condensation: Boiling heat transfer; Bubble nucleation; Pool boiling; Subcooled and saturated flow boiling; Flow boiling; Heat transfer coefficients; Critical heat flux; Effect of sub-cooling; Flow boiling- onset of nucleation; Post- boiling-crisis heat transfer; Condensation heat transfer; Film and drop-wise condensation; Condensation heat transfer correlations; Numerical problems.
Heat Exchangers: Types of heat exchangers; Overall heat transfer coefficient; Analysis of heat exchangers; Log Mean Temperature (LMTD) method; Effectiveness (ε)-NTU method; Double pipe heat exchangers: Thermal and Hydraulic design; Shell and Tube heat exchangers: basic design procedure; Heat Exchanger Network (HEN) and process integration; Compact heat exchangers

Unit 5 (Radiation Heat Transfer):
Radiation: Fundamentals, Radiative properties of opaque surfaces; Intensity, emissive power and radiosity; Planck's law and Wien's displacement law; Black and Gray surfaces; Emissivity and absorptivity; Spectral and directional variations; Stephan Boltzmann and Kirchhoff's law; Radiative properties of molecular gases and particulate media; Exact solutions of one dimensional gray media
View Factors: Definitions and relations; radiation heat transfer between two black surfaces, diffuse gray surfaces; Network methods; Re-radiating surface; Radiation shield; Radiation effects on temperature measurements; Radiative properties of surfaces; Radiant exchange between surfaces; Radiative heat transfer in participating media; Radiative exchange between gray and diffuse surfaces; Radiation combined with conduction and convection

List of experiments to be conducted along with the theory

1	Determination of steady state heat transfer and thermal conductivity of a metal rod
2	Determination of steady state temperature distribution through a composite wall
3	Determination of critical insulation thickness using lagged pipe apparatus
4	Determination of effectiveness of a rectangular fin using natural and forced convection heat transfer
5	Determination of heat transfer coefficient for natural and forced convection

6	Determination of emissivity of a surface/test plate using Stefan Boltzmann apparatus
7	Determination of Stefan-Boltzmann constant using graphical method
8	Determination of Log Mean Temperature Difference (LMDT) and effectiveness in a counter flow and parallel flow heat exchangers
9	Determination of effectiveness of cross-flow heat exchanger
10	Demonstration of boiling heat transfer
11	Demonstration of droplet and film condensation heat transfer for studying the condensation regime

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3											3	
CO-2		3										2	
CO-3				2								3	
CO-4					2							2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

Term Tests, Laboratory Examination/Written Examination, Presentations	10
Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2	x	x			x	
CO-3			x		x	
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--

11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. J. P. Holman, 2009, Heat Transfer, McGraw-Hill Inc.
3. F. P. Incropera and D. P. Dewitt, 2017, Fundamentals of Heat and Mass Transfer, Wiley India Pvt. Ltd.

b. Recommended Reading

1. Y. A. Cengel, 2006, Heat and Mass Transfer: A Practical Approach, McGraw-Hill Higher Education
2. S. M. Ghiaasiaan, 2007, Two-Phase Flow, Boiling and Condensation, Cambridge University Press
3. M. Tirumaleshwar, 2008, Fundamentals of Heat and Mass Transfer, Pearson Education
4. K. Nag, 2011, Heat and Mass Transfer, Tata McGraw-Hill

c. Magazines and Journals

1. International Journal of Heat and Mass Transfer
2. International Communications in Heat and Mass Transfer
3. Journal of Thermo-physics and Heat Transfer
4. Journal of Thermo-physics and Heat Transfer

d. Websites

1. www.machinedesignonline.com
2. ocw.mit.edu
3. www.class-central.com
4. sshttps://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC311A	
Course Title	Heat Transfer	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Finite Element Analysis

Course Title	Finite Element Analysis
Course Code	MEC312A
Course Type	Core Theory and Laboratory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed to prepare students to solve structural problems using finite element methods. Students are taught variational principles in solid mechanics, formulations of finite elements and finite element analysis technique. Application of finite element method to solve linear, dynamic and thermal problems will be trained to use FEA tools to solve complex problems.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the principles of finite element methods to solve engineering problems
- **CO-2.** Formulate elemental equations for 1D, 2D, 3D and higher order finite elements
- **CO-3.** Design and analyse linear, static, dynamic and thermal engineering problems using FEA tools
- **CO-4.** Analyse engineering problems using FEM techniques and interpret results

4. Course Contents

Unit 1 (Introduction):
Engineering analysis, types of engineering analysis problems, methods to solve engineering problems- analytical, numerical and experimental methods, FEA in design and analysis of a component, Principle of Minimum Potential Energy, Origin of FEM, Principle of FEM, Classification of FEM, Types of Analysis-Linear, Dynamic, Harmonic, Thermal, Computation Fluid Flow analysis.
General procedure of FEM. Review of Solid Mechanics: Degrees of Freedom, Rigid Body Motion, Discrete Structures, Continuous Structures, Material Properties, Stress and Strain at a Point, Equilibrium Equations, Generalised Hooke's law, Stress –Strain relations for plane stress and plan strain conditions, Strong form and weak form solutions, General Variational methods in elasticity problems, variational formulation in FEA, Rayleigh-Ritz Method, and Galerkin Method-

Significance and Examples.

Unit 2 (Element formulation of 1D Element):
Element stiffness, Different approaches for element formulation, Use of energy approach for element formulation, Shape functions and natural coordinates, Gauss Quadrature, convergence requirements of shape functions, shape functions by Lagrange method.
Derivation of stiffness and equivalent load vector for a two node bar element, two node truss element, and two node beam element, methods of handling boundary conditions-elimination approach and penalty method, Solution of bar, stepped bar and tapered bar problems using two node bar element, plane truss problems using two node truss element and problems on beams.

Unit 3 (Element formulation of 2D, 3D and Higher Order Elements):
Formulation of 2D Constant Strain Triangular element, Quadrilateral element and solution of simple problems, Formulation of 3D tetrahedral element, Formulations of 1D, 2D and 3D higher order elements

Unit 4 (Dynamic Analysis):
Static versus Dynamic analysis – loads and response, Dynamics and Vibration, Types of problems in dynamic analysis – Modal, Transient, Harmonic, Inclusion of dynamic forces in finite element methodology, Solution methodologies for dynamic problems. Problems on dynamic analysis of bars to determine natural frequencies and mode shapes.

Unit 5 (Thermal Analysis):
Physics of heat transfer, Governing equations for heat transfer, Extension of FE methodology for structures to thermal problems, Loads and boundary conditions for thermal problems. 1D problems on thermal analysis to determine temperature distribution.

Unit 6 (Modelling and analysis using Software):
Stress analysis of stepped bar and tapered bar; Stress analysis of different types of beams; Stress analysis of plane truss structures; Stress analysis of plane frame structures; Stress analysis of Plane stress and Plane strain examples; Stress analysis of a rectangular plate with a Circular Hole; Stress analysis of corner angle bracket; Thermal analysis of fin; Thermal analysis of composite wall; Modal analysis of stepped bar and cantilever beam; Harmonic analysis of cantilever beam; Dynamic analysis of bar subjected to forcing function.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		3											
CO-2				2									2
CO-3					3								3
CO-4		3											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**	
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	**SEE (Weightage: 25%)**	**SEE (Weightage: 15%)**
Subcomponent Type ▶	**Term Test – 1**	**Term Test – 2**	**Assignment**	**Laboratory**	**Written Exam**	**Lab Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**	
CO-1	x	x			x	
CO-2	x	x			x	

CO-3			x		x	
CO-4				x		x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.						

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Laboratory
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Chandrupatla, T. R., Belegundu, A. D. (2021) Introduction to Finite Elements in Engineering, 5th Edition, Pearson Education India
3. Reddy, J. N., (2021) Introduction to Finite Element Method, 4th Edition, McGraw-Hill

b. Recommended Reading

1. Zienkiewicz, O. C. (2005) The Finite Element Method, Tata McGraw-Hill Publishing Co. Ltd.
2. Fagan, M. J. (1992) Finite Element Analysis: Theory and Practice, Pearson Education Ltd
3. Bathe, K.-J. (1997) Finite Element Procedures, Prentice Hall India
4. Adams, V., Askenazi, A. (1998) Building Better Products with Finite Element Analysis, Onward Press

c. Magazines and Journals

1. Finite Elements in Analysis and Design
2. Computers and Structures
3. Journal of Computational and Applied Mathematics
4. International Journal of Computational Methods

d. Websites

1. http://nptel.ac.in/
2. http://www. machinedesignonline.com
3. http://www.asminternational.org

e. Other Electronic Resources

1. www.mece.ualberta.ca
2. www.ansys.com
3. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC312A	
Course Title	Finite Elements Analysis	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Design of Machine Elements-2

Course Title	Design of Machine Elements-2
Course Code	MEC313A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at preparing the students to apply engineering principles and methods for the design and analysis of common machine elements under various loading conditions used in machinery. Stress analysis of machine elements and fatigue design methodologies will be taught. Students will be trained to design machine components using prescribed standards, correction factors and codes based on loading conditions. Students will be able to design mechanical components like springs, bearings, gears, clutches, brakes and chain drives.

2. Course Size and Credits:

Number of Credits	3
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the basic concepts, principles, and governing design criteria applicable to machine components and systems subjected to static and fluctuating loads, with emphasis on selecting appropriate standards based on the component
- **CO-2.** Design machine components like springs, clutches, brakes, gears, wire ropes, chains and bearings for a given functional requirements
- **CO-3.** Estimate the design parameters of machine components using standard design procedures to verify their adequacy within allowable limits

4. Course Contents

Unit 1 (Design for Fatigue Strength):
Introduction- S-N Diagram, Low Cycle Fatigue, High Cycle Fatigue, Endurance Limit, Modifying Factors: Size effect, Surface effect, Stress Concentration effects, Fluctuating Stresses: Goodman and Soderberg relationship; Numerical examples on fatigue design.

Unit 2 (Design of Springs):
Stresses in Helical coil springs of circular cross sections; Tension and compression springs, springs under fluctuating loads, Energy stored in springs, Torsion springs, Leaf Springs: Stresses in leaf springs, Equalized stresses.

Unit 3 (Design of Gear):
Classification of gears; Nomenclature; Law of gearing, Conjugate action, Gear profiles, Pressure angle, Standard gear tooth, Backlash, Interference and undercutting; Simple and compound gear trains; Force analysis, Gear tooth failure, Material selection, Gear blank design, Strength of gear tooth, Permissible stress, Module estimation with beam and wear strength; Design of spur gear; Internal gear, helical gear, Herringbone gear, bevel and worm gears.

Unit 4 (Design of Rolling and Sliding Contact Bearings):
Overview of types and classification of bearings, static and dynamic load bearing capacity, Stribeck's equation, equivalent bearing load, load-life relationship, load factor, equivalent bearing load, selection of bearings from manufacturer's catalogue, mounting of bearing. Comparison of rolling and sliding bearings, basic lubrication modes, Petroff's equation, Reynold's equation, bearing design-selection of parameters, bearing materials, bearing failure-causes and remedies.

Unit 5 (Design of Clutches and Brakes):
Energy equation and thermal Considerations of clutch and brakes, Torque transmission capability, design of single and multidisc clutches, cone clutches, centrifugal clutches, Block brake with short and long shoe, Band brake and Disc brake.

Unit 6 (Design of Chain Drives and Wire Ropes):
Advantages of Chain drives over other drives, geometrical relationships in roller chains, polygonal effects, power rating based on failure criteria's, design of chain drives, Advantages of wire ropes, construction of wire ropes, stresses in wore ropes, examples on analysis of wire ropes.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	2												
CO-2			3										3
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2		x		x	x
CO-3			x	x	x
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Bhandari, V. B. (2020) Design of Machine Elements, 5th ed, McGraw-Hill
3. Budynas, R. G., Nisbett, J. K., Tangchaichit, K. (2026) Shigley's Mechanical Engineering Design, 12th Edition, McGraw-Hill
4. Mahadevan, K., Balaveera Reddy, K. (2025) Design Data Handbook for Mechanical Engineers, 4th Edition, CBS Publishers & Distributors

b. Recommended Reading

1. Lingaiah, K. (2017) Machine Design Handbook, 2nd ed, McGraw-Hill
2. Juvinall, R. C., Marshek, K. M. (2016) Machine Component Design, 5th ed, John Wiley & Sons Inc (Sea) Pte Ltd
3. Norton, R. L. (2018) Machine Design, 5th ed, Pearson Education
4. Mott, R. L. (2020) Machine Elements in Mechanical Design, 4th ed, Pearson Education
5. Klebanov, B. M., Barlam, D. M., Nystrom, F. E. (2007) Machine Elements: Life and Design, Boca Raton, CRC Press

c. Magazines and Journals

1. Journal of Advanced Mechanical Design, Systems, and Manufacturing
2. Journal of Machine Design

d. Websites

1. http://www.machinedesignonline.com
2. http://www.asminternational.org
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC313A	
Course Title	Design of Machine Elements-2	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Automation in Manufacturing and Industry 4.0

Course Title	Automation in Manufacturing and Industry 4.0
Course Code	MEC314A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides an understanding of automation in manufacturing and its progression to Industry 4.0. It begins with evolution, principles, and strategies of automation, followed by automated system components; sensors, actuators, controllers, PLCs, and CNC machines with programming. The role of industrial robots and cobots in flexible and intelligent manufacturing is emphasized. Students will explore smart factory concepts, including IoT, cyber-physical systems, cloud, AI, big data, additive manufacturing, and digital twin. The course also addresses sustainability, lean automation, safety, ethics, and the transition toward Industry 5.0, highlighting human-centric and resilient manufacturing systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of automation and Industry 4.0 technologies to analyse their need and interrelationship in modern manufacturing and industrial applications
- **CO-2.** Develop pneumatic circuits that include sensor, actuator and controller
- **CO-3.** Design lean robotic cell for given application

4. Course Contents

Unit 1 (Overview):
Need for automation solution for manufacturing, types of automation; strategies of automation, expectations from manufacturing processes and automation solution. pre-requites for automation solution development, process qualification for automation process; standard and standardization process improvement tools.

Unit 2 (Automated System):
Block diagram of automated systems and functional components; process elements, actuators,

sensors, controllers, and feedback mechanisms; role of actuators in motion control and material handling; sensors for measurement and monitoring; controllers for logic and system integration; interaction of hardware and software in automation; PLC, DCS, and SCADA platforms; CNC systems – structure, drives, feedback, and basic part programming (G-codes and M-codes).

Unit 3 (Robots in Manufacturing):
Introduction to industrial robots and their role in manufacturing systems; anatomy and configuration of robots – joints, links, and end-effectors; types of robots based on degree of freedom, work envelope, and applications; robot actuators, sensors, and control systems; programming methods including online and offline programming; applications of robots in material handling, welding, assembly, painting, and inspection; safety, ergonomics, and human–robot collaboration (Cobots) in manufacturing environments. Flexible and smart manufacturing systems.

Unit 4 (Smart Factories and Building Blocks of Industry 4.0):
Smart factories and digital manufacturing; building blocks of Industry 4.0 – IoT, cyber-physical systems (CPS), cloud computing, big data, AI/ML, robotics, additive manufacturing, AR/VR, and digital twin; integration of Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP); data-driven decision-making, predictive maintenance, and real-time monitoring.

Unit 5 (Sustainability, Ethics, and Future Trends):
Green and sustainable manufacturing practices; lean automation; human–robot collaboration and workforce transformation in smart factories; safety, ergonomics, and cybersecurity in digital manufacturing environments; ethical and societal implications of automation; transition from efficiency-driven Industry 4.0 to Industry 5.0 concepts focusing on human-centric, resilient, and sustainable manufacturing systems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		2											2
CO-2			2										2
CO-3			2										2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x				x
CO-2	x	x		x	x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Mikell P. Groover, (2021), Automation, Production Systems and Computer Integrated Manufacturing, PHI Learning Private Ltd.
3. Petruzella, F.D. (2023) Programmable Logic Controllers, 6th edition. McGraw Hill India, New Delhi.
4. Smid, P. (2007) CNC Programming Handbook, 3rd edition. Industrial Press Inc., New York
5. Craig, J.J. (2021) Introduction to Robotics: Mechanics and Control, 4th edition. Pearson Education India, New Delhi.
6. Gilchrist, Alasdair (2016) Industry 4.0: The Industrial Internet of Things. Berkeley, CA, Apress

b. Recommended Reading

1. Bi, Z.M., Xu, L. and Wang, C. (2021) Smart Manufacturing: Concepts and Applications of Industry 4.0. Singapore: Springer.
2. Raj, B. and Sridhar, R. (2021) Cyber-Physical Systems and Industry 4.0: Basic Principles. Singapore: Springer.
3. Singh, N. (2006) Systems Approach to Computer-Integrated Design and Manufacturing. Hoboken: John Wiley & Sons.

c. Magazines and Journals

1. Journal of Manufacturing Systems
2. Journal of Intelligent Manufacturing
3. International Journal of Advanced Manufacturing Technology (IJAMT)
4. Robotics and Computer-Integrated Manufacturing
5. International Journal of Computer Integrated Manufacturing (IJCIM)

d. Websites

1. www.ifr.org
2. www.automationworld.com
3. www.controleng.com
4. www.iiconsortium.org
5. www.automationmag.com

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC314A		
Course Title	Automation in Manufacturing and Industry 4.0		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Project Management and Cost Accounting

Course Title	Project Management and Cost Accounting
Course Code	MEC315A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with project management techniques used in engineering applications. The students will be exposed to various concepts and practices of project management used in contemporary engineering applications. All the phases and steps required for successful execution of engineering projects will be explained and discussed with case studies. Critical decision making skills, trade off analysis, project audit and project proposals drafting will be explored in the course. Students are taught to interpret financial information and prepare a balance sheet.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the principles of project management and prepare a project plan, perform feasibility study and analyze the tradeoffs for project acceptance
- **CO-2.** Apply the concepts of project management to monitor the projects, determine most economical route/s to execute projects and carryout post completion audit on projects
- **CO-3.** Evaluate the worthiness of a project by calculating the financial metrics like PBP, NPV, ARR, IRR and PI and develop a profitability statement of an organization for a specific time period

4. Course Contents

Unit 1 (Basic Concepts of Project Management):
Understanding Project Management, Need for executing projects, PM Triangle and Relevance, Portfolios in PM, Relevance of PM in business organizations, Project objectives and their criteria, Members of PM team, Different views of Project Management, Project life cycles, Onion Syndrome and its impact on project planning, Cost impact analysis for the different stages of project lifecycle.

Unit 2 (Project Strategy and its Variables):
Identification of Strategic Project Variables: Statement of Work, Project Specifications and Milestone Schedules; Project Feasibility Studies: Technical, Operational, Financial, Economic, Social and Environmental; Work Breakdown Structure and Planning Cycle, Master Project Scheduling, PERT/ CPM; Crashing of Projects.

