Academic Document for the Programme

M Tech in Advanced Machinery Design

Program Code – 028

Batch – 2022 - 2024

M.S. Ramaiah University of Applied Sciences * Bangalore

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560058

Department of Mechanical and Manufacturing Engineering
Faculty of Engineering and Technology (FET)
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University House, New BEL Road, MSR Nagar, Bengaluru – 560 054
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Faculty	Engineering and Technology
Department	Mechanical and Manufacturing Engineering
Name of the Programme	M Tech in Advanced Machinery Design
Programme Code	028
Mode of Study	Full Time
Date of Commencement of the Programme	August 2022
Date of Programme Approval by the Academic Council of MSRUAS	June 2019

1. Programme Objective

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of contemporary machinery design; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of industry, academics, research or take up entrepreneurship.

2. Programme Outcomes (POs) / Graduate Attributes

PO 1. Summarize machinery design concepts for farming equipment, construction machinery, general engineering machines, material handling equipment, etc.
PO 2. Explain underlying engineering principles for design and control of machinery
PO 3. Identify materials and processing knowledge for design of machine elements
PO 4. Use CAE tools to model, simulate and analyze the behavior of machinery systems for design optimization and performance improvement
PO 5. Design and develop machinery systems to meet varied functional and operational requirements
PO 6. Develop a career in Advanced Machinery Design
PO 7. Practise Teamwork, lifelong learning and continuous improvement

3. Programme Specific Outcomes (PSOs)

The programme specific outcomes are listed under four headings:

1. Knowledge and Understanding
2. Cognitive skills
3. Practical skills and
4. Capability/Transferable skills

Knowledge and Understanding: After undergoing this programme, a student will be able to:

PSO1: Explain the importance of various engineering materials and processing techniques
PSO2: Discuss the design principles applied to advanced machinery systems
PSO3: Identify the types of load acting on machine elements and explain their effect
PSO4: Identify the scope for optimisation for improved design

Cognitive Skills: After undergoing this programme, a student will be able to:

PSO5: Synthesise a mechanism for development of a machine
PSO6: Plan and arrive at detailed engineering design of a machine and its components
PSO7: Create models, simulate, analyse and optimise the design
PSO8: Design, model and simulate appropriate controls for machine operation

Practical Skills: After undergoing this programme, a student will be able to:

PSO9: Use commercially available tools for simulation and analysis of mechanisms, structures and controls

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PSO10: Select materials for machine elements using commercially available database based on functionality
PSO11: Conduct tests of machine systems and structures
PSO12: Estimate life of components using simulation

Capability Skills / Transferrable Skills: After undergoing the programme, a student will be able to:
PSO13: Manage information, develop technical reports and make presentations
PSO14: Build, Manage and Lead a team to successfully complete a project and communicate across teams and organizations to achieve professional objectives
PSO15: Work under various constraints to meet project targets
PSO16: Adopt to the chosen profession by continuously upgrading his/her knowledge and understanding through Life-long Learning philosophy

4. Eligibility for Admission:

4.1. Eligibility for students seeking admission under Government of Karnataka quota (for 40% seats):

i. A candidate seeking admission to postgraduate programme must have passed graduate level in Engineering and Technology in a related discipline with at least 50% marks in aggregate or equivalent CGPA.
ii. A candidate belonging to SC/ST category will be entitled to a relaxation in the qualifying marks in accordance with the related government notification in this regard.

4.2. Eligibility for Indian students seeking admission under the university quota:

Students seeking admission under University quota must have passed graduate level degree in Engineering in a related discipline with at least 50% marks in aggregate or equivalent CGPA.

4.3. Eligibility for foreign students seeking admission under University quota:

i. Foreign students should have Association of Indian Universities recognized first degree qualification in the Engineering related discipline of equivalent
ii. Should have proof of proficiency in English.

4.4 : Selection of Students

Selection of students for admission under Government of Karnataka will be based on Karnataka

Government notified admission tests.

Selection of students for admission to University quota of seats is based on admission policy of the University notified from time to time.

Selection of foreign students for admission to University quota of seats is based on the admission policy of the University notified from time to time.

4.4.1 : Admission to Programme

Selected candidates shall complete the admission procedure within the prescribed date by paying the prescribed fees and completing all other admission formalities notified by the University. Failure to do so may lead to cancellation of the selection.

4.4.2 : Annual Programme Fee

Details of the fees payable for each Programme will be notified well in advance to the commencement of the programme.

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The fees, once paid, will not be refunded under any circumstances.
The continuation of a student's registration in subsequent academic years is subject to payment of the prescribed programme and registration fees for each of those years.

4.4.3 : Free-ship and scholarships
The Board of Management, in consultation with the Board of Governors, may consider offering free ships / scholarships to deserving students who maintain a minimum level of academic performance on a yearly basis.

5. Programme Duration

5.1. Normal Duration: The normal duration of the M.Tech. postgraduate programme is:

a. Two years in the Full-Time Route
b. Three years in the Part-Time Route

5.2. Maximum Duration: The maximum period a student is allowed to complete the M.Tech Programme shall be double the normal duration of the programme, i.e., Four Years for Full-Time students and Six years for Part-Time students.

5.3. Duration for Lateral Entry Scheme: N/A

6. Medium of Instruction

English is the medium of instruction for the programme.

7. Programme Structure

The programme structure is presented in **Appendix A**.

8. Programme Curriculum

The programme curriculum is presented in **Appendix B**.

9. Attendance Requirement

A student is required to have a minimum attendance of 80% to be eligible to appear for the examination and for assignment submission. Students who fail to achieve the minimum attendance will be declared as "FAIL". A failed student is required to re-register, attend the course and take up all the components of assessment at the next offering.

10. Assessment

10.1. Achievement Testing: During each semester, students' performance is assessed through two components, Continuous Evaluation (CE) and a Semester-End Examination (SEE). Both CE and SEE carry equal weight.

10.1.1. Continuous Evaluation (CE): This includes term tests, assignments, viva-voce, quiz, seminars, mini projects and other such evaluation methods designed for specific courses and conducted as per the norms of the University for Assessment.

10.1.2. Semester End Examination (SEE): This includes a written/laboratory examination conducted as per the norms of the University for Assessment.

The attainment of student in all COs are evaluated. A typical evaluation template in a theory course is presented in Table 1. A student is required to score a minimum of 40% marks in each course, scoring a minimum of 40% in each of CE and SEE.

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Table 1: Typical evaluation template for a theory course					
Course Outcome	CE (Weightage: 50 %)				SEE (Weightage: 50 %) Semester End Exam
	Component	Component	Component	Component	
	XX Marks	XX Marks	XX Marks	XX Marks	50 Marks
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					

In the case of a laboratory course, there are two components: Component-1 and Component-2. Component-1 (CE) carries a weight of 50% and Component -2 (SEE) carries a weight of 50%.

The template for weightage of CE and SEE in percentages for each course is indicated in Table 2.

Table 2: Typical evaluation template for a laboratory course						
Course Outcome		CE (Weightage: 50 %) 25 Marks				SEE (Weightage: 50 %): 25 Marks
	Assessment Type	Conduction of Lab Exercises	Viva-Voce	Lab Record Submission	Lab Test	SEE
	Component Weightage	10 Marks	05 Marks	05 Marks	05 Marks	25 Marks
CO-1						
CO-2						
CO-3						
CO-4						
CO-5						
CO-6						

10.1.2: Second Assessment and External Review

Each student's work is first assessed by the Course teaching team. All the answer scripts of a given course are to be assessed by a second examiner. 10% of the evaluated scripts will be further reviewed by an examiner who is external to the University. An External examiner will have tenure of 2 years which can be renewed for a further period of 2 years. The first assessor or assessing team is required to fill in the evaluation data and write the Post Module Assessment Report (PMAR).

10.1.2.2: Feedback on Assessed work

The awarded marks and distribution pattern will be reviewed by the Dean of the Faculty before scheduling a face-to-face feedback session with the student. After completing assessment of the course, the course teaching team along with the concerned Head of the Department should provide face-to-face feedback to the student regarding his/her performance after handing over the assessed

documents on a prescheduled day. After the feedback, the assessed documents are collected and deposited with the Examination and Assessment Unit of the Faculty.

10.3. Credits not earned in a Course and Opportunities for Make-up:
A minimum of 40 % marks in the assignment and a minimum of 40% marks in the written examination are required for successful completion of a course. A student failing in any one of the components will be declared 'FAILED' in the course. A failed student who has fulfilled the attendance criterion is eligible to re-sit under the fast track scheme.

There is no provision for a re-examination or re-submission of any of the assessment components for a failed course.

A maximum of 3 attempts, including the first attempt, are permitted for successful completion of a course.

11. Academic Awards

Award of Grades: Students will be awarded grades based on the marks scored. The basis for awarding grades is shown in Table 3.