Unit 3 (Contracts, Project Proposals and Audits):
The low Bidder Dilemma; Contracts – their influence on Projects, Industry Trade off Preference, Developing Marketing Strategy: The Bid – No Bid Decision, The Kickoff Memo, Proposal Types: The single Volume, The Technical Volume, The Management Volume, The Cost Volume proposals; Project Audit: Methods of Audit, Pre-completion and Post completion audits.

Unit 4 (Capital Budgeting and Economic Analysis):
Costing system, Types of Product cost estimation, Elements of product cost, Evaluation of cost using traditional and ABC Costing, Life cycle cost analysis, Break even analysis, Working capital cycle, profit and loss accounting, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Methods: NPV, IRR, ARR, PBP, and PI, S-Curve, Metrics like ACWS, BCWS, BCWP and ACWP, Benchmarking of Manufacturing Operations.

Unit 5 (Statements of Financial Information):
Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account, Preparation of a balance sheet, Trial Balance and its significance.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1						2						2	
CO-2										3		3	
CO-3										3		3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	15	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2		x		x	x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Harold Kerzner (2025), Project Management: A Systems Approach to Planning, Scheduling and Controlling, 14th Edition, Wiley
3. Dan Epstein and Rich Maltzman (2013), Project Workflow Management: A Business Process Approach, J Ross Publishing
4. Parameshwar P. Iyer, (2004), Engineering Project Management with Case studies, Vikas Publishing House Pvt. Limited

b. Recommended Reading

1. Phil Simon (2022), Project Management in the Hybrid Workplace, Racket Publishing
2. Chris Croft (2022), Project Management Quickstart Guide, Clydebank Media LLC
3. Neil G Siegel (2019), Engineering Project Management, Wiley
4. Stephen Hartley (2018), Project Management: A Practical Guide to Planning and Managing Projects, Taylor and Francis

c. Magazines and Journals

1. International Journal of Project Management, Elsevier
2. International Journal of Productivity and Performance Management, Emerald Group Publishing Limited

d. Websites

1. http://www.pmi.org.in
2. http://www.apics.org

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC315A		
Course Title	Project Management and Cost Accounting		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Internship-2

Course Title	Internship-2
Course Code	MEI301A
Course Type	Skill Enhancement Course
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

Students are required to undergo an internship of 60 hours during the vacation following the completion of the 4th Semester. The internship is carried out using the facilities available within the University and/or outside the University, under the guidance of a faculty mentor. It aims to reinforce classroom learning while fostering creativity, problem solving, teamwork and entrepreneurial thinking, thereby bridging the gap between academic knowledge and real-world applications.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	60
Number of Weeks in a Semester	15*
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

* For credit computation only; the 60 internship hours are completed during the vacation period

3. Addressed POs and assessment

- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out through Technical Report Preparation and Documentation and Presentation and Communication Skills. Students are evaluated based on their ability to prepare professional technical reports, effectively present their internship work, communicate engineering concepts clearly, and participate in technical discussions and viva voce examinations.
- **Program Outcome 11 (Lifelong Learning)**
  The assessment of this Program Outcome is carried out through Initiative towards Learning New Concepts/Skills and Reflection on Learning and Professional Development. Students are evaluated based on their ability to undertake self-directed learning, acquire new technical competencies, reflect on their professional growth, and demonstrate commitment towards continuous learning and professional development.
- **Other Program Outcomes**
  In addition to the direct assessment of PO9 and PO11, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes addressed through the individual internship activities undertaken by each student. The mapping is carried out based on the nature of work performed, engineering tasks executed, tools employed, and learning experiences gained during the internship. This mapping is used solely for documenting Program Outcome attainment and is not considered for evaluation or allocation of marks in the internship course.

4. Evaluation Methodology

The internship carries a maximum of 50 marks and is assessed through the internship technical report, presentation, and viva voce examination conducted by a panel of examiners at the beginning of the 5th Semester. The evaluation criteria, marks distribution, performance-level descriptors, and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section INTERNSHIP. The said document shall be read in conjunction with these Course Specifications and is available with the Department of Mechanical Engineering, ensuring outcome-based and transparent assessment of student performance.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: INTERNSHIP).

6. Course Organization

Course Code	MEI301A	
Course Title	Internship-2	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Logic and Coding

Course Title	Logic and Coding
Course Code	PTU302A
Course Type	Ability Enhancement
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course helps learners understand core programming, data structures, algorithms, databases, operating systems, and networks. Students apply these concepts to solve coding problems and develop backend applications. Through intensive DSA practice, learners analyze problem efficiency and scalability. They evaluate design and architectural choices and create production-ready, scalable systems using modern backend frameworks, cloud fundamentals, and system design concepts, preparing them for high-package software engineering roles.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	40
Number of Weeks in a Semester	15
Department Responsible	Directorate of Training, Placement and Career services
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recall basic programming concepts such as variables, operators, and control structures.
- **CO-2.** Explain the use of arrays, functions, and recursion.
- **CO-3.** Use programming techniques to solve coding and logic-based problems.
- **CO-4.** Analyze problems and select appropriate algorithms for efficient solutions.

4. Course Contents

Unit 1 (Programming Fundamentals & Logical Thinking):

Placement-oriented coding approach, Time and space complexity basics, Programming fundamentals (C / C++ / Python), Conditional statements, Looping constructs, Basic number and logic-based problem solving, Simple pattern problems.

Unit 2 (Arrays, Strings & Mathematical Problem Solving):

One-dimensional and two-dimensional arrays, Searching and sorting techniques, String handling and string-based problems, Mathematical and number-based problems, Pattern-based problem solving, Medium-level placement practice problems.

Unit 3 (Functions, Recursion & Data Structures Basics):
Functions and modular programming, Recursion techniques, Structures and pointers, Introduction to stacks and queues, Problem solving using basic data structures, Medium to hard level practice problems.

Unit 4 (Advanced Problem Solving & Placement Readiness):
Introduction to advanced data structures, Algorithmic problem-solving techniques, Frequently asked placement coding problems, Competitive coding style questions, Company-specific coding focus, Mock tests, debugging, and code optimization

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		05
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Final Evaluation of the course				
	Term Test 1	**Quiz 1**	**SEE**	**Final Marks**
Maximum marks	20	10	20	50
Test format	Q&A	Mock Interview	Q&A	
No. of Questions	5	5	5	
Weightage	40%	20%	40%	

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Mode of Evaluation

- One Term test (40%)
- One Quiz (20%)
- Semester End Exam (SEE) – 40%

8. Evaluation & Assessment Breakdown

To ensure structured learning and measurable progress, the evaluation will consist of Continuous Assessment Tests (Term Tests), Quizzes, and Semester End Exam.

1. Continuous Assessment Tests – Term Test – 40%

Objective: To evaluate **ongoing progress** and ensure that students retain key concepts.

Frequency: One term test will be conducted during the course

Format:

- Written (Pen and Paper style format)
- Term Test 1 for 20 marks

2. Quizzes – 20%

Objective: Mock Interview which enables the students to face the technical interviews confidently

Frequency: One Quiz will be given during the course

Format:

Quiz 1 (20%)

- Interview Questions on the topics covered before the first Term Test

3. Semester End Examination (SEE) – 40%

Objective: To ensure students gain the necessary knowledge, skills, and competencies that are needed to perform well in their professional career.

Format:

- Written (Pen and Paper style format)
- SEE for 20 marks

9. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	--
4.	Analytical Skills	Classroom lectures
5.	Problem Solving Skills	Classroom lectures
6.	Practical Skills	Classroom lectures
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Examination
14.	Personal Management	--
15.	Leadership Skills	--

10. Course Resources

a. Essential Reading

1. Course notes
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Computer Algorithms, second Edition, Universities Press, 2007.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C, second Edition, Universities Press, 2008.

b. Recommended Reading

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Edition, MIT Press, 2009.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, 2nd Edition, Wiley India, 2013.

3. Bradley N. Miller, David L. Ranum, Problem Solving with Algorithms and Data Structures Using Python, 2nd Edition, Wiley, 2011.

c. Websites

1. https://www.geeksforgeeks.org
2. https://www.leetcode.com
3. https://www.programiz.com

d. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

11. Course Organization

Course Code	PTU302A		
Course Title	Logic and Coding		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Integrated Design Project

Course Title	Integrated Design Project
Course Code	MEP401A
Course Type	Project
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to give students experience of identifying an engineering problem, conceptualising a solution, performing basic design calculations, modelling, solving and analyzing it, and demonstrating its performance in a virtual environment and/or through a prototype. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new engineering solution is required. The team needs to demonstrate the working of the solution and write a technical report. Students are required to choose a project from the students' projects database available in the Department.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	0:0:8
Total number of hours available per student	120
Total number of hours for the team of 4 members	480
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Program Outcomes and Assessment

- **Program Outcome 2 (Problem Analysis)**
  The assessment of this Program Outcome is carried out during the Pre-Project Presentation through the evaluation of Problem Identification and Relevance, Literature Survey and Gap Identification, Problem Analysis and Requirement Specification, and Feasibility Analysis and Project Planning. Students are evaluated based on their ability to identify relevant engineering problems, conduct literature review, analyze requirements, establish the need for the proposed solution, and develop a feasible project execution plan.
- **Program Outcome 3 (Design/Development of Solutions)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Design and Development of Solution and Implementation and Validation of Solution. Students are assessed on their ability to develop engineering solutions, apply design principles, implement the proposed solution, validate the outcomes, and demonstrate the effectiveness of the developed system or process.
- **Program Outcome 5 (Modern Tool Usage)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Engineering Tool Usage

and Application of Engineering Tools. Students are evaluated based on their ability to select and utilize appropriate modern engineering tools, software packages, simulation platforms, analytical techniques, and experimental methods for the design, analysis, implementation, and validation of the project.

- **Program Outcome 7 (Ethics and Professional Practice)**
  The assessment of this Program Outcome is carried out during the Final Project Presentation through the evaluation of Ethics and Professional Practice. Students are assessed based on their consideration of ethical, environmental, safety, sustainability, social, and professional aspects associated with the developed engineering solution.
- **Program Outcome 8 (Individual and Collaborative Teamwork)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Individual and Collaborative Teamwork. Students are evaluated based on their ability to function effectively as individuals and as members of a team, contribute to collaborative activities, manage responsibilities, and demonstrate professional interaction during project execution.
- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Technical Communication, Final Report Preparation, Presentation, and Project Defense. Students are assessed based on their ability to prepare technical documentation, communicate engineering concepts effectively through oral presentations, defend their work, and participate in technical discussions.
- **Student-Specific Program Outcome Mapping**
  In addition to the direct assessment of the targeted Program Outcomes, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes and Program Specific Outcomes addressed through the individual project activities undertaken by each student. The mapping is carried out based on the nature of the problem, design activities, tools used, implementation approaches, and learning outcomes achieved during the project. This mapping is used solely for documenting outcome attainment and NBA compliance purposes and is not considered for evaluation or allocation of marks in the Integrated Design Project course.

4. Evaluation Methodology

The Integrated Design Project carries a maximum of 100 marks and is assessed in three stages, namely the Pre-Project Presentation, the Interim Project Presentation, and the Final Project Presentation, conducted by a panel of examiners. The evaluation criteria, stage-wise marks distribution, performance-level descriptors, and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section INTEGRATED DESIGN PROJECT. The said document shall be read in conjunction with these Course Specifications and is available with the Department, ensuring systematic, transparent, and outcome-based assessment of student performance across all stages of project execution.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: INTEGRATED DESIGN PROJECT).

6. Course Organization

Course Code	MEP401A		
Course Title	Integrated Design Project		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Internship-3

Course Title	Internship-3
Course Code	MEI401A
Course Type	Skill Enhancement Course
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

Students are required to undergo an internship of 60 hours during the vacation following the completion of the 6th Semester. The internship is carried out using the facilities available within the University and/or outside the University, under the guidance of a faculty mentor. It aims to reinforce classroom learning while fostering creativity, problem solving, teamwork and entrepreneurial thinking, thereby bridging the gap between academic knowledge and real-world applications.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	60
Number of Weeks in a Semester	15*
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

* For credit computation only; the 60 internship hours are completed during the vacation period

3. Addressed POs and assessment

- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out through Technical Report Preparation and Documentation and Presentation and Communication Skills. Students are evaluated based on their ability to prepare professional technical reports, effectively present their internship work, communicate engineering concepts clearly, and participate in technical discussions and viva voce examinations.
- **Program Outcome 11 (Lifelong Learning)**
  The assessment of this Program Outcome is carried out through Initiative towards Learning New Concepts/Skills and Reflection on Learning and Professional Development. Students are evaluated based on their ability to undertake self-directed learning, acquire new technical competencies, reflect on their professional growth, and demonstrate commitment towards continuous learning and professional development.
- **Other Program Outcomes**
  In addition to the direct assessment of PO9 and PO11, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes addressed through the individual internship activities undertaken by each student. The mapping is carried out based on the nature of work performed, engineering tasks executed, tools employed, and learning experiences gained during the internship. This mapping is used solely for documenting Program Outcome attainment and is not considered for evaluation or allocation of marks in the internship course.

4. Evaluation Methodology

The internship carries a maximum of 50 marks and is assessed through the internship technical report, presentation, and viva voce examination conducted by a panel of examiners at the beginning of the 7th Semester. The evaluation criteria, marks distribution, performance-level descriptors, and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section INTERNSHIP. The said document shall be read in conjunction with these Course Specifications and is available with the Department of Mechanical Engineering, ensuring outcome-based and transparent assessment of student performance.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: INTERNSHIP).

6. Course Organization

Course Code	MEI401A	
Course Title	Internship-3	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Capstone Project

Course Title	Capstone Project
Course Code	MEP412A
Course Type	Project
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to give students experience of identifying an engineering problem, conceptualising a solution, performing basic design calculations, modelling, solving and analyzing it, and developing a prototype or working model to demonstrate its performance. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new engineering solution is required. The team needs to demonstrate the working of the solution and write a technical report. Students are required to choose a project from the students' projects database available in the Department.

2. Course Size and Credits:

Number of Credits	12
Credit Structure (Lecture: Tutorial: Practical)	0:0:24
Total number of hours available per student	360
Total number of hours for the team of 4 members	1440
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

- **Program Outcome 1 (Engineering Knowledge)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation through the evaluation of Application of Engineering Knowledge. Students are assessed based on their ability to apply engineering fundamentals, domain-specific knowledge, and technical concepts to analyze and solve complex engineering problems addressed in the capstone project.

- **Program Outcome 2 (Problem Analysis)**
  The assessment of this Program Outcome is carried out during the Pre-Project Presentation through the evaluation of Problem Identification and Relevance and Literature Review and Gap Analysis. Students are assessed based on their ability to identify relevant engineering problems, perform a comprehensive literature review, identify research gaps, and formulate well-defined problem statements.

- **Program Outcome 3 (Design/Development of Solutions)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Design and

Development of Solution and Implementation and Validation of Solution. Students are assessed based on their ability to develop, implement, optimize, and validate engineering solutions that address the identified problem effectively.

- **Program Outcome 4 (Investigation of Complex Problems)**
  The assessment of this Program Outcome is carried out during the Pre-Project Presentation and Interim Project Presentation through the evaluation of Investigation Methodology, Project Planning and Feasibility Analysis, and Investigation, Analysis and Validation. Students are assessed based on their ability to design appropriate methodologies, perform investigations, analyze data, validate results, and establish the feasibility of the proposed solution.

- **Program Outcome 5 (Modern Tool Usage)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Engineering Tool Usage and Application of Engineering Tools. Students are assessed based on their ability to select and apply appropriate engineering software, analytical methods, simulation tools, experimental techniques, and modern engineering tools for project execution and validation.

- **Program Outcome 7 (Ethics and Professional Practice)**
  The assessment of this Program Outcome is carried out during the Final Project Presentation through the evaluation of Ethics and Professional Practice. Students are assessed based on their consideration of ethical, environmental, safety, sustainability, social, and professional aspects associated with the proposed engineering solution.

- **Program Outcome 8 (Individual and Collaborative Teamwork)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Individual and Collaborative Teamwork. Students are assessed based on their ability to work effectively as individuals and team members, share responsibilities, collaborate professionally, and contribute to the successful completion of the project.

- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out during the Interim Project Presentation and Final Project Presentation through the evaluation of Technical Communication, Final Report Preparation, Presentation, and Project Defense. Students are assessed based on their ability to prepare technical reports, communicate engineering concepts effectively, present project outcomes, and defend their work during technical discussions and viva voce examinations.

- **Program Outcome 10 (Project Management and Financial Planning)**
  The assessment of this Program Outcome is carried out during the Final Project Presentation through the evaluation of Project Management and Financial Planning. Students are assessed based on their ability to plan project activities, manage resources and timelines, estimate costs, and demonstrate an understanding of project management and financial considerations associated with engineering projects.

- **Program Outcome 11 (Life-long Learning and Professional Development)**
  The assessment of this Program Outcome is carried out during the Final Project Presentation through the evaluation of Life-long Learning and Professional Development.

Students are assessed based on their initiative towards self-learning, acquisition of new knowledge and skills, reflection on learning experiences, and commitment towards continuous professional and personal development.

- **Student-Specific Program Outcome Mapping**
  In addition to the direct assessment of the targeted Program Outcomes, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes and Program Specific Outcomes addressed through the individual capstone project activities undertaken by each student. The mapping is carried out based on the nature of the problem, investigation methods, design activities, engineering tools used, implementation approaches, and learning outcomes achieved during the project. This mapping is used solely for documenting outcome attainment and NBA compliance purposes and is not considered for evaluation or allocation of marks in the Capstone Project course.

- **Evaluation Methodology**
  The evaluation of the Capstone Project is conducted as per the evaluation metrics and assessment rubrics developed and approved by the Department, ensuring systematic, transparent, and outcome-based assessment of student performance across all stages of project execution.

4. Evaluation Methodology

The Capstone Project carries a maximum of 100 marks and is assessed in three stages, namely the Pre-Project Presentation, the Interim Project Presentation, and the Final Project Presentation, conducted by a panel of examiners. The evaluation criteria, stage-wise marks distribution, performance-level descriptors, and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section CAPSTONE PROJECT. The said document shall be read in conjunction with these Course Specifications and is available with the Department, ensuring systematic, transparent, and outcome-based assessment of student performance across all stages of project execution.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: CAPSTONE PROJECT).

6. Course Organization

Course Code	MEP412A	
Course Title	Capstone Project	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Technical Seminar

Course Title	Technical Seminar
Course Code	MES411A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to train the students in data collection, analysis and presentation about a chosen topic. In this course students are required to deliver seminars on various relevant topics from the broad areas mentioned in the course content. The learner shall search in the literature, including peer-reviewed journals, conference proceedings, books, project reports, etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. Students will be trained to prepare a brief report on the chosen seminar topic and to present and defend it before a panel of examiners.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Program Outcomes (POs)

- **Program Outcome 2 (Problem Analysis)**
  The assessment of this Program Outcome is carried out through the evaluation of Topic Identification and Relevance, Literature Review, and Technical Analysis and Content Depth. Students are assessed based on their ability to identify relevant engineering problems or research areas, conduct a comprehensive review of recent literature, identify research gaps, critically analyze technical information, compare existing methodologies, interpret results, and demonstrate a thorough understanding of the selected technical topic.

- **Program Outcome 9 (Communication)**
  The assessment of this Program Outcome is carried out through the evaluation of Technical Report Preparation and Presentation and Communication. Students are assessed based on their ability to prepare technically sound and professionally organized reports, communicate engineering concepts effectively through oral presentations, use appropriate visual aids, respond to technical questions, and demonstrate effective written and verbal communication skills.

- **Program Outcome 11 (Life-long Learning and Professional Development)**
  The assessment of this Program Outcome is carried out through the evaluation of Self-Learning and Technical Updates. Students are assessed based on their ability to independently acquire new knowledge, explore recent technological developments, utilize contemporary technical resources, standards, tools, and emerging technologies, and demonstrate commitment towards continuous learning and professional development.

- **Student-Specific Program Outcome Mapping**
  In addition to the direct assessment of the targeted Program Outcomes, a Student-Specific Program Outcome Mapping Sheet is maintained to document all Program Outcomes and Program Specific Outcomes addressed through the individual technical seminar topics undertaken by each student. The mapping is carried out based on the selected topic, literature reviewed, technical analysis performed, and learning outcomes achieved during the seminar. This mapping is used solely for documenting outcome attainment and NBA compliance purposes and is not considered for evaluation or allocation of marks in the Technical Seminar course.

- **Evaluation Methodology**
  The evaluation of the Technical Seminar course is conducted as per the evaluation metrics and assessment rubrics developed and approved by the Department, ensuring systematic, transparent, and outcome-based assessment of student performance.

4. Evaluation Methodology

The Technical Seminar carries a maximum of 50 marks and is assessed through the seminar technical report, presentation, and viva voce conducted by a panel of examiners. The evaluation criteria, marks distribution, performance-level descriptors, and assessment sheets are prescribed in the Department-approved document "Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029", under the section TECHNICAL SEMINAR. The said document shall be read in conjunction with these Course Specifications and is available with the Department, ensuring systematic, transparent, and outcome-based assessment of student performance.

5. Reference Documents

a) Standard Operating Procedure (SOP) and Evaluation Metrics – B.Tech. in Mechanical Engineering Degree Programme (Programme Code: 005), Batch 2025–2029, Department of Mechanical Engineering, Faculty of Engineering and Technology (Section: TECHNICAL SEMINAR).

6. Course Organization

Course Code	MES411A	
Course Title	Technical Seminar	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Design Thinking and Idea Lab

Course Title	Design Thinking and Idea Lab
Course Code	DIL101A
Course Type	ESC (SEC)
Department	All Departments(FET)
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to create a strong foundation on Design Thinking and Idea Lab. The primary objective of this course is to introduce students to innovative approaches for creative problem-solving, with a focus on the Design Thinking process and its application in developing impactful products. It aims to prepare students for their engineering careers by nurturing a mindset geared towards innovation. The course will help students gain hands-on experience with various tools and resources available in the IDEA Lab. They will also learn essential mechanical and electronic fabrication techniques. Emphasis is placed on acquiring the practical skills needed to design and build standalone systems or projects, including their physical enclosures. Additionally, students will be trained to create professional print and electronic documentation for their projects, ensuring a comprehensive understanding from concept to completion.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	1:0:2
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Electrical and Electronics Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Apply different stages of design thinking and its processes
CO-2: Design real-time innovative engineering products
CO-3: Demonstrate proficiency in using tools and equipment's at IDEA Lab
CO-4: Exhibit capstone project

4. Course Contents:

Unit 1 (Self-Awareness, Learning, and Emotional Intelligence): The unit helps students understand how they learn, retain information, and interact with others. It covers Kolb's Learning Styles, memory processes, retention techniques, and emotional expression with an emphasis on empathy. Activities promoting self-awareness and appreciation of individual differences are included to foster collaborative learning.

Unit 2 (Design Thinking and Innovation for Problem Solving): Introduced to the principles and stages of Design Thinking—Empathize, Define, Ideate, Prototype, and Test—through real-world examples. The unit develops creative thinking, structured problem-solving, and product design skills, culminating in a hands-

on project that addresses an engineering challenge using innovative solutions.

5. List of Demonstrations:

Demonstration 1: Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.

Demonstration 2: Machining of 3D geometry on soft material such as soft wood or modelling wax

Demonstration 3: 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.

Demonstration 4: 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.

Demonstration 5: 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs

Demonstration 6: Familiarity and use of welding equipment.

Demonstration 7: Familiarity and use of normal and wood lathe.

Demonstration 8: Embedded programming using Arduino and/or Raspberry Pi.

Demonstration 9: Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

6. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3	1											
CO-2		2	3	1	3	1		3			3		
CO-3					3	1		3	2				
CO-4					3			3	3		3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

7. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		05
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Terms, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**60**

8. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE, COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Project)				
Focus of COs on each Component or Subcomponent of Evaluation				
Course Outcome	**CE (Weightage: 60 %)**		**SEE - Theory (Weightage: 10 %)**	**SEE- Project Presentation (Weightage: 30 %)**
	Tests / objectives (30 %)	**Interim Project Presentation (30%)**	**Written exam**	**Micro Capstone Project Demonstration**
CO-1	x		x	
CO-2		x		x
CO-3		x		x
CO-4				x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

9. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

4.	Analytical Skills	Assignment, Lab
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment, Lab
7.	Group Work	Assignment
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Presentation, Lab
11.	Presentation Skills	Presentation
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

10. Course Resources

- **Essential Reading**
  1. Course Notes
  2. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
  3. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual),Khanna Book Publishing.

- **Recommended Reading**
  1. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393,Khanna Book Publishing Company, New Delhi.
  2. Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
  3. 3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
  4. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects.Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.

- **Magazines and Journals**
  1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
  2. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

- **Websites**
  1. https://www.aicte-india.org/
  2. https://idealnet.aicte.gov.in/

- **Other Electronic Resources**

Course Specifications: Foundation Mathematics-1

Course Title	Foundation Mathematics-1
Course Code	MTF210A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts of calculus, partial derivatives, and matrix algebra. Students are taught the concepts of limits, continuity, differentiation, series expansion for the functions of one variable, indefinite and definite integrals of single real variable functions. Mathematical operations in matrix theory, elementary row operations, row reduced echelon form, eigenvalue and eigenvector of the matrix, solution for linear system of equations and implementation are discussed in this course.

2. Course Size and Credits:

Number of Credits	00
Credit Structure (Lecture: Tutorial: Practical)	1:1:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the principles of single variable calculus, multivariable calculus, and matrix algebra to solve mathematical problems arising in science and engineering.
- **CO-2.** Analyze the problem-solving techniques using concepts of single and multivariable calculus, optimization, matrix operations, linear systems, eigenvalues, and eigenvectors.

4. Course Contents

Unit 1: (Single Variable Calculus): (15 Hours)

Functions of single real variable with graphical representation, concept of limit and continuity. Differentiation - product rule, quotient rule and chain rule. Indefinite integrals, methods of integration - integration by parts, integration by substitution, integration by method of partial fractions. Problems on definite integrals, evaluation of integrals using gamma and beta functions. Power series, Taylor's and Maclaurin's series.

Unit 2 (Two Variable Calculus): (7 Hours)

Functions of two variables, partial differentiation. Total differential, errors and approximations. Partial differentiation of composite functions - chain rule, unconstrained and constrained extrema.

Unit 3 (Matrix Algebra): (8 Hours)

Matrix algebra, elementary row operations, row reduced echelon form. Linear system of equations, existence and uniqueness of solution. Eigenvalues and eigenvectors for 2X2 matrix.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3	3											
CO-2	3	3											
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	

6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In CE component or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (100% Weightage): 50 marks				**Component 2: SEE (0% Weightage)**
	50% Weightage		**50% Weightage**		
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Quiz**	
Maximum Marks ▶	**25**	**25**	**40**	**10**	
CO-1	×	×		×	
CO-2	×	×	×	×	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. James Stewart, 2015, Calculus: Early Transcendental, 8th edition, Boston, Cengage Learning.
2. Steven Leon, 2014, Linear Algebra with Application, 9th edition, New Jersey, Pearson.
3. Erwin Kreyszig, 2014, Advanced Engineering mathematics, U K, Wiley

b. Recommended Reading

4. Maurice D. Weir and Joel Hass, 2017, Thomas Calculus, 13th edition, New Jersey, Pearson.
5. Gilbert Strang, 2016, Introduction to Linear Algebra, 5th edition, Massachusetts, Cambridge Press.

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. https://www.khanacademy.org/
3. tutorial.math.lamar.edu/

10. Course Organization

Course Code	MTF210A		
Course Title	Foundation Mathematics-1		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	080 4906 5555
		E-mail:	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Foundation Mathematics -2

Course Title	Foundation Mathematics - 2
Course Code	MTF220A
Course Type	Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts of vector calculus, vector spaces, and numerical methods. The solution procedures for standard problems involving vector operations, vector fields, and coordinate systems are illustrated. The role and relevance of vector spaces and vector calculus in modelling real-world scientific and engineering problems are emphasized. The significance of numerical techniques in approximating solutions to mathematical problems is discussed. Numerical methods for solving nonlinear equations, systems of linear equations, interpolation problems, and numerical integration are studied.

2. Course Size and Credits:

Number of Credits	00
Credit Structure (Lecture: Tutorial: Practical)	1:1:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of vector algebra, vector calculus, and numerical methods to solve engineering and mathematical problems.
- **CO-2.** Evaluate the numerical and interpolation techniques for solving algebraic equations, systems of equations, interpolation problems, and numerical integration problems.

4. Course Contents

Unit 1 (Vector Calculus):
Scalar and vector product of two vectors, dot product of three vectors and their applications. Vector and scalar fields, derivatives of vector valued functions, curves, tangents, arc length. Gradient of a scalar field, directional derivatives, divergence and curl of a vector field. Introduction to Polar, Cylindrical and Spherical coordinates systems**.**

Unit 2 (Vector Spaces):
Vector spaces, subspaces, linear independence, basis and dimension. Row, column and null space of a matrix, Rank-Nullity Theorem.

Unit 3 (Numerical Methods):
Numerical solution of algebraic and transcendental equations, Newton-Raphson method. Numerical solution of linear system of equations- Gauss-Seidel method. Interpolation - Lagrange interpolation. Numerical Integration – trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3	3											
CO-2	2	3											
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Mechanical Engineering Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the CO's. In CE component or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (100% Weightage): 50 marks				Component 2: SEE (0% Weightage)
	50% Weightage		50% Weightage		
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Quiz	
Maximum Marks ▶	25	25	40	10	
CO-1	×	×		×	
CO-2	×	×	×	×	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes.

2. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson.
3. Steven J. Leon, 2010, Linear Algebra with Applications, 8th edition, Pearson.
4. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition, Massachusetts, Brooks/Cole.

b. Recommended Reading

1. Marsden and Tromba, 2012, Vector Calculus, 6th edition, W. H. Freeman and Company.
2. Dennis G.Z, 2017, Advance Engineering Mathematics, 6 th edition, Jones and Bartlett India Pvt.Ltd.
3. Grewal B S, 2021, Higher Engineering Mathematics, 44th edition, Khanna Publication.
4. S.S Sastry, 2012, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited.

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. https://ocw.mit.edu/index.htm
4. Tutorial.math.lamar.edu/

e. Other Electronic Resources

10. Course Organization

Course Code	MTF220A	
Course Title	Foundation Mathematics-2	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	080 4906 5555
	E-mail:	hod.mt.mp@msruas.ac.in
Course Specifications Approval Date	**June 2026**	
Next Course Specifications Review Date	**June 2030**	

Course Specifications: Kannada Kali

Course Title	Kannada Kali
Course Code	TSM104A
Course Type	Theory
Department	Mechanical Engineering
Faculty/ School	Engineering and Technology

1. Aim and Summary

To enable students to communicate in Kannada at a rudimentary level. To understand basic conversation and to familiarize with basic legal usage.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	1:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Humanities
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes

4. After undergoing this course, students will be able to:.

CO-1 Develop Kannada communication skills necessary for day-to-day conversation.

5. Course contents

Unit 1:

a) ಕನ್ನಡ ಅಕ್ಷರಮಾಲೆ

b) ಸ್ವರಗಳು

ಹ್ರಸ್ವಸ್ವರ

ದೀರ್ಘಸ್ವರ

C) ಸಂಧ್ಯಾಕ್ಷರಗಳು

d) ಯೋಗವಾಹಕಗಳು

e) With respect or Plural (wrp) Kannada word, English word, and simple sentences. – Session 1

Unit 2:

With respect or Plural (wrp) Kannada word, English word, and simple sentences. – Session 2

a) ವ್ಯಂಜನಗಳು

ವರ್ಗೀಯ ವ್ಯಂಜನಗಳು ವಿವರಣೆ

ಅವರ್ಗೀಯ ವ್ಯಂಜನಗಳು ವಿವರಣೆ

b) ಅಲ್ಪಪ್ರಾಣ ಮಹಾಪ್ರಾಣ ಅನುನಾಸಿಕ ಪದಗಳು

c) ಗುಣಿತಾಕ್ಷರಗಳು ವಿವರಣೆ

ಲೇಖನ ಚಿಹ್ನೆಗಳು ವಿವರಣೆ

d) ಕನ್ನಡದ ಅಂಕಿಗಳು ಬರವಣಿಗೆ

ವಾಕ್ಯಗಳಲ್ಲಿ ಪ್ರಯೋಗ ಮಾಡುವುದು

Unit 3:

With respect or Plural (wrp) Kannada word, English word, and simple sentences. – Session 3

- **Words conveying relations**
- **Numbers 1 to 20 and 10 to 100**
- **Commonly required vegetables, fruits and colors name**

Unit 4:

a) ಕಾನೂನು ಪದಕೋಶ

(ಕನ್ನಡ ಟು ಇಂಗ್ಲಿಷ್ ಮತ್ತು ಇಂಗ್ಲಿಷ್ ಟು ಕನ್ನಡ)

b) ನ್ಯಾಯಾಲಯದ ಪರಿಭಾಷೆಯಲ್ಲಿ ಎರವಲು ಪದಗಳು

C) ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ಬರವಣಿಗೆ

ಸಾಮಾಜಿಕ ಪತ್ರ

ವ್ಯವಹಾರಿಕ ಪತ್ರ

ಉದಾಹರಣೆಗಳ ಸಮೇತ ಬರೆಯುವುದು

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech Programme (Mechanical Engineering) The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table:

Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent	SC1 30 marks	SC2 30 marks	
Subcomponent Type	Term Test	Term Test	50 Marks
Maximum Marks	25	25	
Weightage (%)	30	30	40
CO-1			
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Essential Reading:

1. Lingadevaru Halemane , Kannada Kali, A Language text book for Non Kannada Professional Degree courses
2. N. Gopalkrishna Udupa, Kannada Vyakarna Rachana (Kannada Grammar), 2020
3. U.R. Mediratta & Mehul Mediratta, General English Kannada (for all classes), Kannada Edition, 2016
4. Pramilamma, Sulabha Kannada Vyakarna, Sunstar Publishers, 2022

Suggested Reading:

1. B.S. Rukkamma, Navkarnataka Sachitra Sarala Vyakarna, 2012
2. S.N. Sridhar, Modern Kannada Grammar, Manohar publications, 2007.
3. Wren & Martin, revised by N.D.V Prasada Rao, High School English Grammar & Composition (English-Kannada), S. Chand.

8. Course Organization

Course Code	TSM104A	
Course Title	Kannada Kali	
Course Leaders Name	As per Timetable	
Course Leader Contact Details	**Phone:**	080 – 4536 6666
	E-mail:	director.tsld@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date:	June 2030	

Course Specifications: Data Analytics

Course Title	Data Analytics
Course Code	CSE421A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course enables the students to design, develop, analyze and evaluate Data Analytics applications employing appropriate techniques, methods and technology. The role and application of Data Analytics in various application domains of computing is discussed. Machine Learning and Data Mining methods are employed for Knowledge Discovery in textual and other forms of structured and unstructured data. Students are trained in the use of modern techniques and technologies to develop Data Analytics applications.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of knowledge representation, machine learning and data mining to discuss and compare data analytics techniques for various application domains
- **CO-2.** Analyse data and evaluate the performance of analytics applications by selecting appropriate data warehousing, machine learning and various data mining techniques
- **CO-3.** Solve large-scale data analysis problems to generate actionable insights from given datasets using appropriate tool

4. Course Contents

Unit 1 (Introduction):

Data Analytics and its role in Business Intelligence and Knowledge Discovery. Data Analytics processes (Life Cycle): Preparation, Warehousing, Analysis, Mining, Validation and Performance Evaluation. Data Analytics tools and platforms

Unit 2 (Data Management):

Data Definitions and Analysis Techniques, Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Measures of central tendency, Measures of location of dispersions, Normalization techniques.

Unit 3 (Big Data Processing):
Traditional Data Base systems for data storage and processing. Data Warehousing and Analysis, Big Data. Modern platforms for data storage and processing: Cloud computing.

Unit 4 (Data Analysis Techniques):
Regression analysis, Classification techniques, Clustering, Association rules analysis, Artificial neural networks, Handling of outliers and Anomalies, cross- validation and sensitivity analysis.