Table 3: Grade Definition and Grade Points

Sl. No.	Marks Scored	Grading	GPA Grade Points
1.	91-100	O (Outstanding)	10
2.	75-90	A+ (Excellent)	9
3.	61-74	A (Very Good)	8
4.	55-60	B+ (Good)	7
5.	50-54	B (Above Average)	6
6.	45-49	C (Average)	5
7.	40-44	P (Pass)	4
8.	Below 40	F (Fail/Absent) RS – Re-sit RR – Re-registration	0
'RS' and 'RR' to be considered as 'F' for SGPA and CGPA calculations.			

The SGPA is indicated in the transcript only if all credits prescribed for the semester are earned by the student.

Computation of CGPA:

$$\text{CGPA} = \frac{\sum_1^N \text{Grade points scored in a given course} \times \text{Number of credits for that course}}{\text{Total number of registered credits}}$$

Here, N is the total number of courses registered for in a semester.

Example: Typical SGPA and CGPA calculations for two semesters are shown in Table 4.

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Table 4: SGPA and CGPA calculations for two semesters

SGPA and CGPA: Sem-1 (All courses excluding 'Consideration Courses')

Course	Grade	Grade Point (GP)	Credit	GP * Credit	
C1	A	8	4	32	**SGPA** = 129/18 = 7.166 = 7.17
C2	B+	7	4	28	
C3	C	5	3	15	
C4	B	6	4	24	
C5	O	10	3	30	
		Total	**18**	**129**	
Cumulative Credits and Grade Point * Credits			**18**	**129**	**CGPA** = 129/18 = 7.17

SGPA and CGPA: Sem-2 (All courses excluding 'Consideration Courses')

Course	Grade	Grade Point (GP)	Credit	GP * Credit	
C10	O	10	3	30	**SGPA = 97/14 = 6.93**
C11	A+	9	3	27	
C12	C	5	4	20	
C13	C	5	4	20	
		Total	**14**	**97**	
Cumulative Credits and Grade Point * Credits			**18 + 14 = 32**	**129 + 97 = 226**	**CGPA** = 226/32 = 7.0625 = 7.10

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Appendix A

Programme Structure

The Programme consists of four semesters as shown below. A student is required to successfully complete the following courses and earn credits for the award of the degree.
Complete details of each of the courses such as ILO's, content, resources, teaching-learning processes and other related information are outlined in Course Specification of the respective programme.

SEMESTER 1

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MME502A	Engineering Materials and Processes	3	1		4	100
2	19MDC501A	Advanced Mechanics of Materials	3	1		4	100
3	19MDC502A	Synthesis and Dynamics of Mechanisms	3	1	2	5	100
4	19MDC503A	Finite Element Analysis of Mechanical Structures	3	1	2	5	100
5	19MDC504A	Drives and Controls	3	1		4	100
6	19FET508A	Research Methodology & IPR	2	--	--	2	50
7	19FET509A	Professional Communication	1	--	--	0	
		Total	**18**	**3**	**4**	**24**	**550**
	25 hours						
	Minimum			**19**		**Maximum**	**24**

SEMESTER 2

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MDC505A	Vibrations in Machinery	3	1		4	100
2	19MDE5X1A	*Refer Elective Course Table*	3	1		4	100
3	19MDE5X2A	*Refer Elective Course Table*	3	1		4	100
4	19MDE5X3A	*Refer Elective Course Table/ MOOC*	3	1		4	100
5	19MDE5X4A	*Refer Elective Course Table/ MOOC*	3	1		4	100
9	19FET510A	Value Education	1			0	
			16	**5**	**X**	**20**	**500**
		21 hours					
		Minimum	**16**			**Maximum**	**20**

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SEMESTER 3

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
X	19MDP521A	*Internship*			10	4	100
	19MDP522A	Group project			15	8	200
	19MDP523A	Dissertation – Phase -1					
Total					25	12	300
Total number of contact hours per week			XX hours				
Number of credits can be registered			Minimum	XX		Maximum	XX

SEMESTER 4

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
	19MDP523A	Dissertation and Publication – Phase - II			24	24	400
Total					24	24	400
Total number of contact hours per week			24 hours				
Number of credits can be registered			Minimum	24		Maximum	24

Elective Course List			
Stream / Specialization	**S. No.**	**Course Code**	**Course Title**
Stream -1: Design Optimization	E11	**19MDE511A**	Fatigue and Fracture
	E12	**19MDE512A**	Industrial Tribology
	E13	**19MDE513A**	Design of Machinery
	E14	**19MDE514A**	Optimization Techniques
Stream-2: Machinery Design	E21	**19MDE511A**	Fatigue and Fracture
	E22	**19MDE522A**	Engineering System Design
	E23	**19MDE523A**	Machine Tool Design
	E24	**19MDE524A**	Industrial Machinery Design

Note:
The Vacations and other activities shall be as per the Timetable for the corresponding batch.

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Appendix B

Course Title	Engineering Materials and Processes
Course Code	19MME502A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course will enable the students to critically evaluate and make appropriate selection of materials and manufacturing processes for automotive, aircraft and general engineering components. The course will elucidate structure-property-processing correlation, typically used in metallic and non-metallic materials, manufacturing processes, interrelation between manufacturing processes and materials. The students will get hands on experience on software package Cambridge Engineering Selector (CES), for selection of materials and manufacturing techniques for a given component based on specific attributes.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Identify different metallic and non-metallic materials and their application areas
- **CO 2.** Arrive at material properties and requirements for achieving intended functionality in an engineering product
- **CO 3.** Critically evaluate and select suitable materials / alternate materials based on the performance of the component
- **CO 4.** Analyse the correlation between materials and processes and recommend suitable manufacturing process to produce a component
- **CO 5.** Construct a process flow for manufacturing the component
- **CO 6.** Select appropriate combination of materials and manufacturing process for a specified application using CES Software

Course Contents

Unit 1 :
Overview of materials and manufacturing: classification of materials, functional classification of materials, classification based on structure, importance of microstructure, properties, processing and performance, processing characteristics of materials

Unit 2 :
Strengthening Mechanisms in Metals: Strengthening mechanisms and types of strengthening mechanisms

Unit 3 :
Ferrous Alloys in general engineering applications: Ferrous alloys and its classification, AISI/SAE and UNS designation systems, steels, stainless steels. Cast iron: classification, structure, properties and engineering applications, Heat treatment of steels - bulk and surface heat treatments

Nonferrous Alloys general engineering and applications: Aluminum alloys, Copper alloys, Magnesium alloys, Zinc alloys, Titanium alloys - classification, structure, properties and engineering applications

Unit 4 :
Polymers: structure, classification and properties and engineering applications of polymers, Processing techniques for polymer components

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Ceramics: classification, properties and engineering applications of ceramics, different forming techniques for ceramics, powder metallurgy process

Unit 5 :
Composites: classification, properties, engineering applications of composites, manufacturing processes for composite materials

Unit 6 :
Metal Casting Processes: Overview of sand casting, investment casting and die casting processes, casting process capabilities, casting process selection, application examples

Metal Forming Processes: Overview of rolling, forging, extrusion, drawing, sheet metal operations, process capabilities of forming processes, process selection, application examples

Unit 7 :
Material Removal Processes: Overview of machining processes, cutting tool materials and cutting fluids, Advanced machining processes- USM, EDM, ECM and LBM, process selection and application examples

Joining Processes: Overview of joining processes, classification, solid state and fusion welding techniques – resistance, arc, friction, laser welding processes and mechanical sheet metal joining processes

Unit 8:
Practical/Laboratory content:
Use of Cambridge Engineering Selector for selection of material and manufacturing processes LAB
Selection of Engineering Materials and Manufacturing Processes: Basics of material selection, strategy for optimum selection of a material for a particular application based on the case studies

Practical/Laboratory content:
Exercises on identification of service conditions in which a particular material is used, category of materials and their properties. Identification of manufacturing processes adopted
Demonstration Materials characterisation- testing of commonly used engineering materials- strength tests, chemical and metallurgical tests

Course Resources

a. Essential Reading

1. Class Notes
2. Serope Kalpaljian, Steven R. Schmid, (2004), Manufacturing Processes for Engineering Materials, Pearson Education
3. W. D. Callister, (2005), Materials Science and Engineering- An Introduction, 6th Edition, John Wiley & Sons

b. Recommended Reading

1. M. P. Groover, (2005), Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 2nd Edition, John Wiley & Sons
2. M. F. Ashby and H. Shercliff, D. Cibon, (2007), Materials Engineering Science, Processing and Design, Butterworth Publications
3. Manas Chanda, Salil K. Roy, (2006), Plastics Technology Handbook, CRC Press.
4. Robert M. Jones, (1999), Mechanics of Composite Materials, McGraw-Hill.
5. C. Barry Carter, M. Norton Grant, (2007), Ceramic Materials - Science and Engineering, Springer.