Unit 5 (Data Visualization):
Text Mining, Mining other forms of data. Data Visualization and Reporting: Concepts, methods and tools for enterprise data visualization and reporting. Laboratory exercise.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2		2											2
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	

6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X	X		X	X
CO-2	X	X		X	X
CO-3			X		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination

14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Mohammed J. Zaki, Wagner Meira, (2020), Data Mining and Analysis, Cambridge University Press.

b. Recommended Reading

1. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
2. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
3. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013
4. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
5. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and Piercesare Secchi, Springer, 2013
6. Hadoop: The Definitive Guide (2nd Edn.) by Tom White, O'Reilly, 2014.

c. Magazines and Journals

1. Analytics Magazine from INFORMS
2. Big Data Open Access Journal

d. Websites

1. http://flowingdata.com/Abbott Analytics
2. http://abbottanalytics.blogspot.com/
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	CSE421A	
Course Title	Data Analytics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Sustainable Energy Technologies

Course Title	Sustainable Energy Technologies
Course Code	MEE406A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The world is passing through revolutionary shift in the field of energy generation and utilization as sustainability problems related to pollution and climate change force a shift from traditional fossil fuel based energy to renewable and carbon neutral sources of energy. This course attempts to provide a synoptic overview of the rapidly developing ecosystem of sustainable energy technologies that are being developed and deployed to exploit the various carbon neutral energy resources, to improve the efficiency and sustainability of current energy systems and to develop a more flexible energy grid and energy storage system for the future. India is expected to remain as one of the largest producers and consumers of energy in this coming decades and challenges and opportunities for the Indian energy ecosystem will also be highlighted. While the course will not delve deep into any one technology, the course will provide a broad description of each of the technologies and their associated basic theoretical and analytical underpinnings.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the global energy landscape, sustainability imperatives, and the working principles of solar, wind, biomass, hydro, and hydrogen-based renewable energy technologies

CO-2. Analyse the performance characteristics, design considerations, and application potential of sustainable energy systems to determine their suitability for given energy requirements and operating conditions

CO-3. Evaluate the role of energy storage systems, smart grids, and next-generation sustainable energy technologies in addressing environmental challenges and enabling a low-carbon energy transition

4. Course Contents

Unit 1 (Global Energy Scenario and Sustainability): Global energy demand and consumption trends – Conventional and non-conventional energy resources – Fossil fuel depletion – Climate

change and environmental impacts – Greenhouse gas emissions – Sustainability concepts and sustainable development goals – Carbon neutrality and net-zero energy systems – Indian energy scenario, policies, and future challenges.

Unit 2 (Fundamentals of Energy Conversion and Sustainability): Principles of energy conversion – Thermodynamic aspects of energy systems – Energy efficiency and exergy concepts – Environmental impacts of energy conversion – Life cycle assessment (LCA) – Carbon footprint analysis – Sustainable engineering principles – Energy economics and cost analysis.

Unit 3 (Solid Waste Management & Energy Conversion Technologies): Introduction: global and Indian waste scenario; waste composition; energy potential; waste hierarchy; role of WtE in circular economy; classification of waste for energy conversion. Thermochemical technologies; pyrolysis; gasification; Biochemical technologies; Landfill gas recovery; Integrated WtE systems; Economics and policy; Environmental challenges; Case studies: Timarpur-Okhla Delhi; biogas yield calculation and CHP sizing for a given organic waste stream; mass and energy balance for a moving grate incineration plant; R1 formula application

Unit 4 (Hydro, Geothermal and Hydrogen Energy Systems): Hydropower generation principles and small hydro systems – Geothermal energy systems – Hydrogen production, storage, and transportation – Fuel cells and applications – Challenges in hydrogen economy.

Unit 5 (Energy Storage, Smart Grids and Future Energy Systems): Energy storage technologies – Batteries, supercapacitors, and thermal energy storage – Hybrid renewable energy systems – Smart grids and microgrids – Electric vehicles and charging infrastructure – Energy management systems – AI and IoT applications in energy systems – Future trends in sustainable energy technologies.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2											3	
CO-2		3										3	
CO-3						3						3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00

1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes.
2. John Twidell and Tony Weir, (2015) *Renewable Energy Resources*, 3rd Edition, Routledge/Taylor & Francis Group.
3. G.D. Rai, (2017), *Non-Conventional Energy Sources*, 6th Edition, Khanna Publishers, New Delhi.
4. V.V.N. Kishore, (2014), *Renewable Energy Engineering and Technology*, 2nd Edition, TERI Press, New Delhi.
5. Godfrey Boyle, (2012), *Energy Systems and Sustainability: Power for a Sustainable Future*, 3rd Edition, Oxford University Press.

b. Recommended Reading

1. John A. Duffie and William A. Beckman, *Solar Engineering of Thermal Processes*, 4th Edition, Wiley, 2013.
2. D. Mukherjee, *Fundamentals of Renewable Energy Systems*, New Age International Publishers, 2011.
3. Stephen Peake, *Renewable Energy: Power for a Sustainable Future*, 4th Edition, Oxford University Press, 2018.
4. Charles F. Kutscher, Jana B. Milford, and Frank Kreith, *Principles of Sustainable Energy Systems*, 3rd Edition, CRC Press, 2018.
5. Vaughn Nelson and Kenneth Starcher, *Introduction to Renewable Energy*, 2nd Edition, CRC Press, 2015.

c. Magazines and Journals

1. Renewable Energy
2. Solar Energy
3. Energy for Sustainable Development
4. International Journal of Renewable Energy Research

d. Websites

1. https://ocw.mit.edu/index.htm
2. https://www.coursera.org/

3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE406A		
Course Title	Sustainable Energy Technologies		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Operations Research

Course Title	Operations Research
Course Code	MEE408A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course aims to provide knowledge of optimal design and operation of man - machine systems usually requiring the allocations of scarce resources. Different approaches to balancing conflicts objectives, in the light of alternative courses of action, will be taught. The students will be introduced to constructing mathematical, economic or statistical models of the problem and analyse the relationships among different variables associated with the problem to determine consequences of decision alternatives. In addition, students will be trained to suggest suitable measures to evaluate the merit of decision alternatives.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss the principles of linear programming models and define the various mathematical functions of an existing system

CO-2. Analyze the objectives and constraints of a system to optimize the utilization of resources for obtaining the most feasible solution for the identified problem

CO-3. Develop a mathematical model for optimizing the operations of an existing system and perform a sensitivity analysis to validate the model

4. Course Contents

Unit 1 (Quantitative Approach to Decision Making): History, Nature and significance of OR, Features of OR, Models and modelling in OR, Methods of solution in OR, OR as a tool for research study, Applications of OR and basic OR models

Unit 2 (Project Strategy and its Variables): (Linear Programming): LP and allocation of resources, LP definition, Linearity requirement Maximization, Minimization problems, Graphical LP Minimization solution, Simplex method definition, formulating the Simplex

model, Simplex Method for similar and mixed limitations, Example containing mixed constraints, Minimization example for similar limitations, Revised Simplex Method and Dual Simplex Method; Sensitivity Analysis: Changes in Objective Function, Changes in RHS, Big M Method

Unit 3 (Game Theory): Fundamentals, Two-Person Zero-Sum Games, The Maximin-Minimax Principle, Games without saddle points – Mixed Strategies, Dominance Property, Algebraic method of solving rectangular games, Minimax and Saddle point theorems

Unit 4 (Sequencing and Transportation Model): Problems with 'n' jobs and two machines, Problems with 'n' jobs and three machines, Problems with 'n' jobs and 'm' machines, Graphical solutions.
Transportation Model: Basic Assumptions; Solution Methods: Feasible Solution: The Northwest Method, The Lowest Cost Method; Optimal Solution: The Stepping Stone Method, Modified Distribution (MODI) Method, Degeneracy in Transportation Problems, Assignment Problem, Travelling Salesman Problem

Unit 5 (Queuing Theory and Simulation): Essential Features of a Queuing System; Performance Measures of a Queuing System; Probability Distributions in Queuing Systems; Queuing Models and their Solutions: Single Server Queuing Model, Multi – Server Queuing Model; Application to Engineering and Business Problems

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2												2
CO-2			2										2
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment

5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes
2. J. K. Sharma, 2013, Operations Research: Theory and Applications, Macmillan Publishers
3. Dan Epstein and Rich Maltzman (2013), Project Workflow Management: A Business Process Approach, J Ross Publishing
4. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag and Preetam Basu, (2025), Introduction to Operations Research, McGraw-Hill Publications

b. Recommended Reading

1. A. Ravindran, Don .T Philips, James J. Solberg, 1987, Operations Research: Principles and Practice, 2nd Edition, Wiley & Sons Chris Croft (2022), Project Management Quickstart Guide, Clydebank Media LLC
2. Harvir Singh Kasana and Krishna Dev Kumar, 2010, Introductory Operations Research: Theory and Applications, Springer
3. Hamdy A. Taha, 2010, Operations Research: An Introduction, Pearson
4. Wayne L. Winston, 2004, Operations Research: Applications and Algorithms, 4th Edition, Indian University

c. Magazines and Journals

1. Journal of Operations Research Society, The OR Society Publications
2. Interfaces: An International Journal of the Institute of Operations Research and Management Sciences (INFORMS) Publications
3. International Journal of Operations and Production Management, Emerald Group Publications

d. Websites

1. http://www.theorsociety.com
2. http://www.phpsimplex.com
3. http://www.orsi.in
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE408A		
Course Title	Operations Research		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Drone Technology

Course Title	Drone Technology
Course Code	MEE409A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course introduces the fundamentals of unmanned aerial vehicles (UAVs), commonly known as drones, including their design, components, flight dynamics, navigation systems, and applications. Students will learn about drone hardware architecture, propulsion systems, sensors, flight controllers, and communication systems. The course also covers simulation, control algorithms, and real-world drone applications such as aerial mapping, surveillance, agriculture, inspection, and delivery systems. Emphasis is given to practical implementation, system integration, and safe drone operation.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Apply the concept of architecture and operational principles of drone and UAV systems for given applications

CO-2. Identify the appropriate hardware components, propulsion systems, sensors, and communication modules to analyze UAV and Drone operation

CO-3. Select and Identify suitable UAV configurations to assess flight dynamics, navigation, and application-specific requirements for real-world scenarios

4. Course Contents

Unit 1 (Introduction to Drone Systems): Introduction to drones and UAV technology, History and evolution of UAVs, Classification of drones: Fixed-wing drones, Rotary-wing drones, Hybrid drones, Basic drone architecture and working principle, Overview of drone components, Civil and military applications of UAVs, Safety guidelines and basic drone regulations.

Unit 2 (Drone Hardware and Components): Drone frame and structural design basics, Propulsion systems: Brushless DC motors, Propellers, Electronic Speed Controllers (ESCs), Batteries and power management systems, Flight controllers and their functions, Sensors used in drones: IMU, GPS, Barometer, Magnetometer, Communication modules and radio

systems, Payload systems and cameras.

Unit 3 (Flight Dynamics and Control): Principles of drone flight, aerodynamics of multirotor drones, roll, pitch and yaw motion, thrust generation and stabilization Introduction to PID control, Attitude stabilization concepts, GPS-based navigation, Autonomous flight and waypoint navigation, Obstacle detection and avoidance basics, Telemetry systems and ground control stations.

Unit 4 (Applications of UAVs in Different Domains): Agriculture monitoring and precision farming, Aerial photography and videography, Mapping and land surveying, Disaster management and rescue operations, Infrastructure and powerline inspection, Logistics and delivery services, Surveillance and security applications, Environmental and wildlife monitoring, Smart city and traffic monitoring, Healthcare and medical supply delivery, Defense and military applications, Industrial inspection and monitoring.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												3
CO-2		2											2
CO-3				2									3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	

4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	X		X	X
CO-2	x	X		X	X
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--

12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Austin, R., (2010), Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley
3. Paul Fahlstrom & Thomas Gleason, (2022), Introduction to UAV Systems, Wiley

b. Recommended Reading

1. Reg Austin, (2010), UAV Systems, Wiley
2. Kimon P. Valavanis, (2022), Handbook of Unmanned Aerial Vehicles, Springer Nature
3. Beard & McLain, (2012), Small Unmanned Aircraft: Theory and Practice, Princeton University

c. Magazines and Journals

1. Journal of Intelligent & Robotic Systems
2. Robotics and Autonomous Systems
3. UAV Systems International Journal

d. Websites

1. https://ardupilot.org
2. https://px4.io
3. https://dronecode.org
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE409A		
Course Title	Drone Technology		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Fluid Power Systems

Course Title	Fluid Power Systems
Course Code	MEE311A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the working of hydraulic and pneumatic actuators. Students will be taught basic principles of hydraulics and pneumatics and their application to fluid power drive systems. Knowledge will be imparted on types of hydraulic and pneumatic drives available for use in various applications and their selection procedures. Students will be able to simulate the working of simple hydraulic and pneumatic systems for better understanding of various components of fluid power systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Apply the principles and fundamentals of fluid power systems
CO-2. Select and evaluate hydraulic and pneumatic components
CO-3. Design and analyse hydraulic and pneumatic circuits for practical applications

4. Course Contents

Unit 1 (Fluid Power):
Review of fundamental properties of fluids; fundamental laws and equations of fluid mechanics applicable to pneumatic and oil hydraulic systems; History, applications, advantages and limitations of fluid power systems; General components of a basic fluid power systems. Pascal's law and its applications. Hydraulic power, Hydraulic circuit analysis.

Unit 2 (Hydraulic pumps and Hydraulic Actuators in Fluid Power):
Pump classification, pumping theory, pressure regulation, Pump performance and its ratings; Pump noise; pump selection Hydraulic cylinders, operating features and types; cylinder mountings and cushioning in hydraulic cylinders; Gear, vane and piston motors; hydraulic motor theoretical torque, power, flow rate and its performance characteristics.

Unit 3 (Control Valves and Pneumatic System):
Non return valves, flow control valves, direction control valves, proportional valves.
Review of properties of air, perfect gas laws; types of compressors and its specifications in pneumatics; working of pneumatic system; comparison of hydraulic and pneumatic system; different types of actuators and control valves used in pneumatic system.

Unit 4 (Hydraulic and Pneumatic Circuits):
Circuit symbols, regeneration in circuits; metering in – metering out circuits; counterbalance circuit; simple hydraulic and pneumatic circuits to accomplish push-pull, fail-safe, quick-return, mechanisms.
Design and analysis of simple hydraulic and pneumatic circuits for better understanding of relationships and interactions of various fluid power system components.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2			3										3
CO-3					2								3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Anthony Esposito, 2013, Fluid Power with Applications, Pearson Education
3. Andrew Par, 2011, Hydraulics and Pneumatics, Jaico Publishing House

b. Recommended Reading

1. Ilango Sivaraman, Introduction to Hydraulics and Pneumatics, PHI, 3rd Edition
2. James L. Johnson, Introduction to Fluid Power, Delmar - A Thomson learning Inc
3. G. E. Totten, 1999, Handbook of Hydraulic Fluid Technology, CRC Press.

c. Magazines and Journals

1. International Journal of Fluid Power
2. International Journal of Fluid Power System
3. Hydraulics and Pneumatics Magazine
4. Drives and controls by Bosch Rexroth

d. Websites

1. http://www.hydraulicspneumatics.com
2. http://www.hpmag.co.uk
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	Fluid Power Systems		
Course Title	MEE311A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Advanced Manufacturing Technologies

Course Title	Advanced Manufacturing Technologies
Course Code	MEE312A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course equips students with the knowledge and analytical skills to understand, compare, and select non-traditional machining processes - spanning mechanical, electrical, electrochemical, and thermal energy-based methods - for precision manufacturing of complex components. This course further bridge into micro and nanofabrication, covering MEMS/NEMS techniques, lithography, CVD and ALD, preparing students to evaluate and apply cutting-edge fabrication technologies for miniaturised and high-precision industrial applications.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Apply the working principles and process parameters of non-traditional machining and advanced fabrication processes to determine their material removal characteristics, merits, demerits and suitability for given manufacturing conditions

CO-2. Discuss the types, process parameters, and performance characteristics of advanced manufacturing processes to compare their applicability for various industrial applications

CO-3. Select the most appropriate non-traditional machining or additive manufacturing process for a given component by evaluating material properties, geometric complexity, surface finish requirements, and production criteria

4. Course Contents

Unit 1 (Non-Traditional Machining Processes and Mechanical Energy based Non-Traditional Process):

Need for and importance of Non-traditional machining process, comparison between traditional and non-traditional machining process, advantages and disadvantages.

Mechanical energy based non-traditional process: Working principles, equipment, Material Removal Rate (MRR), surface finish, process characteristics and applications of Ultrasonic Machining (USM), Abrasive Jet Machining (AJM) and Water Jet Machining (WJM).

Unit 2 (Electrical, Chemical and Electro Chemical Energy based Non-Traditional Process):
Working principles, equipment, MRR, surface finish, process characteristics and applications of Electric Discharge Machining (EDM), Die-Sinker EDM and Wire Cut EDM.
Electro chemical energy based non-traditional process: Working principles, equipment, MRR, surface finish, process characteristics and applications of Electrochemical Machining (ECM), Chemical Machining (CHM) and Electrochemical Grinding (ECG).

Unit 3 (Thermal energy based non-traditional process):
Working principles, equipment, MRR, surface finish, process characteristics and applications of Plasma Arc Machining (PAM), Laser Beam Machining (LBM), Electron Beam Machining (EBM) and Ion Beam Machining (IBM).

Unit 4 (Micro and Nanofabrication):
Material Addition Process - MEMS and NEMS Fabrication Techniques; Basic Micro-fabrication Techniques, Etching and Substrate Removal, Substrate Bonding, MEMS Fabrication Techniques.

Unit 5 (Nanotechnology):
Importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nano Technology, Fundamentals of film growth, Chemical based material addition process – Lithography, Sol-Gel Films, Molecular Beam Epitaxy (MBE), Chemical Vapour Deposition (CVD), Thermal based material addition process - Atomic layer deposition (ALD), Electrochemical deposition (ECD).

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2		2											2
CO-3				3									3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2		x	x		x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. P. N. Rao, 2018, Manufacturing Technology, Machine Tools and Machining Operations, Tata McGraw-Hill
3. Pandey P.C and Shah H.S, 2014, Modern Machining Process, Tata McGraw-Hill Publications
4. Ian Gibson, David W. Rosen, Brent Stucker, (2021), Additive Manufacturing Technologies, Rapid Prototyping to Direct Digital Manufacturing, Springer

b. Recommended Reading

1. V K Jain, 2011, Advanced Manufacturing Processes, India, Allied Publishers Pvt. Ltd.
2. Hassan Abdel-Gawad El-Hofy, 2005, Advanced Machining Processes, India, The Mcgraw Hill Publications
3. Andreas Gebhardt, Jan-steffen Hotter, 2014, Additive Manufacturing Technologies, Hanser Publishers
4. Mikell P. Groover, (1994), CAD/CAM, India, Pearson Education
5. Serope Kalpakjian and S.R. Schmid, (2004), Manufacturing Engineering and Technology, India, Prentice Hall

c. Magazines and Journals

1. Additive Manufacturing Journal
2. International Journal of Additive Manufacturing and Subtractive Materials Manufacturing
3. International Journal of Machine Tools and Manufacturing

d. Websites

1. http://www.advancedmachining.com
2. http://www.progea.com
3. https://www.coursera.org/
4. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	Advanced Manufacturing Technologies		
Course Title	MEE312A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Quality Management and Six Sigma

Course Title	Quality Management and Six Sigma
Course Code	MEE313A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with evolution of quality paradigm and enables students to adopt quality as a strategy for continuous improvement in business performance. The students will be taught strategies of competitive quality, quality in design and manufacture and supplier quality. The student will be able to apply the methodology of Six sigma –DMAIC approach to address industry relevant quality issues. Software tools will be extensively used for data analysis and root cause identification. In addition, the course emphasises the role of Quality Management Systems like ISO 9000, ISO 14000 etc., which are essential part of the present manufacturing organizations.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the evolution of quality management, quality standards and Six Sigma principles in organizational contexts
- **CO-2.** Apply Six Sigma tools and quality management techniques to analyse defects, improve processes and enhance organizational performance
- **CO-3.** Formulate Six Sigma project plans integrating quality management practices

4. Course Contents

Unit 1 (Fundamentals and Evolution of TQM):

Concept of quality; Principles of TQM; Customer focus philosophy and market-driven quality; Benefits of TQM; Stages of quality evolution – Inspection, Quality Control (QC), Quality Assurance (QA), and Total Quality Management (TQM); Evolution of quality concepts across different periods; Comparison between traditional and modern approaches to quality management.