c. Other Electronic Resources

1. http://nptel.ac.in/

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Course Title	Engineering Materials and Processes
Course Code	19MME502A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course will enable the students to critically evaluate and make appropriate selection of materials and manufacturing processes for automotive, aircraft and general engineering components. The course will elucidate structure-property-processing correlation, typically used in metallic and non-metallic materials, manufacturing processes, interrelation between manufacturing processes and materials. The students will get hands on experience on software package Cambridge Engineering Selector (CES), for selection of materials and manufacturing techniques for a given component based on specific attributes.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Identify different metallic and non-metallic materials and their application areas
- **CO 2.** Arrive at material properties and requirements for achieving intended functionality in an engineering product
- **CO 3.** Critically evaluate and select suitable materials / alternate materials based on the performance of the component
- **CO 4.** Analyse the correlation between materials and processes and recommend suitable manufacturing process to produce a component
- **CO 5.** Construct a process flow for manufacturing the component
- **CO 6.** Select appropriate combination of materials and manufacturing process for a specified application using CES Software

Course Contents

Unit 1 :

Overview of materials and manufacturing: classification of materials, functional classification of materials, classification based on structure, importance of microstructure, properties, processing and performance, processing characteristics of materials

Unit 2 :

Strengthening Mechanisms in Metals: Strengthening mechanisms and types of strengthening mechanisms

Unit 3 :

Ferrous Alloys in general engineering applications: Ferrous alloys and its classification, AISI/SAE and UNS designation systems, steels, stainless steels. Cast iron: classification, structure, properties and engineering applications, Heat treatment of steels - bulk and surface heat treatments

Nonferrous Alloys general engineering and applications: Aluminum alloys, Copper alloys, Magnesium alloys, Zinc alloys, Titanium alloys - classification, structure, properties and engineering applications

Unit 4 :

Polymers: structure, classification and properties and engineering applications of polymers, Processing techniques for polymer components

Ceramics: classification, properties and engineering applications of ceramics, different forming techniques for ceramics, powder metallurgy process

Unit 5 :
Composites: classification, properties, engineering applications of composites, manufacturing processes for composite materials

Unit 6 :
Metal Casting Processes: Overview of sand casting, investment casting and die casting processes, casting process capabilities, casting process selection, application examples

Metal Forming Processes: Overview of rolling, forging, extrusion, drawing, sheet metal operations, process capabilities of forming processes, process selection, application examples

Unit 7 :
Material Removal Processes: Overview of machining processes, cutting tool materials and cutting fluids, Advanced machining processes- USM, EDM, ECM and LBM, process selection and application examples

Joining Processes: Overview of joining processes, classification, solid state and fusion welding techniques – resistance, arc, friction, laser welding processes and mechanical sheet metal joining processes

Unit 8:
Practical/Laboratory content:
Use of Cambridge Engineering Selector for selection of material and manufacturing processes LAB Selection of Engineering Materials and Manufacturing Processes: Basics of material selection, strategy for optimum selection of a material for a particular application based on the case studies

Practical/Laboratory content:
Exercises on identification of service conditions in which a particular material is used, category of materials and their properties. Identification of manufacturing processes adopted
Demonstration Materials characterisation- testing of commonly used engineering materials- strength tests, chemical and metallurgical tests

Course Resources

a. Essential Reading

4. Class Notes
5. Serope Kalpaljian, Steven R. Schmid, (2004), Manufacturing Processes for Engineering Materials, Pearson Education
6. W. D. Callister, (2005), Materials Science and Engineering- An Introduction, 6th Edition, John Wiley & Sons

b. Recommended Reading

6. M. P. Groover, (2005), Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 2nd Edition, John Wiley & Sons
7. M. F. Ashby and H. Shercliff, D. Cibon, (2007), Materials Engineering Science, Processing and Design, Butterworth Publications
8. Manas Chanda, Salil K. Roy, (2006), Plastics Technology Handbook, CRC Press.
9. Robert M. Jones, (1999), Mechanics of Composite Materials, McGraw-Hill.
10. C. Barry Carter, M. Norton Grant, (2007), Ceramic Materials - Science and Engineering, Springer.

c. Other Electronic Resources

2. http://nptel.ac.in/

Course Title	Advanced Mechanics of Materials
Course Code	19MDC501A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with principles of mechanics of materials applicable for designing structural components. Students are taught the concepts of elasticity, plasticity and their application in machinery design. Failure criteria, fatigue, fracture and creep concepts will be discussed. Students will be able to analyse the response of the materials with respect to loading conditions. Students will develop MATLAB programmes to predict material behaviour.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss material behaviour under various loading conditions
- **CO 2.** Perform stress analysis for given loading and boundary condition from first principles
- **CO 3.** Identify the critical region of a structure and use appropriate failure model to analyse the failure
- **CO 4.** Develop mathematical models to predict material behaviour under various loading conditions
- **CO 5.** Predict material behaviour using MATLAB

Course Contents

Unit 1 : General consideration in mechanics of material; types of forces, types of materials; stress-strain behaviour for ductile and brittle material

Unit 2 (Analysis of linear elastic materials) : Introduction to tensor, stress as a tensor, components of stress, types of stresses, stress at a point, stresses under different co-ordinate systems (Cartesian, cylindrical and polar Co-ordinates), stress transformation, principal stresses and its invariants; Strain as a tensor, types of strain, strain displacement relationship, strain transformation and strain invariants; plane stress and plane strain, axisymmetry; elastic constants, constitutive, equilibrium equations and compatibility conditions; generalized Hooke's law; elastic strain energy; effect of temperature on stress-strain relation, thermal stresses; combined loading, failure theories.

Unit 3 (Plasticity) : True stress and strain; nonlinearity; Mechanism of deformation; Bauschinger effect; yield criteria, yield locus, flow rules; plastic stress-strain relations; hardening behaviour.

Unit 4 (Contact mechanics): Problem of determining contact stress; Method of computing contact stresses; Defection of bodies in point contact; stress for two bodies in line contact, loads normal to contact area, loads normal and tangent to contact area.

Unit 5 (Analysis of linear elastic orthotropic materials): Introduction to orthotropic materials, elastic properties, stress-strain relationship for a laminate, compliance and stiffness matrix; Forces and moments on lamina, stresses and strains due to applied loads, laminate strains; failure theories applied to orthotropic materials

Unit 6 (Creep): Time dependent mechanical behaviour, the creep curve, structural changes during creep, fracture at elevated temperature

Unit 7 :

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Practical/Laboratory content:
Material testing demonstration

Practical/Laboratory content:
Programming of mathematical models in MATLAB for material behaviour

Course Resources

a. Essential Reading

7. Class Notes
8. G. E. Dieter. (1988) Mechanical Metallurgy: SI Metric Edition, McGraw-Hill.

b. Recommended Reading

11. L. S. Srinath. (2003) Advanced Mechanics of Solids, 2nd edition, Tata McGraw-Hill
12. A. P. Boresi, R. J. Schmidt. (2009) Advanced Mechanics of Materials, John Willey & Sons.
13. J. M. Gere, S. P. Timoshenko. (2002) Mechanics of Materials, CBS.

c. Other Electronic Resources

3. http://nptel.ac.in/

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Course Title	Synthesis and Dynamics of Mechanisms
Course Code	19MDC502A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

The course deals with synthesis, kinematic and dynamic analysis of planar and spatial mechanisms. Students are taught kinematics and dynamics of commonly used planar and spatial mechanisms. They are trained to use MATLAB and ADAMS software for analysis of such mechanisms. Students are taught to synthesize mechanisms to achieve desired motion.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss kinematics, kinetics and dynamics and their importance in machinery design
- **CO 2.** Perform kinematic and dynamic analysis of well-known planar mechanisms
- **CO 3.** Synthesize mechanisms to achieve desired motion in 2D spaces
- **CO 4.** Evaluate spatial mechanisms
- **CO 5.** Simulate kinematic and dynamic behaviour of mechanisms using MATLAB and ADAMS software

Course Contents

Unit 1: Planar mechanisms and kinematics: Principles of planar mechanisms, spatial mechanisms, mechanisms and their inversions; examples of various mechanisms and their practical applications; Gruebler and Kutzbach's equation; Grashof condition for linkage; rules and techniques of linkage transformation

Unit 2: Kinematic analysis of planar mechanisms: Need for kinematic analysis; Type of linkages motion; Concepts of kinematics; velocity and acceleration of linkages; analytical methods; position, displacement, velocity and acceleration analysis of fourbar linkage and slider-crank mechanism using analytical methods; determining position, velocity and acceleration of a point on a linkage; Programming in MATLAB to carry out kinematic analysis

Unit 3: Dynamic analysis planar mechanisms: Understanding the concepts of dynamic model, equivalent system, free body diagrams; principles of superposition; static forces analysis; D'Alembert's principle; Inertia forces in mechanisms, equivalent offset inertia force; dynamic force analysis using analytical methods; shaking force and moments

Unit 4: Synthesis of planar mechanisms: Stages of synthesis; number synthesis; function, path and motion generation; limiting conditions – toggle position, transmission angle; two and three position synthesis using graphical method; graphical synthesis of quick return mechanism; coupler curves, dwell mechanism.