Unit 2 (TQM Tools and Process Management):

Process management concepts; Tools and techniques used in organizational processes; Quality Function Deployment (QFD); Failure Mode and Effect Analysis (FMEA); Management and Planning (MP) tools; Application of quality tools for process improvement and decision-making.

Unit 3 (Leadership, Quality Culture, and Excellence Models):
Leadership styles suitable for TQM; Building quality culture in organizations; Contributions of quality gurus and institutions in the TQM journey; Customer-centric quality approach; Quality grids for assessing organizational quality status; Study of national and international quality awards and excellence models.

Unit 4 (Statistical Quality Control and Quality Management Systems):
Statistical Process Control (SPC) and process capability; Causes of variation in processes; Basic statistical concepts for quality improvement; Quality control tools and Management Planning tools; Introduction to ISO family of standards; Elements and process approach of ISO standards; Accreditation and certification methodology; Benefits of ISO certification.

Unit 5 (Six Sigma Methodology and Applications):
DMAIC philosophy of Six Sigma; Tools and techniques used in Define, Measure, Analyze, Improve, and Control phases; SIPOC, CTQ, Measurement System Analysis (MSA), Hypothesis Testing, Regression, ANOVA, Design of Experiments (DOE) and Process Optimization; Formulation, execution, and evaluation of Six Sigma projects.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		2											2
CO-2					3								3
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00

1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2		x	x		x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--

8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. John S. Oakland, Robert J. Oakland, Michael A. Turner, (2021), Total Quality Management and Operational Excellence: Text with Cases, 5th edition, Routledge
3. Urdhwareshe Hemant, (2020), Six Sigma for Business Excellence, 1st edition, Pearson Education India

b. Recommended Reading

1. Sundara Raju S.M, (2001), Total Quality Management, Primer, McGraw Hill
2. Kume and Hitoshi, (2004), Quality Management in New Product Development, Productivity Press
3. Gopalan M. R. and Bicheno John, (2005), Management Guide to Quality and Productivity, Biztantra
4. Besterfield and Dale H, (2006), Total Quality Management, Pearson Education Publication
5. Basem El-Haik, (2005), Axiomatic Quality Integrating Axiomatic Design with Six Sigma, Reliability and Quality Engineering, Wiley
6. Bergma, Boklefjo and Bengt, (2006), Quality; From Customer needs to Customer satisfaction, Overseas Press
7. K. Sridhar Bhat, (2007), Total Quality Management, Himalaya Publishing House
8. Bhote and Kekir, (2007), The Ultimate Six Sigma; Beyond Quality Excellence to Total Business Excellence, Prentice Hall India

c. Magazines and Journals

1. Total Quality Management & Business Excellence, Taylor & Francis
2. Benchmarking: The International Journal, Emerald Publishing Group
3. The TQM Magazine, Emerald Publishing Group
4. Benchmarking: The International Journal, Emerald Publishing Group

d. Websites

1. http://www.asq.org
2. http://www.elmasr.org
3. http://www.isixsigma.com
4. http://www.minitab.com
5. http://www.six-sigma-material.com
6. https://www.coursera.org/
7. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	Quality Management and Six Sigma		
Course Title	MEE313A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Mechatronics and Automation

Course Title	Mechatronics and Automation
Course Code	MEE314A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course introduces the interdisciplinary field of mechatronics, integrating mechanical engineering, electronics, control systems and computer science. It covers the fundamental concepts of sensors, actuators, microcontrollers and control strategies used in modern automated systems. Students will learn about system modeling, feedback control and embedded system design for real-time applications. Emphasis is given to industrial automation and programmable logic controllers (PLC). Laboratory sessions provide hands-on experience in interfacing sensors, programming microcontrollers and developing control systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the working principles of mechatronics for automation and real-time system applications
- **CO-2.** Identify, select and arrive at an appropriate sensor, transducer, drive systems and control systems for a given engineering applications
- **CO-3.** Develop an integrated mechatronic system for a given engineering applications

4. Course Contents

Unit 1 (Introduction to Mechatronics):
Introduction to Mechatronics, Multidisciplinary Scenario, Evolution of Mechatronics, Traditional vs Mechatronic design approach, Key elements of a mechatronic system, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics, Examples of mechatronic systems: CNC machines, robots, automated washing machines, automotive systems.

Unit 2 (Sensors and Transducers):
Introduction to Sensors, Role of sensors in mechatronic systems, Difference between sensors and transducers, Calibration and Performance Characteristics, Classification of sensors: Based

on measurement, operation, Analog and digital, Working principles and applications of displacement and position sensors, velocity and Motion sensors, force and pressure sensors, temperature sensors, Signal conditioning, data acquisition systems, noise reduction techniques, Importance of sensors in measurement and control systems.

Unit 3 (Actuators and Drive Systems):
Definition and role in mechatronic systems, Types of actuators: electrical, hydraulic, pneumatic, Electrical actuators: DC motors, stepper motors, servo motors. Hydraulic and pneumatic actuators, working principles, Characteristics, selection criteria, and applications, Comparison electric, pneumatic with hydraulic systems, Power transmission and drive mechanisms in automation systems.

Unit 4 (Control Systems):
Definition, objectives, and importance of control systems in engineering, Role of control systems in mechatronics and automation, Open-loop and closed-loop control systems. Feedback principles, PID controllers, stability analysis. Introduction to digital control systems and real-time control. Applications like, Motion control in robotics, CNC machine control systems, Process control (temperature, pressure, flow) and Automotive control systems (cruise control, ABS).

Unit 5 (Microcontrollers and Embedded Systems):
Introduction to Micro-controller, Architecture of microcontrollers, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming resources, interrupts, Programmer's model, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, control transfer instructions, programming concepts, interfacing with sensors and actuators. Embedded system design, real-time applications. Introduction to Arduino/embedded platforms. Basics of PLC and industrial automation systems.

Laboratory: includes sensor interfacing, motor control, microcontroller programming, and basic robotic arm operation. Case studies from manufacturing, healthcare, and service robotics.

Case Studies: Material handling, Machine loading and unloading, Assembly, Inspection, Welding, Spray painting, Service, vacuum cleaning, professional cleaning, and logistic systems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2			3										3
CO-3			2		2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		45
Demonstrations		15

1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2		x	x		x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. W. Bolton, (2018). Mechatronics: Electronic Control Systems in Mechanical Engineering, Pearson
3. Devdas Shetty & Richard Kolk, (2012), Mechatronics System Design, Cengage
4. Nicholas Odrey, (2017) Industrial Robotics Technology Programming And Applications

b. Recommended Reading

1. HMT Ltd., (2000), Mechatronics, Tata McGraw Hill
2. N. P. Mahalik, (2024), Mechatronics: Principles, Concepts and Applications, McGraw Hill
3. John J. Craig, (2022), Introduction to Robotics: Mechanics and Control, Pearson
4. Robert H. Bishop, (2007), The Mechatronics Handbook, CRC Press

c. Magazines and Journals

1. Mechatronics Journal
2. IEEE/ASME Transactions on Mechatronics
3. Robotics and Autonomous Systems

d. Websites

1. IEEE Xplore Digital Library
2. Science Direct (Mechatronics & Robotics)
3. Robotics Online Resource

4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	Mechatronics and Automation	
Course Title	MEE314A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Probability and Statistics

Course Title	Probability and Statistics
Course Code	MEE315A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to provide an understanding of probability and statistics. Students are taught the concepts of mean, median and standard deviation in discrete and continuous probability distribution. The course introduces students to the basic definitions and concepts of inferential statistics. Students are taught the concepts of confidence intervals for mean, variance and standard deviation. This course discusses the hypothesis testing for mean, variance and standard deviation.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic concepts of statistics, random variables and probability distribution
- **CO-2.** Apply the principles of statistical models, probability distribution, regression, confidence interval and hypothesis testing to solve the simple problems
- **CO-3.** Develop probabilistic and statistical models to solve real world problem

4. Course Contents

Unit 1 (Random Variables and Discrete Probability Distributions):
Introduction: Randomness and Probability models. Outcomes, events and space. Axioms of probability. Exclusive events, Conditional probability and Independence. Bayes Rule. Random variables: Definitions, illustrations and properties of random variables. Discrete and continuous random variables.
Probability density function (PDF), cumulative distribution function (CDF) of a random variable. Commonly used discrete random variables distribution: Bernoulli, Binomial, Poisson and Uniform distribution along with their characteristic properties such as Mean, variance, standard deviation and limiting/ approximation cases.

Unit 2 (Continuous Probability Distributions and Joint Probability Distribution):
Continuous random variables distribution: Normal and Exponential distributions along with their

characteristic properties such as Probability density function (PDF), cumulative distribution function (CDF), mean, Variance and standard deviation.
Introduction, Joint Probability density function, marginal probability density function, independent random variables, mathematical expectation.

Unit 3 (Statistics):
Elements of statistical models, random samples and outcomes. Univariate statistics and empirical estimation. Sample mean, variance, standard deviation, coefficient of variation, statistical distribution. Histograms, descriptive statistical summary distribution. Quantiles and quartiles, Box and Whisker plot. Bivariate data sets and scatter plots.

Unit 4 (Regression and Estimation):
Correlation and covariance. Least square methods. Unbiased estimators of the expectation and variance. Mean squared error, Regression lines, linear and non-linear regression. Point estimation and interval estimation. Central limit theorem. Steepest descent and conjugate gradient. Confidence intervals for small and large samples. Confidence intervals for population proportions.

Unit 5 (Hypothesis Testing):
Hypothesis Testing: Null and alternative hypotheses, test statistics and p-values. Type I and Type II errors. Significance level, concerning means: Single population, two population and bivariate population. Tests concerning proportion and sample, Chi-Square test for goodness of fit.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2												
CO-2	3												
CO-3			3										
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	**X**	**X**		**X**	**X**
CO-2	**X**	**X**		**X**	**X**
CO-3			**X**		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study

3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Sheldon Ross, 2024, A First Course in Probability, 10th edition, Pearson

b. Recommended Reading

1. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, (2015), An Introduction to Probability and Statistics, Wiley
2. Harold J. Larson, (1974), Introduction to Probability Theory and Statistical Inference, John Wiley & Sons
3. Hogg, Tannis, Rao, 1997, Probability and Statistical Inference, 7h Edition Pearson Publication
4. Pradeep Kumar Sahu. Santi Ranjan Pal, Ajit Kumar Das, 2015, Estimation and inferential Statistics, Springer International Publishing A.G.
5. A. Agresti and C. Franklin, 2012, Statistics: The Art and Science of Learning from Data, 3rd edition, Prentice Hall

c. Magazines and Journals

1. Statistics & Probability Letters
2. Journal of Statistical Planning and Inference
3. Computational Statistics & Data Analysis

d. Websites

1. https://ocw.mit.edu/index.htm
2. https://www.coursera.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	Probability and Statistics		
Course Title	MEE315A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications:

Course Title	Advanced Mechanics of Materials
Course Code	MEE316A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides advanced knowledge of stress, strain, and deformation analysis based on the theories of elasticity and solid mechanics. The course emphasizes three-dimensional stress and strain analysis, elasticity formulations, energy methods, torsion, thick-walled pressure vessels, and elastic stability. The concepts developed in this course form the foundation for advanced structural analysis, machine design, finite element methods, and research in solid mechanics.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply elasticity principles and three-dimensional stress–strain relationships to analyze engineering components subjected to complex loading.
- **CO-2.** Determine stresses, strains, and deformations in structural and machine elements using elasticity solutions and energy methods
- **CO-3.** Evaluate the strength, safety, and stability of engineering components using advanced mechanics of materials concepts and appropriate failure criteria.

4. Course Contents

Unit 1 (Three-Dimensional Stress and Strain Analysis): State of stress at a point, Principal stresses and principal strains, Stress transformation equations, Mohr's circle for three-dimensional stress, Stress invariants, Generalized Hooke's law, Volumetric strain, Strain energy density

Unit 2 (Theory of Elasticity): Fundamental assumptions of elasticity, Stress-strain relations, Equilibrium equations, Compatibility equations, Plane stress and plane strain problems, Boundary conditions, Airy's stress function, Introduction to elasticity solutions

Unit 3 (Energy Methods in Solid Mechanics): Strain energy due to axial loading, Strain energy due to torsion, Strain energy due to bending, Castigliano's first and second theorems, Maxwell-

Betti reciprocal theorem, Impact loading, Applications to statically indeterminate members

Unit 4 (Torsion and Thick-Walled Cylinders): Torsion of non-circular sections, Membrane analogy, Thin-walled closed sections, Thick cylinders and thick spheres, Lame's equations, Compound cylinders, Shrink-fit analysis

Unit 5 (Elastic Stability and Failure Theories): Euler's theory of columns, Effective length and end conditions, Critical buckling load, Limitations of Euler's theory, Maximum principal stress theory, Maximum shear stress theory, Distortion energy theory (von Mises criterion)

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3												3
CO-2		3											3
CO-3		3											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10

Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X			X	X
CO-2	X	X	X	X	X
CO-3			X		X
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. L. S. Srinath. (2017) Advanced Mechanics of Solids, 3rd Edition, McGraw Hill Education (India) Private Limited
3. Dr. Sadhu Singh. (1978) Theory of Elasticity, Khanna Publishers
4. A. P. Borisi, R. J. Schmidt. (2020) Advanced Mechanics of Materials, 6th Edition, Wiley India Pvt Ltd.

b. Recommended Reading

1. T. G. Sitharam, L. Govindaraju. (2022) Theory of Elasticity, Springer Nature
2. V. G. Ukadgaonker. (2015) Theory of Elasticity and Fracture Mechanics, PHI Learning Private Limited
3. M. H. Sadd. (2020) Elasticity: Theory, Applications, and Numerics, 4th Edition, Academic Press.

c. Magazines and Journals

1. Mechanics of Materials
2. Journal of Applied Mechanics
3. International Journal of Solids and Structures
4. Engineering Failure Analysis
5. Journal of Strain Analysis for Engineering Design
6. Journal of The Institution of Engineers (India): Series C

d. Websites

1. http://www.asme.org
2. https://www.asminternational.org/
3. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE316A	
Course Title	Advanced Mechanics of Materials	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Computational Fluid Dynamics

Course Title	Computational Fluid Dynamics
Course Code	MEE401A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with concepts of fluid mechanics and the use of Computational Fluid Dynamics (CFD) techniques to solve practical engineering problems. The students are taught the basics of CFD, modeling and analysis of heat and fluid flow systems. Students are also taught to model a flow problem and derive discretised equations. Students will be able to apply CFD techniques to solve practical problems on heat and fluid flow and evaluate the results.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Interpret the governing equations of fluid flow and classify PDE-based mathematical models
- **CO-2.** Apply and evaluate discretisation schemes to solve fluid flow problems numerically
- **CO-3.** Simulate, validate, and interpret CFD solutions for practical engineering flow problems using software

4. Course Contents

Unit 1 (Introduction to CFD):
Need and Importance of CFD in solving fluid flow problems,
Applications of CFD, Concept of gradient, divergence and curl , Different Models of Flow, Substantial Derivative, Derivation of fluid flow equations - continuity, momentum, energy, Types of flows – External and internal flows, laminar, turbulent and boundary layer flows

Unit 2 (Partial Differential Equations):
Classification of the PDEs, Choice of boundary conditions. Discretisation of PDEs – Finite Difference Method, Finite Element Method, Finite Volume Method, Properties of the discretisation schemes, Stability and error analysis

Unit 3 (Discretization Schemes):
Finite-Volume Methods: Pure Diffusion, Convection Diffusion, upwind differencing schemes, QUICK scheme, SIMPLE scheme; fundamental properties of FVM, solution algorithms
Application of Boundary Conditions for Practical Fluid Flow Problems: Various boundary and initial conditions for governing equations in practical applications, internal flows, external flows, symmetric and cyclic boundary conditions

Unit 4 (Turbulence Modelling):
Turbulent flows, time-averaging, need for turbulence modelling, overview of different turbulence models, selection of appropriate turbulence model for practical fluid flow problems

Unit 5 (Demonstration of solution of fluid flow problems using software):
Laminar and Turbulent flow over a flat plate, cylinders, fins, airfoils, flow through a pump, laminar and turbulent flow through pipes and heat exchangers Grid generation, Grid independence studies

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		3										3	
CO-2	3											3	
CO-3					3							3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. J. D. Anderson, 2012, Computational Fluid Dynamics: The Basics with Applications, McGraw Hill Education.
3. H. K. Versteeg and W. Malalasekara, 2008, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd Edition, Prentice Hall India

b. Recommended Reading

1. S. V. Patankar, 1980, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing.
2. J. C. Tannehill, D. A. Anderson and R. H. Pletcher, 1997, Computational Fluid Mechanics Heat Transfer, Taylor & Francis.
3. Moin, 2010, Fundamentals of Engineering Numerical Analysis, 2nd Edition, Cambridge University Press

c. Magazines and Journals

1. Journal of Fluid Mechanics
2. Physics of Fluids
3. ASME Journal of Fluids Engineering
4. Journal of Heat and Fluid Flow

d. Websites

1. www.cfd-online.com
2. www.simscale.com
3. www.learncax.com
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library
2. ANSYS
3. COMSOL

10. Course Organization

Course Code	MEE401A	
Course Title	Computational Fluid Dynamics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Advanced Materials and Process

Course Title	Advanced Materials and Process
Course Code	MEE402A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with advanced materials and their processes for potential applications in various industrial sectors. Students will gain knowledge on concepts, properties, selection and fabrication of advanced materials in energy, communications, transport and other industrial sectors. Students will get exposure to smart materials, nanomaterials, biomaterials and energy storage materials. Students will learn to select suitable materials for the given functional requirement. Fabrication and testing of advanced materials will be demonstrated.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the principles, properties and usage of advanced engineered materials used in various applications
- **CO-2.** Identify appropriate advanced materials techniques for applications based on sustainable technology
- **CO-3.** Select an appropriate processing method for advanced materials technique to achieve required functionality

4. Course Contents

Unit 1 (Advanced Alloys):
Need for advanced materials, Classification of advanced materials Alloys – Properties, processing and applications of Advanced High Strength Steels, TRIP steels, Maraging steel, Aluminium alloys, Magnesium alloys, Titanium alloys and Super alloys.

Unit 2 (Ceramics):
Properties and applications of Ceramics – Glass, Refractories, Abrasives, Advanced Ceramics, Processing of ceramics – Powder Metallurgy.

Unit 3 (Polymers):
Polymers and Elastomers – Properties, classification and applications of polymers and elastomers; Processing of Polymers and elastomers - Injection moulding process, Extrusion process, Blow moulding process, Compression moulding process, Foam moulding, Calendaring and Thermoforming process.

Unit 4 (Composite Materials):
Properties, classification and applications of Metal Matrix composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs); Processing of PMCs – Hand layup, Vacuum bagging, Autoclave moulding process and Resin infusion process.

Unit 5 (Advanced Materials):
Nanomaterials – Introduction, importance and classification of carbon-based nanomaterials; Synthesis of fullerene, carbon nanotubes and graphene; Physical Vapour Deposition, Chemical Vapour Deposition and other processes.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	2												2
CO-2				2									2
CO-3		3											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X	X			X
CO-2		X	X		X
CO-3			x	X	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. W. D. Callister, 2020, Materials Science and Engineering: An Introduction, 10th Edition, Wiley Publications.
3. Michael F. Ashby, 2024, Materials Selection in Mechanical Design, Processing and Design, Elsevier.

b. Recommended Reading

1. C. Barry Carter and Grant M. Norton, 2013, Ceramic Materials: Science and Engineering, Springer
2. Sanjay Mazumdar, 2001, Composites Manufacturing: Materials, Product, and Process Engineering, CRC Press
3. J. A. Brydson, 1999, Plastic Materials, Butterworth-Heinmann
4. Z. L. Wang and Z. C. Kang, 2012, Functional Materials: Structural Evolution and Structure Analysis, Plenum, New York
5. Bharat Bhushan, 2004, Handbook of Nanotechnology, Springer
6. Peter Martin, 2011, Introduction to Surface Engineering and Functionally Engineered Materials, John Wiley & Sons Publications
7. ASM Handbook, 1994, Volume 5, Surface Engineering, ASM International

c. Magazines and Journals

1. Advanced Functional Materials, Wiley Publications
2. Functional Materials Letters, World Scientific Publications
3. Advanced Materials, Wiley Publications
4. Materials Today Magazine
5. Reinforced Plastics Magazine

d. Websites

1. http://www.mrs.org
2. http://www.mrsi.org.in
3. http://www.asminternational.org
4. http://www.iom3.org/content/electronics-division
5. http://ceramics.org/
6. https://www.coursera.org/
7. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE402A		
Course Title	Advanced Materials and Process		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Kaizen and Lean Manufacturing

Course Title	Kaizen and Lean Manufacturing
Course Code	MEE403A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with Kaizen and Lean Manufacturing principles and practices essential to achieve operational excellence in manufacturing. Students will explore Kaizen concepts, team building, and problem-solving tools like A3, along with theories on workplace behavior and team dynamics. The course covers Lean practices such as waste elimination, 5S, and value stream mapping. Seven QC tools will be taught using appropriate software tools. Students will also learn Kotter's Change Management model and strategies for implementing and managing a waste-free, lean manufacturing system.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss significance of Kaizen and lean manufacturing for business competitiveness
- **CO-2.** Apply the techniques of lean manufacturing to reduce wastes
- **CO-3.** Develop current and future value stream maps for products and deduce action plans

4. Course Contents

Unit 1 (Importance of Kaizen):
Best practices of world class manufacturing companies, Concepts and Systems of Kaizen and Team Building: Definition of Kaizen; Important pillars of kaizen; Quality circles, Seven Quality Control Tools , Team building , A3 problem solving approach ,Concept of Empowerment and creating an ownership culture and Kaikaku

Unit 2 (Gemba Kaizen Management):
Types of Teams and Building and Sustaining Performance: Work needs of Individuals, Theories of people at workplace, Personal Profiling Personality typing; Psychometric testing; McGregor's and Mintberg theories of Employee behavior and Managerial roles and team games.

Unit 3 (Lean Manufacturing):
Evolution of lean manufacturing, House of Lean, different kinds of wastes, visual management, 5S, Poka-Yoke, Jidoka, Just-in-Time (JIT), Total Productive Maintenance (TPM), and Overall Equipment Effectiveness (OEE), House of Lean and system level model for lean enterprise.

Unit 4 (Waste Identification and Lean Improvement Techniques):
Waste identification and elimination techniques, string diagrams, non-value-added analysis, Single Minute Exchange of Die (SMED), cellular manufacturing, line balancing, load leveling, lean metrics, Green Kaizen, and Kaikaku for organizational improvement.

Unit 5 (Value Stream Mapping and Lean Implementation):
Current and future state Value Stream Mapping (VSM), development of improvement action plans, lean implementation roadmap, and management of lean organizations through building waste-free manufacturing systems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1		2											2
CO-2	3												3
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	

3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

Course Resources

a. Essential Reading

1. Course notes
2. Masaaki Imai, (2012), Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Second Edition, Tata McGraw - Hill Education
3. Gopalakrishnan N, (2010), Simplified Lean Manufacture: Elements, Rules, Tools and Implementation, 1st edition, Prentice Hall India Learning Private Limited

b. Recommended Reading

1. Harrison A, (1992), Just in Time Manufacturing in Perspective, Prentice Hall
2. Hirano H, (1995), 5 Pillars of visual workplace, Productivity Press
3. Monden Y, (1998), Toyota Production System: An integrated approach to Just in Time, Chapman & Hall
4. Nicholas J.M, (1998), Competitive Manufacturing Management, McGraw-Hill
5. Rother and Shock, (1999), Learning to See, Lean Enterprise List
6. Tapping D, (2002), Value Stream Management, Productivity Inc.
7. Javier Santos, Richard A. Wysk and Jose M. Torres, (2006), Improving production with Lean thinking, John Wiley
8. Bill Carreira, (2007), Lean manufacturing that works: powerful tools for dramatically reducing waste, Prentice Hall
9. James Huntzinger, (2007), Lean cost management for lean by establishing flows
10. Chis Harris and Rick Harris, (2007), Developing a lean work force, Productivity Press
11. Greg Lane, (2007), Made to order lean: Excelling in a high mix-low volume environment, Productivity Press

c. Magazines and Journals

1. International Journal of Operations and Production Management, Emerald Group Publishing Limited
2. Journal of Manufacturing Technology Management, Emerald Group Publishing Limited
3. International Journal of Productivity and Performance Management, Emerald Group Publishing Limited

d. Websites

1. www.gembaacademy.com
2. www.lssacademy.com
3. www.lean.org
4. https://www.coursera.org/
5. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

9. Course Organization

Course Code	MEE403A		
Course Title	Kaizen and Lean Manufacturing		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		**June 2026**	
Next Course Specifications Review Date		**June 2030**	

Course Specifications: Robot Kinematics and Dynamics

Course Title	Robot Kinematics and Dynamics
Course Code	MEE404A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides fundamental knowledge of robot kinematics and dynamics. Students learn the basics of robot structures, coordinate systems, robot motion, simple manipulator movements, and introductory robot control concepts. The course also introduces students to industrial and service robot applications along with basic simulation demonstrations.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the knowledge of structure, motion and coordinate systems to analyze the robotic manipulators used in engineering applications
- **CO-2.** Evaluate kinematics and motion control concepts for robotic operations
- **CO-3.** Select suitable robotic configurations and assess robot applications for industrial and service environments

4. Course Contents

Unit 1 (Introduction to Robotics and Robot Motion):
Introduction to robotics and automation, History and evolution of robots, Types of robots: Industrial robots, Service robots, Mobile robots, Humanoid robots, Applications of robots in different sectors, Robot kinematics and dynamics, Linear and angular motion, Coordinate systems and reference frames.

Unit 2 (Robot Mechanisms and Components):
Robot anatomy and nomenclature, Links and joints, Degrees of freedom, Types of robotic manipulators, robot configurations, Cartesian robot, cylindrical robot, Spherical robot, Articulated robot, Actuators and drives, Electric actuators, Hydraulic actuators, Pneumatic actuators, Introduction to sensors used in robots.

Unit 3 (Basic Robot Kinematics and Motion Control):
Introduction to forward kinematics, Inverse kinematics concepts, Position and orientation of robots, Translation and rotation concepts, Simple robot path movement, Velocity and acceleration basics, Introduction to robots and control systems, programming and teach pendants, Demonstration using simulation tools.

Unit 4 (Robot Dynamics):
Introduction to Robot Dynamics, Concept of force and torque in robots, Motion and stability of robotic systems, Robot control and movement coordination, Introduction to robot simulation environments.

Unit 5 (Robot Application):
Robot Applications in Industrial automation, Pick and place robots, Welding and painting robots, Medical and healthcare robots, Agricultural robots, Warehouse and logistics robots, Defense and surveillance robots, Service and domestic robots, Space and underwater robots, Collaborative robots (Cobots).

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2				2	2								2
CO-3		2											2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. J. Craig (2021) Introduction to Robotics: Mechanics and Controls, 4th edition, Pearson Education Inc., Harlow.
3. R. L. Norton (2019) Design of Machinery, 6th edition, McGraw-Hill.

b. Recommended Reading

1. K. S. Fu, R. C. Gonzalez and C. S. Lee (1987) Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill.
2. Mark W. Spong, Seth Hutchinson and M. Vidyasagar (2005) Robotic modeling and control, First edition, John Wiley and Sons, New York.
3. Robert J. Schilling (2003) Fundamentals of Robotics: Analysis and Control, Prentice-Hall, Inc., New Delhi.
4. J. M. Selig (1992) Introductory Robotics, Prentice Hall, New York.
5. Ashitava Ghosal (2006) Robotics: Fundamental Concepts and Analysis, Oxford University Press.
6. Jorge Angeles (2007) Fundamentals of Robotic Mechanical Systems: Theory, Methods and Algorithms, 3rd edition, Springer, New York.

c. Magazines and Journals

1. ASME Journal of Mechanisms and Robotics
2. IEEE Robotics and Automation Magazine
3. International Journal of Dynamics and Control, Springer
4. The International Journal of Robotics Research, SAGE Journals

d. Websites

1. http://www.botmag.com/
2. http://www.roboticmagazine.com/
3. http://www.robotshop.com/blog/en/a-first-look-at-robot-magazine-4132
4. http://www.engineersedge.com/
5. http://www.technologystudent.com
6. https://www.coursera.org/
7. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE404A		
Course Title	Robot Kinematics and Dynamics		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Composite Materials and Structural Design

Course Title	Composite Materials and Structural Design
Course Code	MEE405A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides students with a thorough understanding of fiber-reinforced composite materials and their constituents, composite manufacturing, micromechanical behaviour, laminate analysis, failure mechanisms, and structural design. The course bridges material science, structural mechanics, and design methodology, equipping students to analyse and design lightweight, high-performance composite structures for aerospace, automotive, biomedical, civil, and marine applications

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the constituents, properties, manufacturing processes and testing methods of fiber-reinforced composite materials for a structural engineering application.
- **CO-2.** Determine engineering constants of a composite lamina using micromechanical and macromechanical analysis under various loading conditions
- **CO-3.** Apply failure theories and Classical Lamination Theory to analyze stress, failure and damage in composite to assess the structural performance

4. Course Contents

Unit 1 (Composites & Constituent Materials):

Composite materials and their applications; Classification of composites; Advantages and limitations; Types of matrix and reinforcements; Properties of polymer matrix and fibres.

Unit 2 (Composite Manufacturing Process):

Hand lay-up, Vacuum Bagging process, Autoclave moulding, Out-of-Autoclave processes, Filament winding, Pultrusion process; Bulk Moulding Compound and Dough Moulding Compound Processes; Manufacturing-induced defects; Case studies.

Unit 3 (Testing of Composites)

Mechanical testing – Tensile, Compression and Shear testing; Fatigue and fracture tests; Impact tests; NDT testing (Ultrasound C-Scan, X-ray CT, Laser Shearography); Digital Image Correlation (DIC); case studies.

Unit 4 (Micromechanical Analysis of a Lamina)
Specific gravity, Volume and Mass Fractions and Void Content; Longitudinal Modulus and Poisson's Ratio, Transverse Modulus and Shear Modulus; Micromechanics of Unidirectional Lamina.

Unit 5 (Macromechanical Analysis of a Lamina):
Hooke's Law for Anisotropic, Orthotropic, Transversely Isotropic and Isotropic materials; Stress-strain relations in 3D and reduction to 2D plane stress; Reduced stiffness and Compliance matrices; Transformed stiffness for angle lamina; Engineering constants; Failure theories; Hygrothermal stresses and strains.
Strain-displacement relations for a laminate; Resultant forces and moments; ABD matrix; First Ply Failure and progressive failure; Case studies.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1		3											3
CO-2		3											3
CO-3				3									3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X		X	X	X
CO-2		X	X	X	X
CO-3			X	X	X
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes

2. B. D. Agarwal, L. J. Broutman & K. Chandrashekhara. (2018). Analysis and Performance of Fiber Composites (4th Ed.) Wiley
3. R. M. Jones. (1999). Mechanics of Composite Materials (2nd Ed.) CRC Press

b. Recommended Reading

1. R. F. Gibson. (2016). Principles of Composite Material Mechanics (4th Ed.) CRC Press
2. Autar K. Kaw. (2005) Mechanics of Composite Materials. 2nd edn. CRC Press
3. Reddy, J.N. (2004) Mechanics of Laminated Composite Plates and Shells: Theory and Analysis. 2nd edn. CRC Press

c. Magazines and Journals

1. Composites: Part A & B
2. Composites Science and Technology
3. Journal of Composite Materials

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE405A	
Course Title	Composite Materials and Structural Design	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Image Processing and Computer Vision

Course Title	Image Processing and Computer Vision
Course Code	ROC305A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides a comprehensive understanding of the principles and applications of image processing and computer vision for robotic systems. Students will learn how to equip robots with visual perception capabilities, enabling them to interpret and interact with their environment. The curriculum covers image acquisition, low-level image processing, feature extraction, object recognition, 3D visions, visual tracking, and an introduction to visual SLAM. Emphasis is placed on algorithms and techniques crucial for robotic tasks such as navigation, manipulation, and human-robot interaction, with considerations for real-time processing and robustness in dynamic environments. Practical implementation using MATLAB, Python, and the OpenCV library forms a significant part of the course.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Select and identify computational tool to perform image enhancement and filtering for improving image quality and features
- **CO-2.** Apply appropriate computer vision techniques for pattern recognition to interpret features for the selected objects and images
- **CO-3.** Analyse and interpret real-world engineering applications using computer vision techniques

4. Course Contents

Unit 1 (Image Processing and Computer Vision):
Introduction to Image processing and Computer vision, Point processing: Brightness, contrast, histogram equalization. Spatial Filtering: Convolution, mean, Gaussian, median filters for noise reduction. Morphological Image Processing: Erosion, dilation, opening, closing. Geometric Transformations: Affine, perspective. Image warping. MATLAB/Python and OpenCV for image processing

Unit 2 (Feature Detection, Description and Matching):
Edge Detection: Sobel, Canny edge detectors. Corner and Interest Point Detection: Harris, Shi-Tomasi, FAST. Blob Detection: Laplacian-of-Gaussian (LoG), Difference-of-Gaussians (DoG). Local Feature Descriptors: SIFT, SURF, ORB – concepts, scale and rotation invariance. Feature Matching: Brute-force, FLANN. Outlier rejection with RANSAC. Contour Detection and Analysis: Shape properties, moments, fitting geometric primitives. Hough Transform for Line and Circle Detection. MATLAB/Python and OpenCV for feature detection.

Unit 3 (Object detection, Recognition and tracking):
Object Detection: Classical methods- Template matching, Haar cascades. Introduction to Deep Learning: Overview of CNNs, using pre-trained models for object detection. Feature-based recognition. Introduction to CNNs for image classification. Visual Tracking: Feature-based tracking (KLT), Correlation filters, Mean-shift and CamShift, Introduction to Kalman Filter for tracking. MATLAB/Python and OpenCV for object detection, recognition, and tracking.

Unit 4 (3D Vision for Robotics):
Stereo Vision: Epipolar geometry, essential and fundamental matrices, disparity map computation, triangulation for 3D point reconstruction. RGB-D Cameras: Principles of structured light and Time-of-Flight. Processing Depth Data: Point cloud generation, visualization, filtering. Introduction to Point Cloud Registration: Iterative Closest Point concept. 3D Object Pose Estimation: Overview of PnP problems and solutions

Unit 5 (Visual SLAM, Odometry and Servoing):
Introduction to Visual Odometry: Concept and basic pipeline (feature tracking, motion estimation. Introduction to SLAM: Core concepts - tracking, mapping, loop closure, graph optimization. Visual Servoing: Using visual feedback to control robot motion -e.g., Image-Based Visual Servoing, Position-Based Visual Servoing.

Unit 6 (Case Studies):
Autonomous Lane Keeping for a Mobile Robot, Intelligent "Pick-and-Place" for Industrial Sorting, 3D Room Mapping using a Mobile Rover and Drone-Based Surveillance & Target Tracking.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											**Programme Specific Outcomes (PSOs)**	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													
CO-2	3												3
CO-3		2											2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		15
1. Demonstration using Videos	15	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Szeliski, R. (2022). Computer Vision: Algorithms and Applications (2nd ed.). Springer.
3. Forsyth, D. A., & Ponce, J. (2011). Computer Vision: A Modern Approach (2nd ed.). Pearson.
4. Davies, E.R. (2012). Computer and Machine Vision: Theory, Algorithms, Practicalities (4th ed.). Academic Press.
5. Hartley, R., & Zisserman, A. (2004). Multiple View Geometry in Computer Vision. Cambridge University Press.

b. Recommended Reading

1. Bradski, G., & Kaehler, A. (2008). Learning OpenCV: Computer Vision with the OpenCV Library. O'Reilly Media.
2. OpenCV official documentation and tutorials.
3. Corke, P. (2017). Robotics, Vision and Control: Fundamental Algorithms in MATLAB (2nd ed.). Springer.
4. Manas Kamal Bhuyan, 2020, Computer Vision and Image Processing-Fundamentals and Applications, CRC Press.

c. Magazines and Journals

1. IEEE Transactions of Image Processing

2. Relevant research papers from conferences like CVPR, ICCV, ECCV, ICRA, and IROS.

d. Websites

1. EEE-T-PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence)
2. IJCV (International Journal of Computer Vision) - Springer
3. https://www.cs.cmu.edu/~aarti/Class/10701/
4. Segmentation and Registration Toolkit (ITK): https://itk.org/
5. Visualization Toolkit: https://vtk.org/
6. https://www.coursera.org/
7. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library
2. https://ocw.mit.edu/index.htm

10. Course Organization

Course Code	ROC305A	
Course Title	Image Processing and Computer Vision	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Digital Manufacturing

Course Title	Digital Manufacturing
Course Code	MEE407A
Course Type	Professional Core Theory
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course provides an understanding of digital technologies employed throughout the manufacturing lifecycle, from product design and process planning to production and lifecycle management. It covers key concepts such as Industry 4.0, CAD/CAM/CAE systems, product lifecycle management, virtual manufacturing, digital twins, manufacturing data analytics, and sustainable manufacturing practices. The course enables students to develop, analyze, and optimize smart manufacturing systems for enhanced productivity, quality, and operational efficiency.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1: Apply the principles of digital manufacturing, Industry 4.0, cyber-physical systems, Industrial Internet of Things (IIoT), and digital product development methodologies in modern manufacturing environments.