Unit 5: Spatial mechanisms and introduction to Robotics: Overview of spatial linkages; position, orientation and frames; mappings; translation, rotation and transformation; Denavit-Hartenberg parameters; link connection description; frames to link fixing conventions; standard frames; robot anatomy; industrial robots

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Unit 6 :

Kinematics of spatial mechanisms:
Serial and parallel manipulators; forward kinematics; Euler angle representation; inverse kinematics; solvability; algebraic solution methods; motion of a link; linear and rotational velocity; velocity propagation; position, velocity and acceleration analysis of spatial mechanism; Jacobians; singularities

Dynamics of spatial mechanisms:
Newton's and Euler's equations; Iterative Newton-Euler Dynamic Formulation, Structure of Manipulator Dynamic Equations, Lagrangian Formulation, Manipulator Dynamics in Cartesian Space

Unit 7: Synthesis of spatial mechanisms: Analytical synthesis, precision points; Analytical linkage synthesis of spatial slider-crank mechanism; Configuration space; Joint-space and Cartesian-space schemes; point to point planning; trajectory approximations

Unit 8 :
Practical/Laboratory content:
Kinematic analysis of slider crank mechanism, quick return mechanism, toggle mechanism, elliptical trammel mechanism using ADAMS
Carry out dynamic analysis of spring-mass-damper system and cam rocker valve mechanism using ADAMS
Dynamic analysis of spatial mechanism using ADAMS

Practical/Laboratory content:
Demonstration on robotics using Lego kit

Course Resources

a. Essential Reading

9. Class Notes
10. R. L. Norton. (2004) Design of Machinery, 3rd edition, McGraw-Hill.
11. J. J. Craig. (2005) Introduction to Robotics: Mechanics and Controls, 3rd edition, Pearson.

b. Recommended Reading

14. A. G. Erdman and G. N. Sandor. (2011) Advanced Mechanism Design: Analysis and Synthesis, Prentice Hall.
15. K. J. Waldron and G. L. Kinzel. (1999) Kinematics, dynamics and design of machinery, John-Wiley & Sons.
16. J. J. Uicker, G. R. Pennock, and J. E. Shigley. (2003) Theory of Mechanisms and Machines, Oxford University Press.
17. Charles E. Wilson and J. Peter Sadler. (2003) Kinematics and Dynamics of Machinery, 3rd edition, Prentice Hall.
18. D. V. Rao. (2001) Spatial Mechanisms: Analysis and Synthesis, CRC Press.
19. K. S. Fu, R. C. Gonzalez and C. S. Lee. (1987) Robotics: Control, Sensing, Vision, and Intelligence, McGraw-Hill.

c. Other Electronic Resources

4. http://nptel.ac.in/

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Bangalore-560058

Course Title	Finite Element Analysis of Mechanical Structures
Course Code	19MDC503A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to prepare students to solve structural problems using finite element methods. Application of finite element methodology to solve linear, non-linear, dynamic, impact and thermal problems using various material models will be taught. Students will be trained to use tools like HYPERMESH and ANSYS to solve complex problems.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Recognize the scope for finite element analysis in mechanical structural design
- **CO 2.** Develop finite element formulations and solve structural, contact and composite problem
- **CO 3.** Perform finite element modeling and analysis of linear, non- linear, thermal and dynamic problems
- **CO 4.** Apply appropriate algorithm for optimizing weight of structures
- **CO 5.** Model and analyse practical problems using Hypermesh and Ansys software

Course Contents

Unit 1: Overview of Numerical Methods, Role and importance of FEM in design of mechanical machine elements.
Introduction to different types of Finite Elements and their formulations: Formulation of 1-D, 2-D and 3-D structural elements and their applications

Unit 2: Static structural analysis of mechanical components:
Case studies demonstrating the applications of 1-D, 2-D and 3-D structural elements

Unit 3: Dynamic Analysis of Mechanical Components:
Importance of dynamic effects, inertial and damping effects in structural response, modal analysis, time response analysis and frequency response analysis, FEA modeling techniques to model system vibration, Vibration analysis as a design tool, Case studies

Unit 4: Thermal Analysis of Mechanical Components:
Three modes of heat transfer viz. conduction, convection and radiation and the objectives of undertaking a thermal analysis; Classification of linear, non-linear, steady-state and transient thermal problems; Finite element formulation for heat conduction problems like linear steady state analysis, linear transient analysis, non-linear steady state analysis and non-linear transient analysis; Steps Involved in undertaking a thermal analysis viz. geometry, material properties, mesh generation, loading and boundary conditions; Case studies

Unit 5: Non-linear Structural Analysis of Mechanical components:
Need for considering non-linearities in structural analysis, Sources and types of non-linearity, Incremental approach to solution of nonlinear problems, Iterative solution methodologies, Considerations for simulation of non-linear problems, Case studies on various types of non-linearities and solution methodology including impact loading; Case studies

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Unit 6: Contact Analysis:

Definition and implementation of contact analysis, Finite element formulation of contact problems, contact elements, contact analysis procedure and modeling issues

Unit 7: Simulation driven design optimization:
Introduction to optimization; Design optimization of mechanical components; FEA based optimization; Topology, free-size and shape optimization using FEA; Case studies

Unit 8:
Practical/Laboratory content:
Static structural analysis of mechanical components involving composite materials

Practical/Laboratory content: Laboratory demonstrations and exercises on Static, Dynamic, Thermal, Non-linear and contact analysis.

Course Resources

a. Essential Reading

12. Class Notes
13. O. C. Zienkiewicz, (2005), The Finite Element Method, Tata McGraw-Hill
14. J. N. Reddy, (1993), An Introduction to the Finite Element Method, 2nd Edition, McGraw-Hill

b. Recommended Reading

20. V. Adams, A. Askenazi, (1998), Building Better Products with Finite Element Analysis, Onward Press
21. K. J. Bathe, (1997), Finite Element Procedures, 1st Edition, PHI
22. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, (1998), Concepts and Applications of Finite Element Analysis, 4th Edition, Wiley
23. M. J. Fagan, (1992), Finite Element Analysis, Theory and Practice, Longman Scientific and Technical
24. Ted Belytschko, (1990), Nonlinear Finite Elements for Continua and Structures, 2nd Edition, Wiley
25. T. R. Chandrupatla, A. D. Belegundu, (2001), Introduction to Finite Elements in Engineering, 2nd Edition, PHI
26. J. O. Dow, (1999), A unified approach to FEM and Error Analysis Procedures, Academic Press

c. Other Electronic Resources

5. http://nptel.ac.in/

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Faculty of Engineering and Technology
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Course Title	Drives and Controls
Course Code	19MDC504A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with implementation of hydraulic, pneumatic and electric actuators in machinery applications. Students will be taught basic principles of hydraulics and pneumatics and their application to fluid power drive systems. Basics of microcontrollers, PID and simple control circuits will be discussed. Knowledge will be imparted on types of hydraulic and pneumatic drives available for use in various applications and their selection procedures. Students are taught working principles and selection criteria for different electrical drives and evaluate their capabilities and limitations. Students will be trained to evaluate the dynamic response of hydraulic and pneumatic circuits through SIMULINK.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the various electrical, electromechanical, hydraulic and pneumatic control devices as applied to machinery
- **CO 2.** Design control circuit for motion control and identify appropriate drive system
- **CO 3.** Analyze the machine applications for selecting the appropriate sensors, microcontrollers and drive components for control circuit
- **CO 4.** Create models and simulate a control circuit to achieve desired motion and arrive at specifications
- **CO 5.** Select appropriate hydraulic and pneumatic components for a given application
- **CO 6.** Model and simulate hydraulic and pneumatic circuits using Simulink software

Course Contents

Unit 1: Hands on exploration of features like mechanisms, drives and controls, kinematic and structural design aspects of selected machinery

Unit 2: Control systems:
Working of different feedback systems; Position, level, temperature, pressure, weight, flow, counters, Different Types of sensors, Digital and Analogue converters, Introduction to microcontrollers, PID controllers, signal conditioning, simple control system circuits

Design, simulation and analysis of control systems for machinery, programming of PLCs and PC based control for machinery

Unit 3: Electrical and electro mechanical devices:
DC Motors, AC Motors, Stepper motors, induction motors, universal motors etc., Different application of motors, Controller, Variable Frequency drive in motors, selection of motors for specific application, calculation of motor power/torque requirement, Electromechanical systems, application and selection

Unit 4: Hydraulic and Hydraulic devices:
Basic principles of hydraulics, types of hydraulic fluids, Common symbols used in hydraulic diagrams; Functions of the major components of hydraulic systems; Types of pumps, Actuator types and capacity range, Hydraulic actuators, Linear actuators, Rotary actuators, Applications; Pressure control valves, flow control valves, accumulators; types of hydraulic drives and applications; Fluid power system

design, component selection, circuit selection, selection of pumps, pump selection parameters; circuit design, control system design, performance analysis