CO2: Create digital product and manufacturing solutions using CAD/CAE, PLM, process planning, CAM, CNC programming, and virtual manufacturing tools for efficient production.

CO3: Analyse manufacturing data and develop digital twin–based, sustainable manufacturing strategies for process optimization, predictive maintenance, quality improvement, and resource efficiency.

4. Course Contents

Unit 1: Introduction to Digital Manufacturing

Definition, scope and need of digital manufacturing; evolution from conventional manufacturing to computer-integrated and smart manufacturing; principles of Industry 4.0; smart factory concepts; cyber-physical systems; Industrial Internet of Things; digital thread and data flow across the manufacturing lifecycle; benefits, limitations and industrial case examples.

Unit 2: Digital Product Definition, CAD/CAE and Product Lifecycle Management
Digital product-development workflow; engineering drawing to digital product definition; parametric CAD modelling; assembly modelling; design for manufacturing and assembly; tolerance representation and product data standards; CAE-based design validation; product lifecycle management; bill of materials, engineering change management and digital thread across design and manufacturing.

Unit 3: Digital Process Planning, CAM and CNC Manufacturing Workflow
Role of process planning in digital manufacturing; computer-aided process planning; feature recognition and manufacturability analysis; selection of machines, tools, fixtures and process parameters; process sheets and routing; CAM workflow for turning, milling and drilling; CNC part programming fundamentals; tool-path generation and verification; post-processing; machining simulation, collision detection and shop-floor documentation.

Unit 4: Virtual Manufacturing, Manufacturing Simulation and Digital Twin
Concept and need of virtual manufacturing; modelling of machines, fixtures, processes and production systems; discrete-event simulation for material flow, layout planning, line balancing, bottleneck analysis and capacity planning; virtual commissioning; process simulation for machining and assembly; digital twin architecture for product, process and production system; data flow between physical system and virtual model; use of digital twin for monitoring, diagnostics and process improvement.

Unit 5: Data-Driven and Sustainable Digital Manufacturing
Industrial data acquisition from machines, sensors and controllers; manufacturing dashboards and key performance indicators; manufacturing data analytics; quality monitoring and traceability; predictive maintenance; cloud and edge manufacturing; cybersecurity awareness; energy monitoring, resource efficiency and sustainability in digital manufacturing; industrial case studies and implementation challenges.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3													
CO-2	2				3									2
CO-3		3												2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution														

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation	00	
2. Guest Lecture		
3. Industry / Field Visit	00	00
4. Brain Storming Sessions		
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. in Mechanical Engineering Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X	X			X
CO-2		X	X		X
CO-3			X	X	X
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Zude Zhou Shane (Shengquan) Xie Dejun Chen," Fundamentals of Digital Manufacturing Science'' Springer Series in Advanced Manufacturing, 2020
3. Kaushik Kumar, Divya Zindani, J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0 (Science, Technology, and Management) Taylor and Francis.

b. Recommended Reading

1. Thames, L., & Schaefer, D. (2017). Cybersecurity for industry 4.0 (pp. 1-33). Heidelberg: Springer.
2. Shi, L., Chen, X., Wen, S., & Xiang, Y. (2019). Main enabling technologies in industry 4.0 and cybersecurity threats. In Cyberspace Safety and Security: Springer International Publishing.
3. Tabatabaei, B., Huang, R., & Choi, J. W. (2022). 3D Printing and Additive Manufacturing,". Smart Manufacturing: The Lean Six Sigma Way, 267.
4. Ostaševičius, V. (2022). Digital twins in manufacturing: virtual and physical twins for advanced manufacturing. Springer Nature.

c. Magazines and Journals

1. Digital Manufacturing
2. Frontiers in Manufacturing Technology
3. International Journal of Production Research

d. Websites

1. https://iaeme.com/Home/journal/IJDM
2. https://www.mdpi.com/journal/machines/special_issues/DigitalManufacturing
3. https://onlinelibrary.wiley.com/doi/abs/10.1111/jpim.12686

e. Other Electronic Resources

1. Electronic resources on the course area are available at MSRUAS library

10. Course Organization

Course Code	MEE407A	
Course Title	Digital Manufacturing	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2025	
Next Course Specifications Review Date	June 2029	

Course Specifications: Fatigue and Fracture Mechanics

Course Title	Fatigue and Fracture Mechanics
Course Code	MEE410A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with fatigue loading and its effect on mechanical components. Students will be taught about types of fatigue loading, fatigue design criteria and fatigue testing. Basic concepts of fracture mechanics, Laws governing crack growth rate under cyclic loading will be discussed. Students will be able to apply theory of fracture mechanics to carry out stress analysis of cracked components and structures.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the concepts of fatigue loading, fracture mechanics principles and their application to mechanical components and structures
- **CO-2.** Solve problems on fatigue and fracture of simple mechanical components and structures
- **CO-3.** Apply fatigue analysis and fracture mechanics concepts to solve engineering problems and evaluate their structural integrity

4. Course Contents

Unit 1 (Overview of Fatigue):
Fatigue phenomenon; loading patterns and characteristics; Low cycle fatigue, High cycle fatigue, overview on strategies in fatigue based design; Discussion on fatigue design criteria; Fatigue testing methodology and life prediction

Unit 2 (Stress-Life Approach):
Analysis of monotonic and cyclic stress–strain behavior of materials; Cyclic stress-strain relationship and Strain-life behaviour under steady, transient and constant amplitude conditions; Strain-life equation and mean stress correction methods

Unit 3 (Strain-life approach):
Analysis of monotonic and cyclic stress–strain behavior of materials; Cyclic stress-strain relationship and Strain-life behaviour under steady, transient and constant amplitude conditions; Strain-life equation and mean stress correction methods

Unit 4 (Fracture Mechanics):
Difference between strength of material based approach and Fracture mechanics based approach, Significance of fracture mechanics design, displacement modes; Fracture parameters based on Linear Elastic Fracture Mechanics (LEFM) approach: Energy balance based approach and Stress (SIF, CSIF) based approach; fracture toughness testing on various specimens for varied applications; Governing parameters in EPFM: use of COD, CMOD, CTOD concepts; Effect of size of plastic zone and size factors using Irwin's and Dugdale approach

Unit 5 (Fatigue Crack Propagation):
Fatigue crack propagation laws, Paris law, Forman law, Walker law; Fatigue life analysis for combined load cases; Variable amplitude loading and cycle counting techniques; case studies related to fatigue and fracture

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2		3											3
CO-3		3											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00

1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X	X			X
CO-2	X	X	X	X	X
CO-3			X	X	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--

8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. R. I. Stephens, H. O. Fuchs, A. F. Robert, R. Stephens, 2000, Metal Fatigue in Engineering, 2nd Edition, Wiley-IEEE
3. T. L. Anderson, 2017, Fracture Mechanics: Fundamentals and Applications, 4th Edition, CRC Press

b. Recomended Reading

1. K. R. Y. Simha, 2001, Fracture Mechanics for Modern Engineering Design, Orient Blackswan
2. Fatigue of Materials by S. Suresh, Cambridge University Press publication
3. Prashant Kumar, 2009, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India.

c. Magazines and Journals

1. Fatigue & Fracture of Engineering Materials & Structures
2. Engineering Fracture Mechanics
3. International Journal of Fatigue
4. International Journal of Fracture

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE410A	
Course Title	Fatigue and Fracture Mechanics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Power Plant Engineering

Course Title	Power Plant Engineering
Course Code	MEE412A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the working of hydraulic and pneumatic actuators. Students will be taught basic principles of hydraulics and pneumatics and their application to fluid power drive systems. Knowledge will be imparted on types of hydraulic and pneumatic drives available for use in various applications and their selection procedures. Students will be able to simulate the working of simple hydraulic and pneumatic systems for better understanding of various components of fluid power systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the fundamentals of power plants, energy systems and thermodynamic cycles relevant to conventional and renewable power generation
- **CO-2.** Analyse the performance characteristics, design considerations, and application potential of sustainable energy systems to determine their suitability for given energy requirements and operating conditions
- **CO-3.** Develop sustainable business models using circular economy for real-world problems

4. Course Contents

Unit 1 (Fundamentals of Power Plant)
Classification of power plant, Energy and its types for power generation, load duration curves; selection of plant site, resource availability, cost, power plant economics; present and future energy scenario in India, strategies for efficient management of demand forecast in India, review of thermodynamic cycles related to power generation.

Unit 2 (Steam Power Plant and Gas Turbine Power Plant):
Plant Layout, site selection requirements, working of steam power plant, Rankine cycle and its

application in steam cycle, steam power plant performance, cogeneration, Coal handling systems, types of burners, Ash handling and disposal, environmental impacts, Organic Rankine cycle power plant, Maintenance ofSteam power plant, Demonstration of Rankine cycle simulation in MatLab. Plant Layout, classification and elements of gas turbine power plants, cogeneration, auxiliary systems, gas turbine efficiency, combined cycle power plants, Maintenance of Gas Turbine power plant.

Unit 3 (Nuclear Power Plant):
Nuclear energy concepts and terminologies involved, nuclear fusion and fission chain reactions, radioactive decay, nuclear reactor and its classification, nuclear flux, conservation ratio, plant layout, site selection requirements, construction and working, environmental impact and safety concerns in nuclear power generation, maintenance of nuclear plants.

Unit 4 (Diesel Power Plant and Hydro-Electric Power Plant):
Layout, choice and characteristics, plant layout and maintenance. Classification, plant layout and site selection requirements of power plant, Run-off, Hydrograph and flow duration curves, mass curves, Micro hydel power plants.

Unit 5 (Solar Power Plants):
Fundamentals of solar radiation, solar energy availability analyses Solar Thermal power plant - various solar collectors used in power generation plants, working of solar thermal power plants, Plant layout, and maintenance, Factors considered for site selection and site location Solar PV power plant - photovoltaic materials and its electrical characteristics, recent photovoltaic technologies for solar power generation, detailed study of solar photovoltaic power generation systems, Plant layout and maintenance, roof top solar power generation.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3											3	
CO-2		3											2
CO-3			2										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		

1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	**X**	**X**		**X**	**X**
CO-2	**X**	**X**	**X**	**X**	**X**
CO-3			**X**		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. P. K. Nag, 2005, Power Plant Engineering, McGraw Hill Publications, 3rd Edition
3. K. Raja, A. P. Srivastava, 2006, Manish Dwivedi, Power Plant Engineering, New Age International Publishers

b. Recommended Reading

1. Gilbert M. Masters, 2013, Renewable and Efficient Electric Power Systems, Wiley- Interscience
2. G. S. Sawhney, 2016, Non-Conventional Energy Resources, PHI
3. S. C. Arora and S. Domkundwar, 2011, A Course in Power Plant Engineering, Dhanpat Rai and Sons
4. Thomas Elliot, Kao Chen and Robert Swanekamp, 2010, Standard Handbook of Power Plant Engineering, McGraw Hill

c. Websites

1. https://www.coursera.org/
2. www.nptel.ac.in
3. https://ocw.mit.edu/index.htm

d. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE411A		
Course Title	Power Plant Engineering		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in

Course Specifications Approval Date	June 2026
Next Course Specifications Review Date	June 2030

Course Specifications: Advanced Control System

Course Title	Advanced Control System
Course Code	MEE412A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the working of hydraulic and pneumatic actuators. Students will be taught basic principles of hydraulics and pneumatics and their application to fluid power drive systems. Knowledge will be imparted on types of hydraulic and pneumatic drives available for use in various applications and their selection procedures. Students will be able to simulate the working of simple hydraulic and pneumatic systems for better understanding of various components of fluid power systems.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply mathematical modelling and linearisation techniques to derive the transfer function and state space representation of linear and nonlinear robotic systems
- **CO-2.** Discuss the principles of state space analysis, phase plane analysis, and singular points to characterise the dynamic behaviour and stability of robotic control systems
- **CO-3.** Design conventional controllers and develop state space controllers and observers using pole placement techniques to meet specified control design requirements
- **CO-4.** Model, simulate and analyse the time response of a robotic control system with designed controllers to validate performance against given design specifications

4. Course Contents

Unit 1 (Introduction): Nonlinear system, Behavior of nonlinear systems, Common nonlinearities, Examples of non-linear systems.

Unit 2 (Mathematical Modelling of Robotic Systems): Linearization, Transfer function of manipulators, Concepts of state, state variables, state model, State variable representation of linear and nonlinear systems, State variable representation for a n-link manipulator, Conversion

of state variable models to transfer functions and vice versa, Solution of state equations.

Unit 3 (State Feedback Controller and Observer Design): Controllability and observability, state transition matrix basics of state space design: design of controller and observer, pole placement techniques, stability analysis.

Unit 4 (Stability Analysis Methods): Phase plane analysis - Phase portraits, singular points and limit cycles, Lyapunov's stability method.

Unit 5 (Controller Design): Conventional controller design, Nonlinear controller design via feedback linearization, Adaptive control techniques.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2	3												3
CO-3			2										2
CO-4		2			2								2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2	x	x	x		x
CO-3	x	x	x	x	x
CO-4			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	--
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--

11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Saeed B Niku, 2016, Introduction to Mechanical System, Analysis, Control, Applications, Wiley Publications
3. Khalil, H., 2001, Non-linear Systems. 3rd Edition, Prentice Hall

b. Recommended Reading

1. Karl J Astrom, B. Wittenmark, 2006, Adaptive Control, Pearson Publishers
2. Alessandro Astolfi, Dimitris Karagiannis, Romeo Ortega, 2008, Nonlinear and Adaptive Control with Applications, Springer

c. Websites

1. https://www.coursera.org/
2. www.nptel.ac.in

d. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library
2. https://ocw.mit.edu/index.htm

10. Course Organization

Course Code	MEE412A		
Course Title	Advanced Control System		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	

Course Specifications: Supply Chain Management

Course Title	Supply Chain Management
Course Code	MEE413A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course is designed to provide students with comprehensive knowledge of logistics and supply chain management in manufacturing and service organizations. It focuses on supply chain strategies, sourcing decisions, inventory and logistics management, transportation, and supply chain network design for improving organizational competitiveness and operational efficiency. The course also give emphasis to analytical approaches for supply chain planning, forecasting, coordination, and performance evaluation. Students will advance in awareness of modern supply chain practices such as ERP, E-business, sustainable logistics, global logistics, 4PL, 5PL, and emerging trends in supply chain management for enhancing organizational performance and decision-making.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the concepts, strategies, drivers and performance measures of logistics and supply chain management for achieving organizational competitiveness
- **CO-2.** Analyze sourcing, inventory, purchasing, transportation and supply chain network design for effective demand-supply coordination and operational optimization
- **CO-3.** Develop integrated supply chain networks and coordination systems using forecasting, logistics, and emerging SCM practices for improving manufacturing organizational performance

4. Course Contents

Unit 1 (Introduction to Supply Chain Management): Evolution of Supply Chain Management (SCM), value chain concept, objectives and importance of SCM, process and push/pull views of supply chain, decision phases in supply chain, SCM strategy and competitive advantage.

Unit 2 (Sourcing and Supply Chain Strategy): Supply management strategies, strategic sourcing,

supplier selection and contracts, sourcing assessment, vertical integration, outsourcing, make-or-buy decisions and numerical problems, strategic fit in supply chains, responsiveness and efficiency.

Unit 3 (Supply Chain Network Design and Planning): Supply chain drivers and performance metrics, distribution networking, supply chain network design, factors influencing network decisions, impact of uncertainty, decision tree analysis, demand forecasting and aggregate planning.

Unit 4 (Inventory, Purchasing and Logistics Management): Role and evolution of purchasing, purchasing objectives and process, cycle inventory, safety inventory, lot sizing, quantity discounts, role of IT in inventory management, transportation, warehousing, inbound and outbound logistics, third-party logistics (3PL).