Unit 5: Pneumatic and pneumatic devices:
Properties of compressed air; Functions of the major components of pneumatic systems, Common symbols used in pneumatic diagrams; Different types of pneumatic drives and applications, Pneumatic power supply, cylinders, linear actuators, semi-rotary actuators, air motors and air turbines, Compressor, selection of compressor; Directional control valves, shut off valves, pressure control valves, flow control valves; Position control of pneumatic systems, Actuation and control

Unit 6:
Practical/Laboratory content:
Demonstration using hydraulic and pneumatic kits

Unit 7:
Practical/Laboratory content:
Simulation of Drives and controls using Simulink software

Course Resources

a. Essential Reading

15. Class Notes
16. Gopal K. Dubey, (2002), Fundamentals of Electrical Drives, 2nd Edition, Narosa Publishers.
17. A. Parr, (2011), Hydraulics and Pneumatics, 3rd Edition, Elsevier

b. Recommended Reading

27. Johnson James L, (2002), Introduction to Fluid Power, Thomson Delmar Learning
28. G. E. Totten, (1999), Handbook of Hydraulic Fluid Technology, CRC Press
29. N. Sclater, N. P. Chironis, (2007), Mechanisms and Mechanical Devices: Sourcebook, McGraw-Hill Professional

c. Other Electronic Resources

6. http://nptel.ac.in/

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Bangalore-560055

Course Title	Research methodology and IPR
Course Code	19FET508A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the principles of research, research methodology, significant phases of research, Intellectual property and its rights. Students are taught the realistic guidelines to be followed in the choice of field of research, topic of research and formulation of research problem. Key and careful considerations in the choice of tools for the solution of research problem are covered in this course. The course emphasizes the desirable close knit relation between innovation and concept of out of the box thinking. The principles of effective research and the need for a Proactive approach in a successful research programme are also explained. The course discusses the significant role of Literature Review in a research cycle and the expectations from good literature review as well as procedure for systematic literature review. Students will get an insight into the privilege, honour and the associated responsibilities of a researcher. This course gives insight of the intellectual property rights and over view of the benefits.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Explicate the value, scope, relevance and mandatory steps of research as well as principles of effective research, Nature of Intellectual Property
- **CO 2.** Discuss the guidelines to progress from the choice of broad field of research to specific topic of research, patent rights, process of patenting at National and International level, New Developments in IPR
- **CO 3.** Demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be effective
- **CO 4.** Adapt ,Analyze and prepare well-structured research proposal and research paper invoking clearly outlined principles

Course Contents

Unit 1 :

Foundations of Research – Definitions of Research, Mandatory Steps in Research, Types of Research, Relevance of Research for Innovation and Technology Development, Effective Research and Self Discipline.

Unit 2 :

Formulation of Research Problem: Identification of problems, Narrowing down the problem, Factors to be considered for problem selection. History and Evolution of Science & Technology

Unit 3 :

Out Of the Box Thinking and Systematic approach in Research – Transformation to Impossible Thinking, Convergent and Divergent Thinking, Generation, Evaluation and Selection of Ideas, Critical Thinking

Literature Review – Importance of Literature Review, Constituents of Good Literature Review, Strategies for Literature Search, Referencing, Paraphrasing, and Summarizing Academic Standards and Ethics

Research Proposal – Structure of a Good Research Proposal, Getting Started, Tips for Compilation of Good Research Proposal.

Unit 4 :

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Nature of Intellectual Property: Patents, Designs, Trade and Copyright.
Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5 :
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.
Patent information and databases, Geographical Indicators

Unit 6 :
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Copy rights for Software's Traditional knowledge Case Studies.

Course Resources

a. Essential Reading

18. Class Notes
19. Dr. Chakroborty, S.K. ValuStuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
20. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
21. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
22. Halbert, (2007) "Resisting Intellectual Property", Taylor & Francis Ltd.

b. Recommended Reading

30. Mayall, (1192),"Industrial Design", McGraw Hill.
31. Niebel, (1972), "Product Design", McGraw Hill.
32. Asimov, (1962), "Introduction to Design", Prentice Hall.
33. Robert P. Merges, Peter S. Menell, Mark A. Lemley, (2016)," Intellectual Property in New Technological Age".
34. T. Ramappa, (2008)"Intellectual Property Rights Under WTO", S. Chand.

c. Other Electronic Resources

7. http://nptel.ac.in/

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Faculty of Engineering and Technology
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Bangalore-560054

Course Title	Professional Communication
Course Code	19FET509A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course aims at sensitising students to the essentials of professional communication. Professional Communication is essential to achieve the objectives of an organisation.

Course Outcomes

After undergoing this course students will be able to:

CO 1. Compose effective written business communication
CO 2. Practice the techniques of presentation

Course Contents

Unit 1 :
Introduction to Professional Communication, Conversation and Listening

Unit 2 :
Reading Skills for Effective Professional Communication: Introduction, SQ3R (Survey, Question, Read, Retrieve, and Review) Technique of Reading

Unit 3 :
Written Business Communication: Writing Memos, Letters, Circulars and Notices, Communicating through Email

Unit 4 :
Presentation Skills: Message development, content, projection, inflection, and delivery

Course Resources

a. Essential Reading

23. Class Notes
24. Dr. C.S.G. Krishnamacharyulu (2016) Business Communication, Himalaya Publishing House

b. Recommended Reading

35. V. Lesikar, John D. Pettit, Jr., Marie E. Flatley. (1999), Basic Business Communication, 8th Edition, Tata McGraw Hill

c. Other Electronic Resources

8. http://nptel.ac.in/

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Course Title	Vibrations in Machinery
Course Code	19MDC505A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the effect of vibration on machineries and its control. Students will be taught basic concepts of vibration, methods of vibration analysis and its application to mechanical machineries. Experimental techniques to extract vibration signals from machineries and methods of analysis will be introduced. Various methods to control vibration will be discussed. Students will be trained in ISO, API standards and guidelines to carry out fault analysis of various machinery components.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the fundamentals of vibration and vibration effects on machinery components
- **CO 2.** Interpret vibration signals captured from machinery components
- **CO 3.** Analyse vibration response in machinery systems and control using appropriate methods
- **CO 4.** Design various machinery components as per applicable standards and guidelines to minimize vibration
- **CO 5.** Solve practical machinery vibration problems

Course Contents

Unit 1: Vibration fundamentals:
Importance of Vibration Study, Spring-mass system, Descriptors of Vibration, Free and forced vibration, Damped and undamped vibration, Linear and Non Linear Vibration, Deterministic and Random Vibration, Modeling and analysis of single and multi-degree of freedom systems, Natural frequency, mode shape, resonance, critical speed

Unit 2: Vibration of Continuous Systems:
Systems governed by wave equations, Vibration of strings, Vibration of rods, Euler Equation for Beams, Torsional vibration of shafts, Effect of Rotary inertia and shear deformation

Unit 3: Vibration Response Analysis:
Relationship between Time and Frequency, Time Relationship between Displacement, Velocity and Accelerations; Time and Frequency Domain, Important Frequencies, Sources of Frequencies, Forcing Function, Response to Harmonic Loading, Periodic Loading, Impulsive Loading, Dynamic Response, Campbell/interference diagram

Unit 4: Vibration Control:
Vibration source identification procedure, Vibration isolation and absorption; Damping and Selection of Isolators, Tuned Dynamic Vibration Absorbers (DVA) and Auxiliary Mass Dampers

Unit 5: Machinery Fault Analysis:
ISO standards, vibration guidelines for condition evaluation; Fault analysis of imbalance, bent shaft, misalignment, looseness, Gearbox, Electric motors, Steam turbines, pumps, compressors

Unit 6:
Practical/Laboratory content:
Vibration exciters measuring devices, Analysers, signal processing, FFT Analysis, Modal testing and analysis

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Practical/Laboratory content:
Laboratory demonstrations and exercises on gearbox and pump

Course Resources

a. Essential Reading

25. Class Notes
26. Clarence W. de Silva (2006), Vibration: fundamentals and practice, 2nd Edition, CRC Press LLC, Boca Raton, Florida.