Unit 5 (Supply Chain Coordination and Emerging Trends): Supply chain coordination, bullwhip effect, obstacles and managerial levers for coordination, strategic partnerships, supply chain performance measurement, ERP and E-business in SCM, 4PL and 5PL logistics, global logistics, reverse logistics, risk management, lean, sustainable and green supply chains.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1													2
CO-2		3											3
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x		x	x
CO-2	x	x		x	x
CO-3			x		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--

7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Sunil Chopra, Peter Meindl and Dharam Vir Kalra, 2016, Supply Chain Management: Strategy, Planning and Operation, Pearson
3. Robert B. Handfield, Robert M. Monczka, Larry C. Giunipero and James L. Patterson, 2011, Sourcing and Supply Chain Management, Cengage
4. Shapiro and Jeremy F., 2002, Modelling Supply Chain, Thomson
5. Poirer C. C. and Bauer M. J., 2002, E- Supply Chain, Using the Internet to Revolutionize your Business, Viva Books
6. Martin Christopher, 2006, Logistics and Supply Chain Management, Strategies for Reducing Cost and Improving Service, Pearson
7. Stanley Fawcett E., Lisa Ellram M., 2007, Supply Chain Management, From Vision to Implementation, Prentice Hall

b. Recommended Reading

c. Magazines and Journals

1. Supply Chain Management: An International Journal, Emerald Publishing Group Ltd.
2. International Journal of Physical Distribution and Logistics Management, Emerald Publishing Group Ltd.
3. International Journal of Production and Operations Management, Emerald Publishing Group Ltd.

d. Websites

1. www.supplychainmanagement.in
2. www.scmr.com
3. Other Electronic Resources
4. Electronic resources on the subject area are available in RUAS library

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEC413A		
Course Title	Supply Chain Management		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Predictive Maintenance using AI

Course Title	Predictive Maintenance using AI
Course Code	MEE414A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to equip students with the knowledge and skills required to apply artificial intelligence techniques for predicting equipment failures and optimizing maintenance strategies. The course focuses on data driven approaches, including machine learning, sensor data analysis, and anomaly detection, to improve system reliability and reduce downtime. Students will learn to collect, process, and interpret industrial data, develop predictive models, and implement intelligent maintenance solutions.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the predictive maintenance strategies for industrial systems
- **CO-2.** Apply machine learning and AI techniques to sensor data for pattern detection, anomaly identification, and predictive maintenance using real-world datasets
- **CO-3.** Develop and evaluate predictive models for fault detection, remaining useful life (RUL) estimation

4. Course Contents

Unit 1 (Introduction): Evaluation of maintenance of industrial equipment, Reactive, Preventive, Predictive and Prescriptive methods, common failure mechanisms in mechanical systems, condition monitoring

Unit 2 (Sensors and signal acquisition): Review of sensors for mechanical equipment such as vibration sensors, temperature sensors, thermal cameras, acoustic emission sensors, load and pressure sensors

Unit 3 (Data acquisition): DAQ cards, sampling rate, Nyquist frequency, analog, digital, and

remote data acquisition system, signal processing and conditioning, types of data acquisition, data storage and data retrieval

Unit 4 (Data Analysis): Types of data, time series data processing, feature extraction, machine learning techniques, classifiers such as MLP, SVM, K-means, deep learning basics, anomaly detection, applications to real-world datasets

Unit 5 (Case studies): Engine maintenance, smart factory monitoring, aircraft maintenance, Electric Vehicles maintenance, heavy machinery maintenance, oil and gas equipment monitoring

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2	3												2
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	

6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	x	x			x
CO-2	x	x	x	x	x
CO-3			x	x	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination

14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Tanu Singh, V. (2025) Data Analytics and Artificial Intelligence for Predictive Maintenance in Industry 4.0, ISBN: 979-8-89881-088-7
3. Srinivasan M. R. (2011) Smart Maintenance with AI: Preventing Downtime and Saving Millions in Industry 4.0, ISBN: 978-1456667030

b. Recommended Reading

1. Cerquitelli, T., Nikolakis, N., O'Mahony, N., Macii, E., Ippolito, M. and Makris, S., 2021. Predictive maintenance in smart factories. Springer Singapore. Richtmeyer, F. K., Kennard, E.H. and Cooper, J.N (2007) Modern Physics, 6th Ed, TMH
2. Edwin, D.C., Aerospace predictive maintenance: fundamental concepts/Charles Edwin Dibsdale.
3. Mohammed Hamed Ahmed Soliman., "AI in Maintenance & Reliability: Predictive and Prescriptive Maintenance with Artificial Intelligence," ISBN 9798265228635

c. Websites

1. http://www.nptel.ac.in/

d. Other Electronic Resources

1. Electronic resources on the module area are available at MSRUAS library

10. Course Organization

Course Code	MEE414A	
Course Title	Predictive Maintenance using AI	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Industrial Tribology

Course Title	Industrial Tribology
Course Code	MEE415A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with theoretical principles and practical considerations of friction, wear and lubrication in machinery design. Students are taught the laws of friction, mechanisms of friction and resulting surface temperature and control. Students will be able to account for various modes of wear, Identify and apply different types of lubrication in the process of developing machines. Students will be able to identify various modes of wear in each mechanical system and recommend suitable lubrication systems in the process of developing machines.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss Friction, Mechanisms of Friction, Wear and methods of lubrication for design of machine elements.
- **CO-2.** Analyze Tribological Issues at component and machine level and select appropriate type of lubricant and method of lubrication for a given application.
- **CO-3.** Identify suitable type of bearing for a given application.

4. Course Contents

Unit 1 (Introduction):

Overview and importance of different types of wear, friction and lubrication in various machines/machine tools; Introduction to Tribology: Overview of friction, Wear and lubrication, Economic significance, Impact of Tribology on maintenance, plant life, Energy conservation, Material conservation, Safety and pollution.

Unit 2 (Friction, Wear, Lubrication and Lubricants):

Laws of Friction, Types of Friction, Frictional force, Friction coefficient, Significance of wear, Types of wear, Wear regimes, Control of wear, Importance of Lubrication, Boundary Lubrication, Mixed Lubrication, Full Fluid Film Lubrication, Hydrodynamic and Elasto Hydrodynamic lubrication. Types & Properties of Lubricants. Lubricants Additives.

Unit 3 (Fluid Film Lubrication):
Fluid Mechanics concepts, Equation of Continuity & Motion. Generalized Reynolds Equation with Compressible & Incompressible Lubricants. Crude oils, Base oil components, Synthetic oils, Greases, Additives to lubricants, Lubrication types, Fluid film lubrication, Regimes of fluid film lubrication Hydrostatic lubrication, Hydrodynamic lubrication, Elastohydrodynamic lubrication, Mixed lubrication, Boundary lubrication, Principles of hydrodynamic lubrication, Assumptions of hydrodynamic lubrication theory.

Unit 4 (Surface Film Formation):
Surface film formation and failure, Functions and types of lubricants, lubricant properties and testing of lubricants. Study of various types of bearings used in machines/machine tools and Procedures to trouble shoot tribological problems.

Unit 5 (Tribo-Elements):
Classification of bearings, Dry and boundary lubrication bearings, Hydrodynamic bearings, Hydrostatic bearings, Magnetic bearings, Rolling element bearings, Selection criteria, Bearings for precision applications. Noncontact bearings for precision bearings, bearing subjected to frequent starts and stops, Journal bearings, Selection of bearings, type of lubricants, oil film thickness, maximum operating range of temperature and pressure for a given application.

Unit 6 (Journal Bearing):
Long hydrodynamic journal bearing, Journal bearing load capacity, friction in long journal bearing, Practical pressure. Boundary conditions, short journal bearings, Short bearing analysis, Journal bearing stiffness.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1													
CO-2		3											3
CO-3		3											3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		
1. Course Laboratory	00	

2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X			X	X
CO-2	X	X	X	X	X
CO-3			X		X
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes.
2. John Williams. (2012) Engineering Tribology, Cambridge University Press.

b. Recommended Reading

1. Bharat Bhushan. (2013) Introduction to Tribology, John Wiley and Sons.
2. Gwidon W. Stachowiak and Andrew W. Batchelor. (2000) Engineering Tribology, 2nd edition, Elsevier.
3. Avraham Harnoy. (2002) Bearing design in machinery: engineering tribology and lubrication, CRC Press.
4. Mathew Mate C. (2019) Tribology on the Small Scale: A Bottom Up Approach to Friction, Lubrication, and Wear, Oxford University Press.
5. Prasanta Sahoo. (2005) Engineering Tribology, Prentice Hall of India.
6. S.K. Basu, S.N. Sengupta and B.B. Ahuja. (2011) Fundamentals of Tribology, Prentice Hall of India.

c. Magazines and Journals

1. ASME Journal of Tribology
2. Tribology Transactions
3. Tribology- Materials, Surfaces & Interfaces

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources in the course area are available on RUAS library

10. Course Organization

Course Code	MEE415A		
Course Title	Industrial Tribology		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	



Course Specifications: Robot Programming and Simulation

Course Title	Robot Programming and Simulation
Course Code	ROC312A
Course Type	Professional Core Elective
Department	Mechanical Engineering
Faculty	Engineering and Technology

1. Course Summary

The course is designed to provide students with comprehensive knowledge of logistics and supply chain management in manufacturing and service organizations. It focuses on supply chain strategies, sourcing decisions, inventory and logistics management, transportation, and supply chain network design for improving organizational competitiveness and operational efficiency. The course also give emphasis to analytical approaches for supply chain planning, forecasting, coordination, and performance evaluation. Students will advance in awareness of modern supply chain practices such as ERP, E-business, sustainable logistics, global logistics, 4PL, 5PL, and emerging trends in supply chain management for enhancing organizational performance and decision-making.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Mechanical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply various techniques of robot simulation and programming for solving given applications
- **CO-2.** Select and identify a suitable controller for performing specific task to meet Robot control requirements
- **CO-3.** Develop a robotic operation using appropriate software tools to perform a given task

4. Course Contents

Unit 1 (Introduction to Robot simulation): Robot software functions - coordinate systems, position control, other control functions, subroutines, Program planning for Robot flow charting for robot programs with few examples.

Unit 2 (Methods of Robot Programming): Online programming, off-line programming, advantages of off-line programming, lead through methods - powered lead through, manual lead through, teach pendant, Robot program as a path in space, defining position in space,

motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and Limitations of head through methods using python, C&C++, JAVA and MATLAB.

Unit 3 (Robot Languages): Textual ROBOT Languages, first generation and second generation languages, structure of a robot language - operating systems, Elements and Functions, constants, variables and other data objects, Motion commands, points in workspace, End effector and sensor commands, computations and operations, program control and subroutines, communications and Data processing, Introduction to high level robot programming languages.

Unit 4 (Control for Robotic Systems): Feedback control, second order linear systems, control of second order systems, trajectory following control, disturbance rejection, feedback linearization, conventional controller, sliding mode control, variable structure control, adaptive control.

Unit 5 (Stability): Control problem, state equations, state space model of a robot, constant solutions, equilibrium point, liapunov's first method, liapunov's second method, domain of attraction, linear system stability, steady state tracking.

Unit 6 (Case Studies): Modelling and Control of Manipulators, Feedback Control of a Robot, Trajectory and Position Control of a Robot, behavior based systems.
Example: Service robots, Domestic robots, Security, Surveillance and Entertainment robots

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PSO-1**	**PSO-2**
CO-1	3												3
CO-2		2											2
CO-3			3										3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Mechanical Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	**SC4**	
Subcomponent Type ▶	**Term Test**	**Term Test**	**Assignment**	**Assignment/Quiz /Tutorials**	**Written Exam**
Maximum Marks ▶	**15**	**15**	**20**	**10**	**40**
CO-1	X	X		X	X
CO-2	X	X	X	X	X
CO-3			X		
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures

2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, 1986, Industrial Robotics Technology, Programming and Applications, McGraw Hill
3. Robert J. Schilling, 1990, Fundamentals of Robotics: Analysis & Control, 2nd Edition, Pearson
4. J. J. Craig, 1989, Introduction to Robotics, Mechanics, and Control, 2nd Edition,Addison Wesley

b. Recommended Reading

1. Joseph L. Jones, 2004, Robot Programming: A Practical Guide to Behavior-Based Robotics, McGraw-Hill
2. Bernard Hodges, 1993, Industrial Robotics, Second Edition, Jaico Publishing House
3. K. S. Fu, R. C. Gonzalez and C. S. Lee, 1987, Robotics: Control, Sensing, Vision, and Intelligence, McGraw-Hill
4. M. W. Spong and M. Vidyasagar, 1989, Robot Dynamics and Control, New York, Wiley

c. Magazines and Journals

1. The International Journal of Robotics Research
2. Journal of Intelligent & Robotic Systems
3. Robotics and Autonomous Systems, Elsevier
4. Journal of Control, Automation and Electrical Systems, Springer

d. Websites

1. http://www.robotc.net/
2. http://www.robotvirtualworlds.com/

3. http://www.nptel.ac.in/courses/112101099/#

e. Other Electronic Resources

1. http://video.mit.edu/watch/omnidirectional-mobile-robot-kinematic-control-and-spin-motion-4042/
2. http://video.mit.edu/watch/dynamic-walking-2010-robert-gregg-control-and-planning-with-asymptotically-stable-gait-primitives-5972/
3. Electronic resources on the module area are available at MSRUAS library

10. Course Organization

Course Code	ROC312A	
Course Title	Robot Programming and Simulation	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.me.et@msruas.ac.in
Course Specifications Approval Date	June 2026	
Next Course Specifications Review Date	June 2030	

Course Specifications: Applied Physics for Engineers

Course Title	Applied Physics for Engineers
Course Code	PYB101A
Course Type	Core Theory
Department	Physics
Faculty	Engineering and Technology

I. Course Summary

The Applied Physics for Engineers course in the Bachelor of Technology (B. Tech.) program provides students with a comprehensive understanding of the principles of physics and their applications in engineering. The curriculum emphasizes theoretical concepts, practical skills, and their integration into various engineering disciplines.

2. Course Size and Credits:

Number of credits	04
Credit structure (Lecture: Tutorial: Practical)	2:1:1
Total hours of interaction	90
Number of weeks in a semester	15
Department responsible	Physics
Total course marks	100
Pass requirement	As per the academic regulations
Attendance requirement	As per the academic regulations

1. Course Objectives (CO)

After the successful completion of this course, the student will be able to:

CO - 1 **Apply** the concepts of laser and fiber optics, mechanics to analyze physical phenomena and applications.

CO - 2 **Analyze** the behavior of crystal structure, thermoelectricity, fluid dynamics, and quantum mechanics, and interpret them in terms of their applications.

CO - 3 **Solve** the problems in mechanics, crystal structure, fluid dynamics, laser and fiber optics, and quantum mechanics.

CO - 4 **Implement** the experiments and problem-solving methodologies to interpret results, perform error analysis, and validate theoretical concepts.

2. Course Contents

Unit 1 – Lasers and Optical fibers (11 hrs)

Lasers: Interaction of radiation with matter - Absorption, spontaneous emission, and stimulated emission - Characteristics of laser light - Expression for the energy density of electromagnetic radiation – Requisite conditions for production of a laser beam—Helium-Neon laser—Applications of laser—Lidar and laser cutting

Optical Fibers: Principle-- Angle of acceptance—Expression for Numerical aperture-- condition for propagation—Refractive index profiles of step index and graded index fibers (GRIN)—Modal propagation

in step index and GRIN fibers –Attenuation—Different types of loss mechanisms--Fiber optic communication system
Unit 2 - Rigid body dynamics and Fluid dynamics (11 hrs) Rigid body dynamics: Review of Rigid body dynamics. Expressions for moments of inertia of a circular disc and rectangular plate about different axes, MI of the flywheel. Fluid dynamics: Flow of liquids and gases, Streamline and turbulent flow, Bernoulli's theorem and its application, Coefficient of viscosity, Applications of Coefficient of viscosity (Lubrication and tribology), Stoke's law. Introduction to microfluids.
Unit 3 – Crystal structure and Elasticity (11 hrs) Crystal structure: Space lattice, Bravais lattice, Lattice parameters, Crystal systems, Miller indices: Indexing directions and planes in a crystal. Atomic packing fraction and coordination number for simple, body-centered, and face-centered cubic Crystals. Expression for interplanar Spacing. Structure of diamond crystal, Bragg's law. Elasticity: Review of Elasticity, Poisson's ratio, expression for Y, η and K in terms of linear and lateral strains (Deformation of a cube). Expression for couple per unit twist—Torsion Pendulum -- determination of rigidity modulus of a wire using torsion pendulum—Bending of beams—Single cantilever—Expression for Young's modulus of a cantilever beam
Unit 4 – Thermoelectricity (12 hrs) Thermo-emf and thermoelectric current, Seebeck effect, Peltier effect, Thomson effect, Seebeck and Peltier coefficients, Thermoelectric series, neutral temperature, temperature of inversion, Thermoelectric diagrams and uses, laws of thermoelectricity, thermocouples, thermopile, Construction and working of thermoelectric generators (TEG) and Thermoelectric coolers (TEC). Applications of thermoelectricity-thermoelectric pyrometer, Refrigerator.
Laboratory experiments (30 hrs) General experiments will be performed based on the concepts: mechanics, Elasticity, Laser, Optical fibre, quantum theory, fluid dynamics, thermoelectricity, error analysis, etc. **1** **Error analysis** **2** Determination of Numerical aperture and acceptance angle of optical fibre **3** Determination of the wavelength of the laser **4** Determination of Planck's constant **5** Verification of Stefan's law **6** Determination of the temperature coefficient of resistance for metals **7** Experiment on Thermo-emf / Peltier Module **8** Determination of Young's modulus of the material of the given bar by Uniform Bending. **9** Determination of the rigidity modulus of the material of the wire using the Torsional Pendulum. **10** Determination of the mass of a flywheel. **11** Calibration of a thermocouple as a thermometer. **12** Determination of the coefficient of viscosity by Stock's method.

6. Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO-1	3	1										1	
CO-2	3	1											1
CO-3		2										1	
CO-4	2												1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

7. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		18
1. Solving Numerical Problems	18	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Written Examination		10
Total Duration in Hours		90

8. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Program Specifications document pertaining to the B.Tech. programs. The procedure to determine the final course marks is also presented in the program Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 or LSC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation						
Course Outcome	**CE (Weightage: 60 %)**				**SEE (Weightage: 40 %)**	
	TSC1: (30 %) Term Test	**TSC2: (10 %) Assignment**	**TSC3: (10 %) Innovative Assessment**	**LSC4: (10 %) Laboratory CE**	**Theory – SEE (25 %)**	**Laboratory - SEE (15 %)**
	50 marks (TT1+TT2)	**25 Marks**	**25 Marks**	**25 Marks**	**50 Marks**	**25 Marks**
CO-1	√		√		√	
CO-2	√	√	√		√	
CO-3	√	√	√		√	
CO-4				√		√
The details of TSC1, TSC2, TSC3, or LSC4 are presented in the Programme Specifications Document.						

The Course leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8 Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No.	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Class room lectures, and demonstrations
3.	Critical Skills	Assignment
4.	Analytical Skills	Class room, assignment
5.	Problem Solving Skills	Class room, assignment
6.	Practical Skills	Class room, assignment
7.	Group Work	Classroom
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Course
13.	Information Management	Assignment, examination
14.	Personal Management	Assignment, examination
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

1. Rajendran, V. (2011) Engineering Physics, TMH.
2. Srinivasan M. R. (2011) Physics for Engineers, 3rd Ed, New Age International.
3. Gyan Prakash, (2012) Experimental Physics, Studium Press.
4. A Text book of Engineering Physics by M.N. Avadhanulu, P G. Kshirsagar, S Chand, 2014, Revised Edition
5. Michael Sayer, Abhai Mansingh, (1999) Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI.
6. B Saraf et al (1987) Physics through experiments, Vikas Publications.
7. Chauhan & Singh. (1971) Advanced practical physics, Pragathi Publications
8. Class notes/PPTs

b. Recommended Reading

1. Srinivasan M.R. (2011) Applied Solid State Physics, 1st Ed, New Age International
2. S.O. Pillai (2011), A Textbook of Solid State Physics, 6th Ed, New Age International
3. Richtmeyer, F. K., Kennard, E.H. and Cooper, J.N (2007) Modern Physics, 6th Ed, TMH

4. Halliday, I.D., Resnick, R and Walker, J (2010) Fundamentals of Physics, 9th Ed, Wiley
5. Beisser, A. (2009) Concepts of Modern Physics, 6th Ed, TMH
6. Giri, P.K., (2005) Physics Laboratory Manual for Engineering Undergraduates, Department of Physics, Indian Institute of Technology Guwahati

c. Magazines and Journals

1. American Journal of Physics
2. Resonance

d. Websites

1. http://nptel.ac.in/

e. Other Electronic Resources

1. Electronic resources on the subject area are available on MSRUAS library

10. **Course Organization**

Course Code	PYB101A		
Course Title	Applied Physics for Engineers		
Course Leader/s Name		As per Time - table	
Course Leader Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.pi.ns@msruas.ac.in
Course Specifications Approval Date		June 2026	
Next Course Specifications Review Date		June 2030	