b. Recommended Reading

36. Graham S. Kelly (2000), Fundamentals of Mechanical Vibration, 2nd Edition, McGraw Hill, Singapore
37. Giancarlo Genta (2009), Vibration Dynamics and Control, Springer-Verlag, New York.
38. Robert Bond Randall (2011), Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive applications, Wiley, Chichester.
39. Rao J. S. (2000), Vibratory Condition Monitoring of Machines, CRC Press, Boca Raton.
40. Paolo L. Gatti and Vittorio Ferrari (1999), Applied structural and mechanical vibrations: theory, methods, and measuring instrumentation, E & FN Spon, London

c. Other Electronic Resources

9. http://nptel.ac.in/

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Course Title	Fatigue and Fracture
Course Code	19MDE511A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with mechanism of crack initiation and propagation due to fatigue leading to fracture. Students will be taught the basics of fatigue and fracture mechanics. Fatigue and fracture based design approach will be applied for machinery components. Laws governing crack growth rate under cyclic loading will be discussed. Students will be trained to carry out failure analysis of various machinery components. Students will be given hands on experience on fatigue life assessment of mechanical components using simulation tools.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss fatigue and fracture phenomena and governing laws as applied to metals
- **CO 2.** Analyse failure of machinery components using various fatigue design approaches
- **CO 3.** Apply theory of fracture mechanics to model crack and analyse crack tip stress conditions
- **CO 4.** Predict crack growth rate characteristics and evaluate/improve fatigue life of machinery components
- **CO 5.** Estimate life of machinery components using FEA tools

Course Contents

Unit 1:

Overview of Fatigue:

Fatigue phenomenon; loading patterns and characteristics; Overview on strategies in fatigue based design; Discussion on fatigue design criteria; Fatigue testing methodology and life prediction, fatigue crack initiation and growth, Demonstration of high cycle fatigue testing using standard specimens

Stress-life approach:

Analysis of fatigue data in the finite life region; Estimation of S–N curve of a component based on ultimate tensile strength; Effect of modification factors on fatigue strength; Effect of mean stress on fatigue life estimation – mathematical models;

Unit 2:

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

Variable amplitude loading:

Fatigue life analysis for combined load cases; Variable amplitude loading; Cyclic counting techniques; Life Estimation using S-N and ε-N Approach

Unit 3:

Environmental effect on Fatigue:

Corrosion fatigue, fretting fatigue, low and high temperature fatigue

Statistical aspects of fatigue:

Definitions and Quantification of Data Scatter, Probability Distributions, Regression Analysis of Fatigue Data, Reliability Analysis

Unit 4:
Overview of Fracture Mechanics:
Significance of fracture mechanics design; Failure modes; Crack initiation and crack growth; Sources of Cracks Conventional and fracture mechanics based design approach

Linear Elastic Fracture Mechanics (LEFM):
Energy balance and Stress intensity factor (SIF) based approach; Discussion on plane stress and plane strain conditions, Fracture toughness; Design Philosophy Based on LEFM; thick plate and thin plate based on fracture mechanics point of view

Unit 5:
Elastic Plastic Fracture Mechanics (EPFM):
Governing parameters in EPFM; Crack tip plasticity; Effect of size of plastic zone and size factors using Irwin's and Dugdale approach; Use of R curve, J integral, COD, CMOD, CTOD concepts; Damage Tolerance Design Methodology

Unit 6:
Fatigue Crack Propagation and retardation:
Fatigue crack propagation laws (Paris law, Forman law, Walker law); Types of crack closure; Crack retardation following tensile overloads; Crack arresting techniques; Failure analysis and failure investigation of mechanical components

Unit 7:
ASTM E-399 Standard method for plane strain fracture toughness testing on various specimens for varied applications

Practical/Laboratory content:
Case studies on fatigue analysis using ANSYS and life estimation using software

Practical/Laboratory content:
Determination of fatigue life and fracture parameters using FEA tools

Course Resources

a. Essential Reading

27. Class Notes
28. Anderson T. L. (2005), Fracture Mechanics: Fundamentals and Applications, 3rd Edition, CRC Press.

b. Recommended Reading

41. Stephens R. I., Fuchs H. O., Robert A. F., Stephens R. (2000), Metal fatigue in engineering, 2nd Edition, Wiley-IEEE.
42. Juile A. Bannantine, Jess J. Comer, James L. Handrock (1990) Fundamentals of metal fatigue analysis, Pearson Hall.
43. Simha K. R. Y. (2001), Fracture Mechanics for Modern Engineering Design, Orient Blackswan.
44. Dang Van K. Y., Paradopoulos I. V. (1999), High-Cycle Metal Fatigue: From Theory to Applications, Springer Verlag
45. J. Schijve, (2001), Fatigue of structures and materials, Springer

c. Other Electronic Resources

10. http://nptel.ac.in/

Course Title	Industrial Tribology
Course Code	19MDE512A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

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 a given mechanical system and recommend suitable lubrication system in the process of developing machines.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss friction, mechanisms of friction, wear and methods of lubrication for design of machine elements
- **CO 2.** Identify and analyse tribological issues at component and machine level
- **CO 3.** Select appropriate type of lubricant and method of lubrication for a given application
- **CO 4.** Recommend suitable type of bearing for a given application
- **CO 5.** Propose bearings for precision applications

Course Contents

Unit 1: 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 and Wear: Laws of friction, Types of friction, Frictional force, Friction coefficient, Significance of wear, Types of wear, Wear regimes, Control of wear

Unit 3: Lubrication and Lubricants: Importance of Lubrication. Boundary Lubrication. Mixed Lubrication. Full Fluid Film Lubrication Hydrodynamic. Elasto hydrodynamic lubrication. Types & Properties of Lubricants. Lubricants Additives.

Unit 4: 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

Unit 5: Hydrostatic lubrication, Hydrodynamic lubrication, Elastohydrodynamic lubrication, Mixed lubrication, Boundary lubrication, Principles of hydrodynamic lubrication, Assumptions of hydrodynamic lubrication theory

Unit 6: 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 7: 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 8: 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.

Course Resources

a. Essential Reading

29. Class Notes
30. John Williams. (2005) Engineering Tribology, Cambridge University Press.

b. Recommended Reading

46. Bharat Bhushan. (2002) Introduction to Tribology, John Wiley and Sons.
47. Gwidon W. Stachowiak and Andrew W. Batchelor. (2000) Engineering Tribology, 2nd edition, Elsevier.
48. Avraham Harnoy. (2002) Bearing design in machinery: engineering tribology and lubrication, CRC Press.
49. Mathew Mate C. (2008) Tribology on the Small Scale: A Bottom Up Approach to Friction, Lubrication, and Wear, Oxford University Press.
50. Prasanta Sahoo. (2005) Engineering Tribology, Prentice Hall of India.
51. S.K. Basu, S.N. Sengupta and B.B. Ahuja. (2005) Fundamentals of Tribology, Prentice Hall of India.
52. Hans Dieter Baehr and Karl Stephan. (2006) Heat and mass transfer, 2nd edition, Springer.
53. Frank P. Incropera, David P. DeWitt, Theodore L. Bergman and Adrienne S. Lavine. (2006) Fundamentals of heat and mass transfer, 6th edition, John Wiley.
54. Yunus A. Çengel. (2003) Heat transfer: a practical approach, 2nd edition, McGraw Hill.

c. Other Electronic Resources

11. http://nptel.ac.in/

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Course Title	Engineering System Design
Course Code	19MDE522A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the design of complex systems from a top-down integrated perspective, covering the complete life cycle of engineering systems, including needs identification, functional analysis, detailed design and development. Case study approach would be followed to demonstrate complete product development process. Students will be able to carry out complete design of a mechanical system, systematically starting from concept stage to detailed stage.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Demonstrate knowledge and understanding of product development process and related methodologies and methods
- **CO 2.** Analyze the sequence of steps involved in the systems engineering of complex systems
- **CO 3.** Develop detailed set of component design specifications from high-level customer needs and carry out detailed design
- **CO 4.** Asses manufacturability, risk, safety, reliability and cost of a designed component/ system employing appropriate methods
- **CO 5.** Select and apply appropriate design methods for a product development project

Course Contents

Unit 1:

Introduction to Systems Engineering:

Overview of the Engineering of Systems: Definitions of Systems Engineering; Phases of the system life cycle; Cost commitment and incursion in the system life cycle; Systems engineering "Vee"; Approaches for Implementing Systems Engineering; Design and Integration Process; Types of Systems; Overview of the Systems Engineering Design Process: Design Process; Key Systems Engineering Concepts

Engineering Design:

Engineering Design Process; Description of Design Process; Considerations of a Good Design; Computer-Aided Engineering; Designing to Codes and Standards; Design Review; Societal Considerations in Engineering Design

Unit 2:

Product Development Process:

Product Development Process; Product and Process Cycles; Organization for Design and Product Development;

Problem Definition and Need Identification:

Introduction; Identifying Customer Needs; Customer Requirements; Gathering Information on Existing Products; Establishing the Engineering Characteristics; Quality Function Deployment; Product Design Specification

Unit 3: A

Concept Generation:

Introduction to Creative Thinking; Creativity and Problem Solving; Decision Making and Concept Selection; Creative Thinking Methods; Creative Methods for Design; Functional Decomposition and Synthesis; Morphological Methods; TRIZ: The Theory of Inventive Problem Solving

Embodiment Design:
Introduction; Product Architecture; Steps in Developing Product Architecture; Configuration Design; Best Practices for Configuration Design; Parametric Design; Dimensions and Tolerances; Industrial Design; Human Factors Design; Life-Cycle Design; Prototyping and Testing; Design for X (DFX)

Unit 4:
Detail Design:
Introduction; Activities and Decisions in Detail Design; Communicating Design and Manufacturing Information; Final Design Review; Facilitating Design and Manufacturing with Computer-Based Methods

Design for Manufacturing:
Role of Manufacturing in Design; Manufacturing Functions; Classification of Manufacturing Processes; Manufacturing Process Selection; Design for Manufacture (DFM); Design for Assembly (DFA); Role of Standardization in DFMA

Unit 5:
Risk, Reliability, and Safety:
Introduction; Probabilistic Approach to Design; Reliability Theory; Design for Reliability; Failure Mode and Effects Analysis (FMEA); Fault Tree Analysis; Defects and Failure Modes; Design for Safety

Cost Evaluation:
Introduction; Categories of Costs; The Cost of Ownership; Manufacturing Cost; Overhead Cost; Activity-Based Costing; Methods of Developing Cost Estimates

Course Resources

a. Essential Reading

31. Class Notes
32. Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Steven M. Biemer (2011), Systems Engineering Principle and Practice, Second Edition, John Wiley & Sons, Inc. Publication

b. Recommended Reading

55. Dennis M. Buede (2009), The Engineering Design of Systems Models and Method, Second Edition, John Wiley & Sons, Inc. Publication
56. George E. Dieter, Linda C. Schmidt (2013), Engineering Design, Fifth Edition, McGraw-Hill
57. Amaresh Chakrabarti (2002)Engineering Design Synthesis, Springer-Verlag
58. Robert Cloutier, Clifton Baldwin, Mary Alice Bone (2015), Systems Engineering Simplified, CRC Press
59. Karl T. Ulrich and Steven D Eppinger, Product Design and Development, 5th Edition, McGraw-Hill

c. Other Electronic Resources

12. http://nptel.ac.in/

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560058

Course Title	Design of Machinery
Course Code	19MDE513A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to provide an understanding on the functional aspects of various types of machinery, machinery subsystems and components. Students will be exposed to design philosophy, load distribution and evaluation of loads acting on different machine members using analytical/FEA approach. Students will be trained to estimate power requirements for a machine, carryout kinematic/dynamic analysis of the integrated system and design refinement. Students will be able to generate drawings with relevant details for manufacturing.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the functionality of various systems/subsystems/elements of construction, farm and industrial machinery
- **CO 2.** Review design philosophies adopted for the development of a machine for a given application
- **CO 3.** Arrive at specifications and generate conceptual design
- **CO 4.** Design components, develop geometric models and perform engineering analysis
- **CO 5.** Select drives, controls and perform machine integration

Course Contents

Unit 1: Engineering System design
Overview of system design approach, design of mechanical systems through system approach, case studies on mechanical system design

Unit 2: Review of general purpose machines, construction machineries, farm machineries and industrial machines their subsystems and design philosophies

Unit 3: Need for development of a new machine or improve the design of an existing machine

Unit 4: Standard design codes - ASME, IS, DIN, JIS, MIL Arriving at specifications of machine
Concept generation, selection and synthesize (industrial design, kinematics, dynamics, material selection, sizing- create geometric models)

Unit 5: Engineering analysis of modelled structural components (structural, thermal, dynamic)

Unit 6: Selection of bearings, drives and controls; Machine integration and simulation for performance; Instrumentation and testing

Unit 7: A case study approach will be followed on the existing machines like construction machineries, farm machineries, material handling equipment and special purpose machineries on the above aspects Detailing of design and generation of BOM

Unit 8: A design case study using an accepted engineering standard

Course Resources

a. Essential Reading

33. Class Notes
34. R. L. Norton, (2010), Machine Design: An Integrated Approach, Pearson Education India.
35. V. B. Bhandari, (2010), Design of Machine Elements, Tata Mc Graw Hill Education.
36. J. E. Shigley, (2008), Mechanical Engineering Design, Tata Mc Graw Hill Education.

b. Recommended Reading

60. John Williams, (2005), Engineering Tribology, Cambridge University Press.
61. Avraham Harnoy, (2002), Bearing design in machinery: Engineering tribology and lubrication, Edition: Illustrated, CRC Press.
62. P M Joshi, (2007), Machine Tools Handbook: Design and Operation, Tata McGraw.

c. Other Electronic Resources

13. http://nptel.ac.in/

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Bangalore-560058

M.S. Ramaiah University of Applied Sciences

Course Title	Machine Tool Design
Course Code	19MDE523A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with design principles adopted for designing machine tool components and its drive modules. Students are taught to analyze the forces acting on machine tool components. Design of machine tool drive components such as gear, belt and pulley drive will be discussed. Students will be able to analyze the response of the machine tool components to the applied forces and boundary conditions. Students will be able to design components like housing, column, table, spindle and power screw for a given machine tool application.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss design principle of machine tool components and drive systems
- **CO 2.** Identify the types of forces acting on the machine tool and its drive components
- **CO 3.** Analyze the behavior of machine tool components under static and dynamic conditions
- **CO 4.** Propose drives, controls and perform machine integration
- **CO 5.** Select material and processes for machine tool and its drive components using a software

Course Contents

Unit 1: Introduction:
General requirement of machine tool design, Engineering design process applied to machine tool design, Typical components and working of machine tools; Interrelationship between components and design requirements; Types of transmission.

Unit 2: Machine tool Design:
Need for drive design, Types of drives and selection, General requirements for developing the gearing diagram; Design of Speed Box for Speed and feed rate regulation, development of gearing diagram, gearbox Feed Design as per DIN and IS standards, design of pulley and belt system; CASE studies

Unit 3: Design of machine tool structure:
Introduction to machining process; stiffness and strength based design; basic design procedure for machine tool structure; Material and process selection through CES software; Design of beds, column, housing and tables

Unit 4: Design of guideway and power screw
Function and types of guideways, Design of anti-friction guideways, power screws; Combination guideway; Material and process selection through CES software

Unit 5:
Design of spindle and spindle support
Function and need for spindle unit, design calculations of spindle; Material and process selection through CES software; Effect of machine tool compliance on machining accuracy

Unit 6: Dynamic analysis of machine tool:
Need for dynamic analysis; Dynamic characteristics of identified machine tool process; Dynamic characteristics of elements and systems, case studies

Course Resources

a. Essential Reading

37. Class Notes
38. Erjavaec, 2004, Automotive Technology – A system approach, 3rd Edn, Thomson Delmar Learning.

b. Recommended Reading

63. Jurgen R. K. (1999) Automotive Electronics Handbook, 2nd Edn, McGraw-Hill.
64. Bosch. (1999) Automotive Electrics and Electronics, 3rd Edn, Robert Bosch.
65. Bosch. (2000) Automotive Hand Book, Society of Automotive Engineers.
66. Denton T. (2004) Automotive Electrical and Electronic Systems, 3rd Edn, SAE.
67. Bauer H. (2004) Gasoline Engine Management – Systems and Components, 2nd Edition, Robert Bosch.
68. Bauer H. (2005) Diesel-Engine Management – Systems and Components, 3rd, Edn, Robert Bosch.

c. Other Electronic Resources

14. http://nptel.ac.in/

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M.S. Ramaiah University of Applied Sciences

Course Title	Optimization Techniques
Course Code	19MDE514A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the fundamentals of optimization in the context of machinery design. Need for optimization in traditional design methodologies will be explained. Students will be taught basic concepts of optimization and optimality conditions with examples. Numerical methods for solving unconstrained and constrained optimization problems will be discussed. Students will be able to apply modern optimization techniques, MATLAB and CAE tools in optimization.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the fundamental concepts, techniques and scope for optimisation in machinery design
- **CO 2.** Select appropriate functions, constraints and algorithms to solve optimization problem through numerical techniques
- **CO 3.** Apply suitable optimization technique for machinery component design
- **CO 4.** Interpret optimization results for design decision making
- **CO 5.** Solve optimization problems using MATLAB, EXCEL sheets and CAE tools

Course Contents

Unit 1: Fundamental of optimization:
Concept of optimization, Need for optimisation, Applications of Optimization in Engineering, Structure of Optimization Problems, Optimum design of simple mechanical components

Classical Optimization Techniques:
Single-Variable Optimization, Multivariable Optimization with and without constraints

Unit 2: Unconstrained optimisation:
Function approximation, optimality conditions, direct search methods, gradient search methods - Cauchy's method and Newton's method

Unit 3: Linear Programming:
Applications of Linear Programming, Formulation of Linear Programming Models, Graphical Solution of Linear Programs in Two Variables, Simplex Method, Single and Multi-Objective linear models

Unit 4: Constrained optimisation:
Equality-Constrained Problems, penalty function method, Lagrange multipliers, generalized reduced gradient method, Karush-Kuhn-Tucker (KKT) conditions, sensitivity analysis

Unit 5: Modern optimization techniques:
Genetic Algorithms - Representation of Design Variables, Objective Function and Constraints, Genetic Operators, Algorithm; Introduction to Fuzzy and neural network based optimisation; Use of MATLAB and Excel Sheets

Unit 6: Finite Element based optimisation:
Derivative calculations, sizing, topology optimisation of continuum structures, shape optimisation, Optimisation with dynamic response

Unit 7: Strategies for Optimization:

Model formulation, Problem implementation, Solution evaluation

Unit 8:
Practical/Laboratory content:
Solving problems on optimisation through use of analysis software

Course Resources

a. Essential Reading

39. Class Notes
40. Arora, J.S. (2016), Introduction to Optimum Design, Fourth Edition, Elsevier Academic Press, San Diego, CA.

b. Recommended Reading

69. Kalyanmoy Deb (2009), Optimization for Engineering Design, 1st Edition, PHI Publishers. Rao S. S. (2008), Engineering Optimization, 3rd Edition, New Age Publishers.
70. Belegundu, A.D. and Chandrupatla, T.R. (2011), Optimization Concepts and Applications in Engineering, Second Edition, Cambridge University Press.
71. Luenberger and Ye (2008), Linear and Nonlinear Programming Third Edition, Springer.
72. Haftka, R. T. and Gurdal, Z. (1992), Elements of Structural Optimization, Third edition, Kluwer Academic Publishers.
73. Fletcher R. (1980, 1981), Practical Methods of Optimization Volumes 1,2, John Wiley.
74. Ignizio J. P. (1982), Linear Programming in Single and Multi-Objective Systems, Prentice-Hall, Englewood Cliffs, New Jersey.

c. Other Electronic Resources

15. http://nptel.ac.in/

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M.S. Ramaiah University of Applied Sciences

Course Title	Industrial Machinery Design
Course Code	19MDE524A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with functionality, design philosophy of different systems/subsystems of various types of machines. Students will be exposed to design philosophy, load distribution and evaluation of loads acting on different machine members using analytical/analysis approach. Students will be trained to develop design layout and carryout kinematic/dynamic analysis of the integrated system. Students will be able to carry out detailed design, generate drawings with relevant details for manufacturing for a given machine.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the functionality, design philosophies of different systems/subsystems of various machines
- **CO 2.** Apply standard design procedures to design components and sub systems of a given machine
- **CO 3.** Develop geometric model of components and subsystems of a given machine
- **CO 4.** Evaluate alternative designs of components and subsystems through engineering analysis
- **CO 5.** Select drives, controls and perform machine integration

Course Contents

Unit 1: Overview:
Engineering System design, system design approach, case studies on mechanical system design. Review of machineries including, general purpose machines, construction machineries like Earthmoving equipment's, Construction vehicles, Material handling equipment, Construction equipment's. Farm machineries, materials handling equipment, their subsystems and design philosophies.

Unit 2: Farm Machinery:
Agriculture mechanics; Cutting of agriculture materials; Agricultural Mechanization Strategy Need (status of farm power)and scope of machine; Mechanization in farming operations Functionality of various elements of form machine; Analyze Functions and Design requirements of machine components; Need for development of new machine; Arrive at specification and generate conceptual design; Carry out detailed design; Develop geometric models and perform engineering analysis; Select drives and controls and perform machine integration. Case studies on design of farm machinery.

Unit 3: Design of automatic Machinery:
Automation design process; Generalized automatic machine; System specification; Case studies on assembly machine, inspection machine, testing machine and packaging machines.

Unit 4: Vertical Machining Centre ; The machine structure subjecting to various forces; Free body diagrams for all individual components for a specified operations and conditions; Cutting force analysis on machine structure; Force Flow Model for the machine

Unit 5: Case studies on design of different types of industrial machinery like machine tool, farm machinery, construction machinery and industrial automation

Course Resources

a. Essential Reading

41. Class Notes
42. R. L. Norton, (2010), Machine Design: An Integrated Approach, Pearson Education India.
43. V. B. Bhandari, (2010), Design of Machine Elements, Tata Mc Graw Hill Education.

b. Recommended Reading

75. J. E. Shigley, (2008), Mechanical Engineering Design, Tata Mc Graw Hill Education.
76. John Williams, (2005), Engineering Tribology, Cambridge University Press.
77. Avraham Harnoy, (2002), Bearing design in machinery: Engineering tribology and lubrication, Edition: Illustrated, CRC Press.
78. P M Joshi, (2007), Machine Tools Handbook: Design and Operation, Tata McGraw Hill Education.
79. P. F. J. Abeles,(1999), CIGR Handbook of Agricultural Engineering, Published by the American Society of Agricultural Engineers.

c. Other Electronic Resources

16. http://nptel.ac.in/

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M.S. Ramaiah University of Applied Sciences * Bangalore *

Course Title	Value Education
Course Code	19FET510A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course aims at sensitising students to learn the importance of value education. It gives an insight about the Universal Brotherhood.

Course Outcomes

After undergoing this course students will be able to:

CO 1. Discuss the role of Values and Ethics in Self-Development
CO 2. Appreciate the importance of Universal Brotherhood

Course Contents

Unit 1 :
Values, Ethics and Self-Development; Awareness of self-destructive habits, Power of faith, Positive Thinking

Unit 2 :
Value judgements – Stereotypes, prejudices and biases

Unit 3 :
Sense of duty, Self-reliance, Confidence, Concentration, Discipline, Honesty, Truthfulness

Unit 4 :
National Unity, Patriotism, Love for nature

Unit 5 :
Universal brotherhood and religious tolerance

Course Resources

a. Essential Reading
44. Class Notes

b. Recommended Reading
80.

c. Other Electronic Resources
17. http://nptel.ac.in/

M.S. Ramaiah University of Applied Sciences * Bangalore

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Course Title	Internship
Course Code	19MDP521A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

The aim of this course is to make a student experience an industrial or business environment. The student will visit various departments of an industry/business and observe the activities in each department for a certain duration of time and try to relate his/her experience with the theory practiced back at the faculty. The student should develop a report and make a presentation on his/her experience at the industry/business.

Course Outcomes

After undergoing this course students will be able to:

CO 1.
CO 2.

Course Contents

Industry Internship in the relevant organization

Course Resources

a. Essential Reading

45. Organization Website
46. Discussions with Managers/Mentor/Supervisor of different departments of the organization

b. Recommended Reading

81.

c. Other Electronic Resources

18. http://nptel.ac.in/

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M.S. Ramaiah University of Applied Sciences * Bangalore

Course Title	Group Project
Course Code	19MDP522A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to provide student an opportunity to synergise their learning from the earlier courses through working in a team, sharing responsibilities, to conceiving, designing and fabricating a working prototype of a system related to an automotive application. The students will learn skills related to project identification, planning, management and execution, working in teams and verbal and written communication. During design, analysis and synthesis stage, they will get an opportunity to apply theoretical knowledge to develop real life product and prototyping stage will provide them experience of converting a design into a working system through use of various fabrication techniques available.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Work in a team and undertake a project in their area of specialization
- **CO 2.** Apply their knowledge of general and automotive engineering and application, develop a system for automotive application
- **CO 3.** Apply appropriate research methodology while formulating a project
- **CO 4.** Prepare specifications, design, analyse, synthesize, prototype and assess the system
- **CO 5.** Prepare and present appropriate forms of audio-visual and verbal presentations, and written document, to describe the project, its execution and outcome

Course Contents

Unit 1 :

Unit 2 :

Unit 3 :

Unit 4 :

Course Resources

a. Essential Reading

47. Assigned reading relevant to the group project

b. Recommended Reading

82.

c. Other Electronic Resources

19. http://nptel.ac.in/

Course Title	Dissertation and Publication
Course Code	19MDP523A
Department	Mechanical and Manufacturing Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to give an insight to the students on application of principles of research methodology, preparation of research project proposal, research project management, execution of research project and effective technical communication and presentation. It also emphasizes the need and the relevance of a structured approach to identify a research topic and undertake research. This course provides an opportunity for students to apply theories and techniques learnt during programme work. It involves in-depth work in the chosen area of study.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Critically review scholarly literature collected from various sources for the project purpose and formulate a research
- **CO 2.** Prepare and present a research proposal
- **CO 3.** Conduct research to achieve research objectives
- **CO 4.** Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- **CO 5.** Create research document and write research papers for publications
- **CO 6.** Defend the research findings in front of scholarly audience

Course Contents

Unit 1 :
Research Methodology

Information search, retrieval and review

Unit 2 :
Project definition and project planning

Use of conceptual models and frameworks

Unit 3 :
Problem solving and Evaluation

Interpretations and drawing conclusions

Unit 4 :
Proposing ideas or methods for further work

Thesis writing

Unit 5 :
Oral presentation

Authoring Research paper

Course Resources

a. Essential Reading

48. Lecture Sessions on individual project, Thesis Preparation delivered by the concerned Head of Dept.

b. Recommended Reading

83.

c. Other Electronic Resources

20. http://nptel.ac.in/

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